AQA GCSE Physics | 8463

SPECIFICATION POINT 4.1.1.1

Energy stores and systems

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**124**
Available paper years	**2003–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.1.1.1 Energy stores and systems

Answer 01 · Mark scheme June 2003 | 3451H | Original Q13 | Legacy

The full source mark scheme begins on page 151. Follow original question 13 in that document.

Answer 02 · Mark scheme June 2003 | 3462H3 | Original Q11 | Legacy

The full source mark scheme begins on page 173. Follow original question 11 in that document.

Answer 03 · Mark scheme June 2004 | 3451H | Original Q2 | Legacy

The full source mark scheme begins on page 190. Follow original question 2 in that document.

Answer 04 · Mark scheme June 2004 | 3462H3 | Original Q2 | Legacy

The full source mark scheme begins on page 211. Follow original question 2 in that document.

Answer 05 · Mark scheme June 2005 | 3451 | Original Q3 | Legacy

The full source mark scheme begins on page 228. Follow original question 3 in that document.

4.1.1.1 Energy stores and systems

Answer 06 · Mark scheme June 2005 | 3451 | Original Q11 | Legacy

The full source mark scheme begins on page 228. Follow original question 11 in that document.

Answer 07 · Mark scheme June 2005 | 3451 | Original Q13 | Legacy

The full source mark scheme begins on page 228. Follow original question 13 in that document.

Answer 08 · Mark scheme June 2005 | 3451 | Original Q15 | Legacy

The full source mark scheme begins on page 228. Follow original question 15 in that document.

Answer 09 · Mark scheme June 2005 | 3462 | Original Q3 | Legacy

The full source mark scheme begins on page 246. Follow original question 3 in that document.

Answer 10 · Mark scheme June 2005 | 3462 | Original Q9 | Legacy

The full source mark scheme begins on page 246. Follow original question 9 in that document.

4.1.1.1 Energy stores and systems

Answer 11 · Mark scheme June 2005 | 3462 | Original Q10 | Legacy

The full source mark scheme begins on page 246. Follow original question 10 in that document.

Answer 12 · Mark scheme June 2005 | 3462 | Original Q11 | Legacy

The full source mark scheme begins on page 246. Follow original question 11 in that document.

Answer 13 · Mark scheme June 2006 | 3451 | Original Q14 | Legacy

The full source mark scheme begins on page 260. Follow original question 14 in that document.

Answer 14 · Mark scheme June 2006 | 3462 | Original Q12 | Legacy

The full source mark scheme begins on page 280. Follow original question 12 in that document.

Answer 15 · Mark scheme November 2006 | PHY1A | Original Q9 | Legacy

Nine	**4**	**4**	**2**	**1***

*** Q9D** The awarding committee agreed that there are two possible correct answers for this question and therefore the test was marked out of 35.

4.1.1.1 Energy stores and systems

Answer 15 · Mark scheme

PHY1A (Energy and Electricity) Higher Tier

Question	Key		
One	**A**	conclusion	**2**
	B	evidence	**4**
	C	reliable	**1**
	D	research	**3**
Two	**A**	coal	**4**
	B	hydroelectric	**3**
	C	nuclear	**1**
	D	wind	**2**

	A	B	C	D
Three	**4**	**4**	**4**	**1**
Four	**4**	**4**	**2**	**1***
Five	**3**	**2**	**2**	**2**
Six	**1**	**1**	**2**	**4**
Seven	**4**	**4**	**4**	**4**
Eight	**1**	**3**	**2**	**1**
Nine	**3**	**4**	**1**	**4**

*** Q4D** The awarding committee agreed that there are two possible correct answers for this question and therefore the test was marked out of 35.

4.1.1.1 Energy stores and systems

Answer 16 · Mark scheme March 2007 | PHY1A | Original Q2 | Legacy

Two	**A**	coal-fired power stations	**4**
	B	geothermal power stations	**1**
	C	nuclear power stations	**3**
	D	tidal power stations	**2**

Answer 17 · Mark scheme March 2007 | PHY1A | Original Q7 | Legacy

Seven	**4**	**3**	**2**	**3**

Answer 18 · Mark scheme June 2007 | PHY1A | Original Q2 | Legacy

Two	**A**	electrical energy	**1**
	B	gravitational potential energy	**2**
	C	sound energy	**4**
	D	thermal energy	**3**

	A	**B**	**C**	**D**

Answer 19 · Mark scheme June 2007 | PHY1A | Original Q5 | Legacy

Five	**1**	**3**	**3**	**3**

Answer 20 · Mark scheme June 2007 | PHY1A | Original Q6 | Legacy

Six	**3**	**3**	**2**	**4**

Answer 21 · Mark scheme June 2007 | PHY1H | Original Q6 | Legacy

The full source mark scheme begins on page 294. Follow original question 6 in that document.

Answer 22 · Mark scheme November 2007 | PHY1A | Original Q1 | Legacy

One	**A**	gravitational potential energy	**1**
	B	kinetic energy	**2**
	C	light energy	**4**
	D	thermal energy	**3**

Answer 23 · Mark scheme November 2007 | PHY1A | Original Q5 | Legacy

Five	**2**	**3**	**2**	**4**

4.1.1.1 Energy stores and systems

Answer 24 · Mark scheme

November 2007 | PHY1A | Original Q6 | Legacy

Six	**1**	**3**	**1**	**1**

4.1.1.1 Energy stores and systems

Answer 25 · Mark scheme

Question 1

question	answers	extra information	mark
(a)(i)	any **one** from: • coal • oil • (natural) gas	do **not** accept fossil fuels accept diesel accept biofuel or a named biofuel eg wood / straw accept household / industrial waste owtte	1
(ii)	0.3	accept 30% if **2** marks not awarded then: allow **1** mark for 30 (without %) allow **1** mark for 0.3 with a unit or % allow **1** mark for identification of energy input and output eg 20 sq input and 6 sq output **or** 4 sq input and 1.2 sq output **or** 40 sq input and 12 sq output even if subsequent working incorrect allow **1** mark for correct expression of 1.2 over 4 **or** 12 over 40 **or** 6 over 20 (squares)	2
(iii)	(nuclear) fission	accept fision provided it is **not** fusion	1

Question 1 continues on the next page

PHY1H

Question 1 continued

question	answers	extra information	mark
(b)(i)	small proportion of energy / power is wasted **or** transfers most / more / a lot of energy power usefully	accept little / less energy / power / heat is wasted do **not** accept it wastes no energy / power	1
(ii)	it decreases the current / uses low current **or** it increases the voltage / potential difference **or** uses high voltage / potential difference smaller the current the smaller the energy loss	 accept pd for potential difference accept power / heat for energy	1 1
(c)(i)	as a control	accept to make a comparison do **not** accept fair test on its own	1
(c)(ii)	so people know how much data the link was based on **or** people can judge the significance / reliability of the link	accept idea that larger numbers are better do **not** accept significance / reliability on its own ignore reference to accuracy	1

Question 1 continues on the next page

PHY1H

Question 1 continued

question	answers	extra information	mark
(iii)	other possible factors may be responsible **or** have not been investigated named factor eg environment / genetic		1 1
(iv)	first box ticked plus reason **or** second box plus reason	acceptable reason such as so people know there may be a risk as soon as possible / so that other scientists can use findings acceptable reason such as no point to worry / confuse / panic people *(*until the research has been confirmed*)* accept idea that it may lead to wrong advice do **not** accept in case they are wrong	1
total			12

4.1.1.1 Energy stores and systems

Answer 25 · Mark scheme

January 2008 | PHY1H | Original Q1 | Legacy

PHY1H

4.1.1.1 Energy stores and systems

Answer 26 · Mark scheme

January 2008 | PHY1H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
(a)(i)	makes it warmer / raises the temperature	accept produces convection *(current)* accept makes it less dense	1
(ii)	reduced **or** slows down		1
(b)(i)	electrical energy (to run the pump) must be paid for	accept electricity for electrical energy accept electricity is needed for the pump accept it uses electricity accept because of the pump	1
(ii)	more useful (heat) energy is transferred into the house than the energy used to operate the pump **or** reduced cost of heating the house is greater than the cost of running the (electrical) pump **or** costs little to run compared to the savings made	accept for **1** mark reduces energy bills **or** reduced fuel costs / heating costs owtte do **not** accept it's cheap	2
total			5

4.1.1.1 Energy stores and systems

Answer 26 · Mark scheme

January 2008 | PHY1H | Original Q3 | Legacy

PHY1H

4.1.1.1 Energy stores and systems

Answer 27 · Mark scheme

Question 3

question	answers	extra information	mark
(a)(i)	24(V)		1
(ii)	current always flows in the same direction **or** current only flows one way		1
(b)(i)	more power / force needed work done to lift the scooter uphill **or** work done against gravity	accept energy transformed faster accept it moves against gravity accept energy is transformed to gravitational potential energy	1 1
(ii)	reduces it		1
(c)	375	**1** mark for correct substitution **1** mark for an answer = 250 **1** mark for an answer = 125	2
(d)	86400 coulomb	**1** mark for correct substitution **1** mark for an answer = 43200 answer 24 gains **1** mark answer 24 Ah gains **2** marks answer 12 Ah gains **1** mark only accept C	2 1
total			10

4.1.1.1 Energy stores and systems

Answer 27 · Mark scheme January 2008 | PHY2H | Original Q3 | Legacy

PHY2H

Answer 28 · Mark scheme March 2008 | PHY1AP | Original Q8 | Legacy

Eight	**2**	**4**	**4**	**1**

Answer 29 · Mark scheme June 2008 | PHY1AP | Original Q1 | Legacy

No matching mark scheme was available in the supplied archive for this question.

Answer 30 · Mark scheme June 2008 | PHY1AP | Original Q2 | Legacy

No matching mark scheme was available in the supplied archive for this question.

Answer 31 · Mark scheme June 2008 | PHY1AP | Original Q5 | Legacy

No matching mark scheme was available in the supplied archive for this question.

Answer 32 · Mark scheme June 2008 | PHY1AP | Original Q9 | Legacy

No matching mark scheme was available in the supplied archive for this question.

4.1.1.1 Energy stores and systems

Answer 33 · Mark scheme

June 2008 | PHY1H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
(a)(i)	replaced faster than it is used	accept replaced as quick as it is used accept will never run out do **not** accept can be used again	1
(a)(ii)	any **two** from: • wind • waves • tides • fall of water • biomass • geothermal	**two** sources required for the mark do **not** accept water / oceans accept OTEC accept hydroelectric accept a named biomass / biofuel eg wood	1
(b)(i)	any **two** from: • increases from 20 ^{o} to 30 ^{o} • reaches maximum value at 30 ^{o} • then decreases from 30 ^{o} • same pattern for each month	accept peaks at 30 ^{o} for **both** marks accept goes up then down for **1** mark ignore it's always the lowest at 50°	2
(b)(ii)	864	an answer of 108 gains **2** marks allow **1** mark for using 720 value only from table allow **2** marks for answers 852, 816, 768, 825 allow **1** mark for answers 106.5, 102, 96, 103 (.125)	3

Question 4 continues on the next page

PHY1H

Question 4 continued

question	answers	extra information	mark
(c)	the solar cells will not meet demand at all times of the year / day **or** to make up the shortfall in energy required at certain times of the year **or** to be able to sell surplus electricity (to the National Grid)	accept to maintain a constant supply of electricity / energy accept to provide energy at night do **not** accept because it's cloudy on it's own	1
total			8

4.1.1.1 Energy stores and systems

Answer 33 · Mark scheme June 2008 | PHY1H | Original Q4 | Legacy

PHY1H

Answer 34 · Mark scheme November 2008 | PHY1AP | Original Q1 | Legacy

Question	Key		
One	**A**	0.6	**4**
	B	5	**3**
	C	15	**2**
	D	30	**1**

Answer 35 · Mark scheme November 2008 | PHY1AP | Original Q9 | Legacy

Nine	**4**	**2**	**3**	**1**

* The whole of question two was removed from the mark scheme and this test was marked out of 32.

4.1.1.1 Energy stores and systems

Answer 36 · Mark scheme

January 2009 | PHY1H | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)(i)	silvered surfaces	more than the correct number of ticks in a row negates the mark	1
	radiation		1
	plastic cap conduction convection } both required		

	conduction	convection	radiation
vacuum	✓	✓	
silvered surfaces			✓
plastic cap	✓	✓	

(1)

(1)

1(a)(ii)	because there are no particles in a vacuum	any mention of air or any other substance in a vacuum scores zero accept atoms / molecules for particles accept vacuum is empty space accept there is nothing in a vacuum accept there is no air / gas in the vacuum	1
	conduction **and** convection need particles / medium	need reference to both conduction **and** convection accept correct descriptions	1

Question 1 continues on the next page

PHY1H

Question 1 continued

question	answers	extra information	mark
1(b)(i)	less heat lost (to air above the heater)	do **not** accept **no** heat lost	1
	light shiny surfaces are poor emitters (of radiation) **or** dull, matt surfaces are good emitters (of radiation)	accept radiators for emitters references to reflection are neutral do **not** credit answers which infer reflection from the underside of the hood ignore correct reference to absorption	1
1(b)(ii)	correct output arrow n heat arrows ıergy form eg light	flow charts score zero ignore input	1 1
1(b)(iii)	energy cannot be destroyed	accept (principle of) conservation of energy do **not** accept because energy cannot be lost without clarification	1
Total			**9**

4.1.1.1 Energy stores and systems

Answer 36 · Mark scheme January 2009 | PHY1H | Original Q1 | Legacy

PHY1H

4.1.1.1 Energy stores and systems

Answer 37 · Mark scheme

Question 2

question	answers	extra information	mark
2(a)	9	allow **1** mark for correct substitution (1.8 × 5) an answer of 9000 gains **1** mark an answer of 2 or 15 gains **1** mark	2
2(b)	(3 kW) fan heater	accept 3 kW accept the middle one	1

Question 2 continues on the next page

PHY1H

Question 2 continued

2(c)		features common to more than one heater, treat as neutral	
	<u>oil-filled</u>		
	low level heat		1
	cannot be knocked over / space saving / no trailing wires **or** more control over heat output	do **not** accept just wall-mounted do **not** accept just 3 heat settings	
	<u>fan</u>		
	warms (office) rapidly **or** can be used to cool air (in summer)	 accept can be used as a fan accept cool air fan (setting) accept 'it has a cool air setting in case it gets too hot' do **not** accept a specific reference to cooling the heater	1
	<u>ceramic</u>		
	can be switched on for set periods of time **or** can be switched on before office is used / switched off automatically at night	do **not** accept just has a timer	1
Total			**6**

4.1.1.1 Energy stores and systems

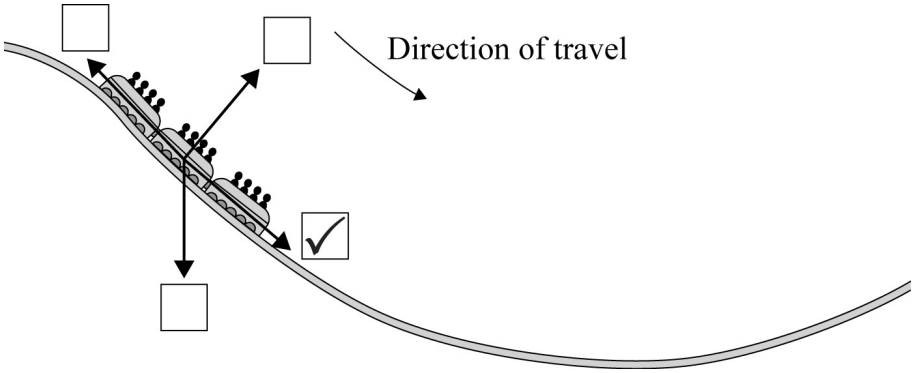
Answer 37 · Mark scheme January 2009 | PHY1H | Original Q2 | Legacy

PHY1H

4.1.1.1 Energy stores and systems

Answer 38 · Mark scheme

Question 1

question	answers	extra information	mark
1(a)	correct box ticked 		1
1(b)	each passenger has a different mass	accept weight for mass ignore other irrelevant factors about the person e.g. mass and height do **not** accept a list with incorrect factors e.g. mass and position accept passengers started with different (gravitational) potential energy	1
1(c)(i)	30	ignore added units	1
1(c)(ii)	2400	accept their (c)(i) × 80 correctly calculated for both marks allow **1** mark for correct substitution of their (c)(i) and 80 an answer of 800 gains **1** mark only if answer to (c)(i) is not 10	2
Total			**5**

4.1.1.1 Energy stores and systems

Answer 38 · Mark scheme January 2009 | PHY2H | Original Q1 | Legacy

PHY2H

Answer 39 · Mark scheme March 2009 | PHY1AP | Original Q4 | Legacy

Four	**A**	coal	**3**
	B	biofuel	**4**
	C	geothermal	**2**
	D	uranium	**1**

Answer 40 · Mark scheme June 2009 | PHY1AP | Original Q4 | Legacy

Four	**3**	**3**	**1**	**2**

Answer 41 · Mark scheme June 2009 | PHY1AP | Original Q8 | Legacy

Eight	**4**	**2**	**1**	**4**

4.1.1.1 Energy stores and systems

Answer 42 · Mark scheme

June 2009 | PHY1H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	0.6	accept 60% allow **1** mark for useful energy = 480 answer 0.6 with any unit or 60 gains **1** mark only	2
3(a)(ii)	transferred to surroundings	accept goes into the air accept heats the surroundings up accept gets spread out accept transferred into heat (only) do **not** accept wasted / lost unless qualified destroyed negates mark transferred into light / sound negates mark	1
3(b)(i)	1.75	allow **1** mark for converting to kW answers of 0.7, 0.525, 0.35, 0.875, 1.05, 5.25 gains **1** mark answers of 1750 or 17.5 gains **1** mark	2
3(b)(ii)	21p or £0.21 or their (b)(i) × 12		1

Question 3 continues on the next page . . .

4.1.1.1 Energy stores and systems

PHY1H

Question 3 continued . . .

question	answers	extra information	mark
3(c)	any **two** from: • (more) electricity needs to be generated • (more) power stations needed • (more) fossil fuels burnt • (more) pollutant gases emitted	(more) electricity is being used accept named fossil fuel accept named gas accept harmful for pollutant accept greenhouse gases accept atmospheric pollution accept answer in terms of any form of electricity generation and an associated environmental problem	2
Total			**8**

4.1.1.1 Energy stores and systems

Answer 42 · Mark scheme

June 2009 | PHY1H | Original Q3 | Legacy

PHY1H

4.1.1.1 Energy stores and systems

Answer 43 · Mark scheme

June 2009 | PHY2H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	47250	answers of 1350/ 33750/ 48600 gain **1** mark allow **1** mark for correct substitution using both 18 and 3	2
5(b)(i)	47250 or their (a)	accept statement 'same as the KE (lost)' ignore any units	1
5(b)(ii)	transformed into heat/ thermal energy	sound on its own is insufficient accept transferred/ lost/ for transformed do **not** accept any other form of energy included as a list	1
Total			**4**

4.1.1.1 Energy stores and systems

Answer 43 · Mark scheme June 2009 | PHY2H | Original Q5 | Legacy

PHY2H

Answer 44 · Mark scheme November 2009 | PHY1AP | Original Q1 | Legacy

Question	Key		
One	**A**	0.6	**4**
	B	140	**2**
	C	200	**3**
	D	300	**1**

Answer 45 · Mark scheme November 2009 | PHY1AP | Original Q2 | Legacy

Two	**A**	chemical	**2**
	B	electrical	**3**
	C	kinetic	**1**
	D	light	**4**

	A	B	C	D

Answer 46 · Mark scheme November 2009 | PHY1AP | Original Q8 | Legacy

Eight	**1**	**3**	**2**	**3**

4.1.1.1 Energy stores and systems

Answer 47 · Mark scheme

November 2009 | PHY1AP | Original Q9 | Legacy

Nine	**1**	**1**	**2**	**4**

Answer 48 · Mark scheme

November 2009 | PHY1BP | Original Q7 | Legacy

Seven	**4**	**1**	**3**	**3**

4.1.1.1 Energy stores and systems

Answer 49 · Mark scheme

January 2019 | PHY1H | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)(i)	0.75	allow **1** mark for correct transformation and substitution ie 0.15 × 5	2
7(a)(ii)	2	accept 1.5 ÷ their (a)(i) correctly calculated	1
7(b)	any **one** from: • seasonal changes • cloud cover	accept specific changes in conditions eg shorter hours of daylight in winter accept idea of change must be stated or unambiguously implied eg demand for water will not (always) match supply of solar energy do **not** accept figures are average on its own do **not** accept solar panels are in the shade	1
Total			**4**

4.1.1.1 Energy stores and systems

Answer 50 · Mark scheme

March 2010 | PHY1AP | Original Q1 | Legacy

Question			Key
One	**A**	conduction	**4**
	B	convection	**3**
	C	insulation	**2**
	D	radiation	**1**

Answer 51 · Mark scheme

June 2010 | PHY1AP | Original Q5 | Legacy

Five	2	2	3	2

Answer 52 · Mark scheme

June 2010 | PHY1AP | Original Q7 | Legacy

Seven	4	3	4	4

4.1.1.1 Energy stores and systems

Answer 53 · Mark scheme

June 2019 | PHY1H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	2.1	correct answer only	1
3(a)(ii)	3.15 **or** their (a)(i) × 1.5 correctly calculated	allow **1** mark for correct substitution ie 2.1 × 1.5 **or** their (a)(i) × 1.5	2
	kilowatt-hour	accept kWh **or** a substitution 2100 × 5400 scores **1** mark 2100 × 5400 incorrectly calculated with answer in joules scores **2** marks an answer of 11 340 000 scores **2** marks an answer of 11 340 000 J scores **3** marks	1
3(a)(iii)	most (input) energy is usefully transformed	accept does not waste a lot of energy accept most of the output / energy is useful do **not** accept it does not waste energy	1

Question 3 continues on the next page . . .

4.1.1.1 Energy stores and systems

PHY1H

Question 3 continued . . .

question	answers	extra information	mark
3(b)	the room is losing energy / heat		1
	at the same rate as the heater supplies it	this mark only scores if the first is scored do **not** accept heater reaches same temperature as room / surroundings rate of heat gain = rate of heat loss scores both marks	1
Total			**7**

4.1.1.1 Energy stores and systems

Answer 53 · Mark scheme June 2010 | PHY1H | Original Q3 | Legacy

PHY1H

4.1.1.1 Energy stores and systems

Answer 54 · Mark scheme

June 2010 | PHY2H | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)(i)	75 000 newtons / N	accept correct substitution for **1** mark ie 7500 × 10 do **not** accept n full credit for using g = 9.8 **or** 9.81	2 1
1(a)(ii)	60 000 000	accept for both marks their (a)(i) × 800 correctly calculated accept correct substitution for **1** mark ie their (a)(i) × 800	2
1(b)(i)	arrow drawn parallel (to) **and** down (the) slope	accept arrow drawn anywhere on the diagram	1
1(b)(ii)	increases GPE transformed to KE **or** speed increasing	 accept is accelerating however 'speed increasing' only scores if correctly linked to increasing kinetic energy	1 1
1(c)	so more likely to wear one **or** they know wearing a helmet is likely to / will reduce (risk) head injury **or** so can make an (informed) choice (about wearing one)		1
Total			**9**

4.1.1.1 Energy stores and systems

Answer 54 · Mark scheme June 2010 | PHY2H | Original Q1 | Legacy

PHY2H

Answer 55 · Mark scheme November 2010 | PHY1AP | Original Q1 | Legacy

Question	Key		
One	**A**	electric drill	**1**
	B	desk lamp	**3**
	C	hair dryer	**2**
	D	television	**4**

Answer 56 · Mark scheme November 2010 | PHY1AP | Original Q7 | Legacy

Seven	**3**	**4**	**2**	**1**

Answer 57 · Mark scheme November 2010 | PHY1AP | Original Q9 | Legacy

Nine	**2**	**3**	**4**	**3**

4.1.1.1 Energy stores and systems

Answer 58 · Mark scheme

Question 4

question	answers	extra information	mark
4(a)(i)	kinetic	accept KE do **not** accept movement	1
4(a)(ii)	0.75 **or** 75 %	allow **1** mark for correct substitution ie $\frac{60\,000}{80\,000}$ an answer 0.75 % **or** 0.75 with a unit gains **1** mark only an answer 75 with or without a unit gains **1** mark only	2
4(b)	any **one** from: • large areas of land are flooded • peoples homes may be destroyed • habitat (of animals and plants) lost / damaged	 uses large areas of land / takes up large areas of land is insufficient construct is neutral very noisy is neutral	1

Question 4 continues on the next page . . .

PHY1H

Question 4 continued . . .

question	answers	extra information	mark
4(c)(i)	system of cables and transformers	both required for the mark accept power lines / wires for cables ignore reference to pylons inclusions of power stations / consumers negates answer	1
4(c)(ii)	less energy loss / wasted (in the cables) as the cables are shorter	accept heat for energy do **not** accept no energy loss do **not** accept electricity for energy	1 1
Total			**7**

4.1.1.1 Energy stores and systems

Answer 58 · Mark scheme January 2011 | PHY1H | Original Q4 | Legacy

PHY1H

4.1.1.1 Energy stores and systems

Answer 59 · Mark scheme

January 2011 | PHY1H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	total saving shown for each method ie: cavity wall £325 jacket £163 central heating £90	allow **1** mark for one correctly calculated value **or** allow **1** mark for showing energy bill savings for each method over 5 years ie: cavity wall £575 jacket £175 central heating £400 there are no marks for calculation of payback time	2
6(b)	energy cannot be destroyed	accept energy is conserved ignore reference to created	1
6(c)	4 (hours)	allow **1** mark for obtaining number of kWh = 10 **or** energy transferred = 10	2
Total			**5**

4.1.1.1 Energy stores and systems

Answer 59 · Mark scheme January 2011 | PHY1H | Original Q6 | Legacy

PHY1H

4.1.1.1 Energy stores and systems

Answer 60 · Mark scheme

Question 4

question	answers	extra information	mark
4(a)	1 080 000	allow **1** mark for correct substitution ie ½ × 15 000 × 12 × 12	2
4(b)	any **one** from: • KE (of wind) more than doubles • mass of air (hitting blades) more than doubles • area swept out by blades more than doubles • area swept out by blades increases × 4	do **not** accept blades are larger / have a bigger area	1
Total			**3**

4.1.1.1 Energy stores and systems

Answer 60 · Mark scheme January 2011 | PHY2H | Original Q4 | Legacy

PHY2H

Answer 61 · Mark scheme March 2011 | PHY1AP | Original Q5 | Legacy

Five	**A** economical **2** **B** efficient **1** **C** environmental **3** **D** ethical **4**			
	A	**B**	**C**	**D**

Answer 62 · Mark scheme March 2011 | PHY1AP | Original Q9 | Legacy

Nine	**4**	**3**	**2**	**2**

4.1.1.1 Energy stores and systems

Answer 62 · Mark scheme

March 2011 | PHY1AP | Original Q9 | Legacy

GCSE

SCIENCE A (4461) / PHYSICS (4451)

Objective Test Answer Key

PHY1AP (Energy and Electricity)

March 2011

Higher Tier

Question	Key		
One	**A**	economical	**2**
	B	efficient	**1**
	C	environmental	**3**
	D	ethical	**4**
Two	**A**	. . . increase the rate at which infra red radiation is absorbed	**4**
	B	. . . increase the rate at which infra red radiation is emitted	**3**
	C	. . . improve the ability to reflect visible light	**1**
	D	. . . prevent the reflection of visible light	**2**

	A	B	C	D
Three	**2**	**4**	**2**	**4**
Four	**4**	**3**	**2**	**2**
Five	**2**	**3**	**1**	**3**
Six	**3**	**2**	**3**	**3**
Seven	**3**	**4**	**3**	**4**
Eight	**1**	**1**	**4**	**1**
Nine	**1**	**2**	**1**	**3**

4.1.1.1 Energy stores and systems

Answer 63 · Mark scheme June 2011 | PHY1AP | Original Q1 | Legacy

Question	Key		
One	**A**	10%	**2**
	B	20%	**3**
	C	40%	**4**
	D	50%	**1**

Answer 64 · Mark scheme June 2011 | PHY1AP | Original Q5 | Legacy

Five	**1**	**1**	**1**	**4**

Answer 65 · Mark scheme June 2011 | PHY1AP | Original Q9 | Legacy

Nine	**1**	**3**	**4**	**1**

The AQA UMS Conversion Calculator can be found at the following web address:

http://www.aqa.org.uk/umsconversion

4.1.1.1 Energy stores and systems

Answer 66 · Mark scheme

Question 4

question	answers	extra information	mark
4(a)(i)	4	allow **1** mark for correct transformation and substitution ie $\frac{0.6}{0.15}$ substitution only scores if no subsequent steps are shown	2
4(a)(ii)	diagram showing two output arrows with one arrow wider than the other with the narrower arrow labelled electrical / electricity / useful		1
4(a)(iii)	any **one** from: • time of day / year • position of solar cells • angle of solar cells (to the Sun) • latitude • cloud cover • solar cells covered in dust / dirt	accept charger for solar cells accept any reasonable suggestion that would lead to a change in intensity of sun(light) the weather is insufficient do **not** accept any physical changes to the charger eg area	1
	causes a change in intensity of sun(light)	accept brightness for intensity accept a description of the reduction of intensity	1

Question 4 continues on the next page

PHY1H

Question 4 continued

question	answers	extra information	mark
4(b)	any **one** from: • to check reliability / validity / accuracy • to avoid bias		1
4(c)	any **two** from: • produce no / less (air) pollution • energy is free • (energy) is renewable • conserves fossil fuel stocks • can be used in remote areas • do not need to connect to the National Grid	accept named pollutant accept produces no waste (gases) accept it is a free resource do **not** accept it is free	2
Total			**8**

4.1.1.1 Energy stores and systems

Answer 66 · Mark scheme June 2011 | PHY1H | Original Q4 | Legacy

PHY1H

Answer 67 · Mark scheme November 2011 | PHY1AP | Original Q7 | Legacy

Seven	**4**	**1**	**3**	**4**

4.1.1.1 Energy stores and systems

Answer 68 · Mark scheme

June 2012 | PH1HP | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)	any **two** from: • black is a good emitter of (infrared radiation) • large surface (area) • matt surfaces are better emitters (than shiny surfaces)	accept heat for radiation ignore reference to absorbing radiation accept matt surfaces are good emitters ignore reference to good conductor	2
1(b)	90 % or 0.9(0)	efficiency = useful energy out / total energy in (×100%) allow **1** mark for correct substitution ie 13.5 / 15 provided no subsequent step shown an answer of 90 scores **1** mark an answer of 90 / 0.90 with a unit scores **1** mark	2
1(c)	(producing) light	allow (producing) sound	1

Question 1 continues on the next page

PH1HP

Question 1 continued

question	answers	extra information	mark
1(d)	any **two** from: • wood is renewable • (using wood) conserves fossil fuels • wood is carbon neutral	 accept wood grows again / quickly accept wood can be replanted accept doesn't use fossil fuels accept a description cheaper / saves money is insufficient	2
1(e)	 2 550 000 joules /J	$E = m \times c \times \theta$ allow **1** mark for correct substitution ie 100 × 510 x 50 provided no subsequent step shown answers of 1 020 000, 3 570 000 gain **1** mark accept kJ / MJ do **not** accept j for full credit the unit and numerical answer must be consistent	 2 1
Total			**10**

4.1.1.1 Energy stores and systems

Answer 68 · Mark scheme June 2012 | PH1HP | Original Q1 | Legacy

PH1HP

4.1.1.1 Energy stores and systems

Answer 69 · Mark scheme

June 2012 | PH2HP | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	13 500 (J)	allow **1** mark for correct substitution, ie 90 x 10 x 15 provided no subsequent step shown	2
4(b)	17 **or** $\sqrt{\frac{their\ (a)}{45}}$ correctly calculated and answer given to 2 or 3 significant figures	accept 17.3 allow **2** marks for an answer with 4 or more significant figures, ie 17.32 **or** allow **2** marks for correct substitution, ie 13 500/ their (a) = ½ x 90 x v^2 **or** allow **1** mark for a statement or figures showing KE = GPE	3
4(c)	work is done (against) friction (between the miner and slide) (due to the) slide not (being perfectly) smooth **or** causing (kinetic) energy to be transferred as heat/internal energy of surroundings	 accept 'air resistance' **or** 'drag' for friction accept miners clothing is rough accept lost/transformed for transferred accept air for internal energy of surroundings	1 1 1
Total			**8**

4.1.1.1 Energy stores and systems

Answer 69 · Mark scheme June 2012 | PH2HP | Original Q4 | Legacy

PH2HP

4.1.1.1 Energy stores and systems

Answer 70 · Mark scheme

June 2012 | PH2HP | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	electric current (rate of) flow of (electric) charge / electrons	accept $I = \frac{Q}{t}$ with Q and t correctly named	1
	potential difference work done / energy transferred per coulomb of charge (that passes between two points in a circuit)	accept $V = \frac{W}{Q}$ with W and Q correctly named	1
5(b)	metals contain free electrons (and ions)	accept mobile for free	1
	as temperature of filament increases ions vibrate faster / with a bigger amplitude	accept atoms for ions accept ions/atoms gain energy accept vibrate more for vibrate faster do not accept start to vibrate	1
	electrons collide more (frequently) with the ions **or** (drift) velocity of electrons decreases	do not accept start to collide accept increasing the p.d. increases the temperature (**1** mark) **and** (and) resistance increases with temperature (**1** mark) if no other marks scored	1
5(c)	7.8	allow **1** mark for obtaining value 1.3 from graph **or** allow **1** mark for a correct calculation using an incorrect current in the range 1.2-1.6 inclusive	2
Total			**7**

4.1.1.1 Energy stores and systems

Answer 70 · Mark scheme

June 2012 | PH2HP | Original Q5 | Legacy

PH2HP

4.1.1.1 Energy stores and systems

Answer 71 · Mark scheme

Question 1

question	answers	extra information	mark
1(a)(i)	5(.0)		1
1(a)(ii)	35 **or** their (a)(i) × 7 correctly calculated	allow **1** mark for correct substitution, ie 5 **or** their (a)(i) × 7 provided no subsequent step shown	2
1(a)(iii)	525(p) **or** (£) 5.25 **or** their (a)(ii) × 15 correctly calculated	if unit p or £ given they must be consistent with the numerical answer	1
1(a)(iv)	decreases temperature difference (between inside and outside) decreases	 accept gradient (of line) decreases do **not** accept temperature (inside) decreases do **not** accept graph goes down	1 1
1(b)(i)	air (bubbles are) trapped (in the foam) (and so the) air cannot circulate / move / form convection current	do **not** accept air traps heat foam has air pockets is insufficient air is a good insulator is insufficient no convection current is insufficient answers in term of warm air from the room being trapped are incorrect and score no marks	1 1

Question 1 continues on the next page . . .

PH1HP

Question 1 continued . . .

question	answers	extra information	mark
1(b)(ii)	how effective / good a material is as an insulator / at keeping energy in	accept heat for energy accept the lower the U-value the better the insulator accept the lower the U-value the lower the rate of energy / heat transfer	1
1(c)	it will increase because the glass is not (such) a good insulator (as the wall)	room will be cooler is insufficient the U-value has increased is insufficient	1 1
Total			**11**

4.1.1.1 Energy stores and systems

Answer 71 · Mark scheme

January 2013 | PH1HP | Original Q1 | Legacy

PH1HP

4.1.1.1 Energy stores and systems

Answer 72 · Mark scheme

January 2013 | PH1HP | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)	(matt) black is a good <u>emitter</u> of infrared / radiation	accept heat for infrared / radiation ignore reference to good absorber attracts heat negates this marking point	1
	to give maximum (rate of) energy transfer (to surroundings)	accept temperature (of coolant) falls fast(er) accept black emits more radiation for **1** mark black emits most radiation / black is the best emitter of radiation for **2** marks	1
2(b)	the fins increase the surface area	accept heat for energy	1
	so increasing the (rate of) energy transfer **or** so more fins greater (rate of) energy transfer		1
2(c)	114 000	allow **1** mark for correct temperature change, ie 15 (°C) **or** allow **2** marks for correct substitution, ie 2 × 3800 × 15 answers of 851 200 **or** 737 200 gain **2** marks **or** substitution 2 × 3800 × 112 **or** 2 × 3800 × 97 gains **1** mark an answer of 114 kJ gains **3** marks	3

Question 2 continues on the next page . . .

Answer 72 · Mark scheme

PH1HP

Question 2 continued . . .

question	answers	extra information	mark
2(d)	increases the efficiency		1
	less (input) energy is wasted **or** more (input) energy is usefully used	accept some of the energy that would have been wasted is (usefully) used accept heat for energy	1
Total			**9**

4.1.1.1 Energy stores and systems

Answer 72 · Mark scheme

January 2013 | PH1HP | Original Q2 | Legacy

PH1HP

4.1.1.1 Energy stores and systems

Answer 73 · Mark scheme

January 2013 | PH2HP | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)(i)	50(Hz)	ignore any unit given	1
6(a)(ii)	any **two** from: • (some) current flows to Earth • current flows through copper braid • RCCB detects difference between current in live and neutral wire	 accept ground for Earth accept current flows through the earth wire accept electricity for current in either the first or second marking point but not both	2
6(a)(iii)	can be reset **or** faster acting	accept does not need replacing accept switches circuit off faster	1
6(b)(i)	79 200 coulombs / C	allow **1** mark for correct substitution, ie $11 = \frac{Q}{2 \times 3600}$ an answer 22 gains **1** mark do **not** accept c	2 1
6(b)(ii)	18 216 000 **or** 230 × their (b)(i) correctly calculated	accept for **2** marks 18 216 kJ **or** 18.216 MJ allow **1** mark for correct substitution, ie 230 × their (b)(i) **or** allow **1** mark for power calculated as 2530(W)	2

Question 6 continues on the next page . . .

PH2HP

Question 6 continued . . .

question	answers	extra information	mark
6(c)	increases temperature of thermistor changes resistance (of thermistor)	 do **not** accept increases resistance (of thermistor) an answer decreases resistance (of thermistor) gains **2** marks	1 1
Total			**11**

UMS Conversion Calculator: www.aqa.org.uk/umsconversion

4.1.1.1 Energy stores and systems

Answer 74 · Mark scheme

June 2013 | PH1HP | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)	warms it	do **not** accept answers in terms of waste gases **or** pollution	1
1(b)	80% **or** 0.8	answers of 80 **or** 0.8 plus a unit gain **1** mark **only** **or** allow **1** mark for a correct substitution, ie $\frac{16}{20}$ an answer of 35% **or** 0.35 gains **1** mark answers of 85%, 75%, 0.85 **or** 0.75 gain **1** mark	2
1(c)	some of the energy that would be wasted (by a coal-burning power station) is usefully used (to heat homes etc)	accept less waste energy accept energy used to heat homes etc	1 1
1(d)(i)	A system of cables and transformers		1
1(d)(ii)	less energy / power loss / wasted (in shorter cables)	accept no energy / power loss / wasted (in shorter cables) accept energy is lost when transmitted through cables do **not** accept electricity for energy	1
Total			**7**

4.1.1.1 Energy stores and systems

Answer 74 · Mark scheme

June 2013 | PH1HP | Original Q1 | Legacy

PH1HP

4.1.1.1 Energy stores and systems

Answer 75 · Mark scheme

June 2013 | PH1HP | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	perpendicular	accept correct description	1
3(a)(ii)	light off – no / slow rotation		1
	light on – fast(er) rotation	accept starts rotating	1
		ignore references to energy transfers	
3(b)	one ray drawn from wrist watch and reflected by mirror	accept solid or dashed lines	1
	two rays drawn from wrist watch and reflected by mirror with i = r for both rays	judge angles by eye	1
	one ray traced back behind mirror	accept solid or dashed lines	1
	image in correct position	judged by eye	1
		accept image marked where two reflected rays traced back cross behind the mirror	
3(c)	cannot be formed on a screen **or** rays of light seem to come from it but do not pass through it	accept image formed behind the mirror	1
Total			**8**

4.1.1.1 Energy stores and systems

Answer 75 · Mark scheme

June 2013 | PH1HP | Original Q3 | Legacy

PH1HP

4.1.1.1 Energy stores and systems

Answer 76 · Mark scheme

June 2013 | PH1HP | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5.		6

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant content.	There is a basic explanation of **one** feature **or** a simple statement relating reduction in energy transfer to **one** feature.	There is a clear explanation of **one** feature **or** a simple statement relating reduction in energy transfer to **two** features.	There is a detailed explanation of at least **two** features **or** a simple statement relating reduction in energy transfer to all **four** features.

examples of the points made in response	extra information
plastic cap: • plastic is a poor conductor • stops convection currents forming at the top of the flask so stopping energy transfer by convection • molecules / particles evaporating from the (hot) liquid cannot move into the (surrounding) air so stops energy transfer by evaporation • plastic cap reduces / stops energy transfer by conduction / convection / evaporation glass container: • glass is a poor conductor so reducing energy transfer by conduction • glass reduces / stops energy transfer by conduction	accept throughout: heat for energy loss for transfer accept insulator for poor conductor

Question 4 continues on the next page . . .

PH1HP

Question 4 continued . . .

question	answers	extra information	mark
	vacuum: • both conduction and convection require a medium / particles • so stops energy transfer between the two walls by conduction and convection • vacuum stops energy transfer by conduction / convection silvered surfaces: • silvered surfaces reflect infrared radiation • silvered surfaces are poor emitters of infrared radiation • infrared radiation (partly) reflected back (towards hot liquid) • silvered surfaces reduce / stop energy transfer by radiation	accept heat for infrared	
4(b)	(the ears have a) small <u>surface area</u> so reducing energy radiated / transferred (from the fox)	ears are small is insufficient accept heat lost for energy radiated do **not** accept stops heat loss	1 1
Total			**8**

4.1.1.1 Energy stores and systems

Answer 76 · Mark scheme

June 2013 | PH1HP | Original Q4 | Legacy

PH1HP

4.1.1.1 Energy stores and systems

Answer 77 · Mark scheme

June 2013 | PH1HP | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	(water) particles / molecules gain energy / move faster	accept atoms for molecules ignore move more do **not** accept move with a bigger amplitude / vibrate more	1
	and (the particles / molecules) move apart		1
	this causes the water to become less dense	accept water expands ignore particles become less dense	1
	and the warm / hot water rises (through the tank)	accept (more energetic water) particles rise to the top ignore heat rises	1
5(b)	conduction		1
5(c)(i)	there is a bigger temperature difference between the water and the surrounding air	accept the water is hottest / hotter	1
	so the transfer of energy (from hot water) is faster	accept heat for energy ignore temperature falls the fastest	1
5(c)(ii)	120	allow **1** mark for converting kJ to J correctly, ie 4 032 000 **or** correctly calculating temperature fall as 8°C **or** allow **2** marks for correct substitution, ie 4 032 000 = m × 4200 × 8 answers of 0.12, 19.2 **or** 16.6 gain **2** marks answers of 0.019 **or** 0.017 gain **1** mark	3

Question 5 continues on the next page . . .

PH1HP

Question 5 continued . . .

question	answers	extra information	mark
5(c)(iii)	water stays hot for longer		1
	so heater is on for less time	accept so less energy needed to heat water	1
	(so cost of the jacket is soon recovered from) lower energy costs / bills	accept short payback time	1
Total			**13**

4.1.1.1 Energy stores and systems

Answer 77 · Mark scheme

June 2013 | PH1HP | Original Q5 | Legacy

PH1HP

Answer 78 · Mark scheme

June 2013 | PH2HP | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	distance vehicle travels during driver's reaction time	accept distance vehicle travels while driver reacts	1
4(a)(ii)	any **two** from: • tiredness • (drinking) alcohol • (taking) drugs • speed • age	accept as an alternative factor distractions, eg using a mobile phone	2
4(b)(i)	320 000	allow **1** mark for correct substitution, ie $\frac{1}{2} \times 1600 \times 20^2$ provided no subsequent step shown	2
4(b)(ii)	320 000 **or** their (b)(i)		1
4(b)(iii)	40 **or** $\frac{\text{their (b)(ii)}}{8000}$ correctly calculated	allow **1** mark for statement work done = KE lost **or** allow **1** mark for correct substitution, ie 8000 × distance = 320 000 **or** their (b)(ii)	2
4(b)(iv)	any **one** from: • icy / wet roads • (worn) tyres • road surface • mass (of car and passengers) • (efficiency / condition of the) brakes	accept weather conditions accept number of passengers	1

Question 4 continues on the next page . . .

PH2HP

Question 4 continued . . .

question	answers	extra information	mark
4(b)(v)	(work done by) friction (between brakes and wheel)	do **not** accept friction between road and tyres / wheels	1
	(causes) decrease in KE and increase in thermal energy	accept heat for thermal energy accept KE transferred to thermal energy	1
4(c)	the battery needs recharging less often **or** increases the range of the car	accept car for battery accept less demand for other fuels **or** lower emissions **or** lower fuel costs environmentally friendly is insufficient	1
	as the efficiency of the car is increased	accept it is energy efficient	1
	the decrease in (kinetic) energy / work done charges the battery (up)	accept because not all work done / (kinetic) energy is wasted	1
Total			**14**

4.1.1.1 Energy stores and systems

Answer 78 · Mark scheme

June 2013 | PH2HP | Original Q4 | Legacy

PH2HP

4.1.1.1 Energy stores and systems

Answer 79 · Mark scheme

June 2014 | PH1HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO spec ref
5(a)	water moves (from a higher level to a lower level) transferring GPE to KE rotating a turbine to turn a generator transferring KE to electrical energy	 accept driving or turning or spinning for rotating moving is insufficient transferring GPE to electrical energy gains **1** mark of the **2** marks available for energy transfers	1 1 1 1	AO1 1.4.1b
5(b)	(TVs in stand-by) use electricity generating electricity (from fossil fuels) produces CO_2 (CO_2) contributes to global warming	accept power / energy accept greenhouse gas accept sulfur dioxide accept climate change for global warming accept greenhouse effect if CO_2 given accept acid rain if linked to sulfur dioxide	1 1 1	AO1 AO2 1.4.1f
5(c)	a factor other than scientific is given, eg economic, political or legal	personal choice is insufficient	1	AO3 1.2
Total			8	

4.1.1.1 Energy stores and systems

Answer 80 · Mark scheme

June 2014 | PH1HP | Original Q7 | Legacy

Question	Answers	Extra information	Mark	AO spec ref
7(a)	conduction		1	AO1 1.1.3
7(b)	35 000		1	AO2 1.1.4a
7(c)	500 J/kg°C	their 7(b) = 2 x c x 35 correctly calculated scores **2** marks allow **1** mark for correct substitution, ie 35000 = 2 x c x 35 **or** their 7(b) = 2 x c x 35	2 1	AO1 AO2
7(d)	energy lost to surroundings **or** energy needed to warm heater	accept there is no insulation (on the copper block) do **not** accept answers in terms of human error or poor results or defective equipment	1	AO3 1.1.3d
Total			**6**	

4.1.1.1 Energy stores and systems

Answer 81 · Mark scheme

June 2014 | PH2HP | Original Q1 | Legacy

1(a)	450	allow **1** mark for correct substitution, ie 18 × 10 × 2.5 provided no subsequent step	2	AO2 2.2.1f
1(b)(i)	friction between child ('s clothing) and slide	accept friction between two insulators accept child rubs against the slide accept when two insulators rub (together)	1	AO1 2.3.1a
	causes electron / charge transfer (between child and slide)	accept specific reference, eg electrons move onto / off the child / slide reference to positive electrons / protons / positive charge / atoms transfer negates this mark answers in terms of the slide being initially charged score zero	1	
1(b)(ii)	all the charges (on the hair) are the same (polarity)	accept (all) the charge/hair is negative / positive accept it is positive/negative	1	AO3 2.3.1d
	charges / hairs are repelling	both parts should be marked together	1	
1(b)(iii)	charge would pass through the metal (to earth)	accept metal is a conductor accept metal is not an insulator accept there is no charge / electron transfer accept the slide is earthed accept metals contain free electrons	1	AO1 2.3.1e
Total			**7**	

4.1.1.1 Energy stores and systems

Answer 81 · Mark scheme

June 2014 | PH2HP | Original Q1 | Legacy

Question	Answers	Extra information	Mark	AO spec ref

4.1.1.1 Energy stores and systems

Answer 82 · Mark scheme

June 2014 | PH2HP | Original Q3 | Legacy

3(a)(i)	friction		1	AO1 2.1.3a

3(a)(ii)	air resistance	accept drag friction is insufficient	1	AO1 2.1.3a

3(a)(iii)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.		**Mark** **6**	**AO spec ref**
0 marks	**Level 1 (1–2 marks)**	**Level 2 (3–4 marks)**	**Level 3 (5–6 marks)**	AO2 AO3 2.1.4c
No relevant content.	There is an attempt to explain in terms of forces A and B why the velocity of the cyclist changes between any two points **or** a description of how the velocity changes between any two points.	There is an explanation in terms of forces A and B of how the velocity changes between X and Y and between Y and Z **or** a complete description of how the velocity changes from X to Z. **or** an explanation and description of velocity change for either X to Y or Y to Z	There is a clear explanation in terms of forces A and B of how the velocity changes between X and Z **and** a description of the change in velocity between X and Z.	

4.1.1.1 Energy stores and systems

Answer 82 · Mark scheme

June 2014 | PH2HP | Original Q3 | Legacy

examples of the points made in the response	extra information
X to Y • at X force A is greater than force B • cyclist accelerates • and velocity increases • as cyclist moves toward Y, force B (air resistance) increases (with increasing velocity) • resultant force decreases • cyclist continues to accelerate but at a smaller value • so velocity continues to increase but at a lower rate **Y to Z** • from Y to Z force B (air resistance) increases • acceleration decreases • force B becomes equal to force A • resultant force is now zero • acceleration becomes zero • velocity increases until… • cyclist travels at constant / terminal velocity	accept speed for velocity throughout

4.1.1.1 Energy stores and systems

Answer 82 · Mark scheme

Question	Answers	Extra information	Mark	AO spec ref
3(b)(i)	3360	allow **1** mark for correct substitution, ie 140 × 24 provided no subsequent step accept 3400 for **2** marks if correct substitution is shown	2	AO1 AO2 2.2.1b
	joule / J	do **not** accept j do **not** accept Nm	1	
3(b)(ii)	decreases	accept an alternative word / description for decrease do not accept slows down	1	AO1 2.1.3e
	temperature	accept thermal energy accept heat	1	
Total			**13**	

4.1.1.1 Energy stores and systems

Answer 82 · Mark scheme June 2014 | PH2HP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO spec ref

Answer 83 · Mark scheme June 2015 | PH1HP | Original Q1 | Legacy

The full source mark scheme begins on page 307. Follow original question 1 in that document.

Answer 84 · Mark scheme June 2015 | PH1HP | Original Q5 | Legacy

The full source mark scheme begins on page 307. Follow original question 5 in that document.

Answer 85 · Mark scheme June 2015 | PH1HP | Original Q7 | Legacy

The full source mark scheme begins on page 307. Follow original question 7 in that document.

4.1.1.1 Energy stores and systems

Answer 86 · Mark scheme

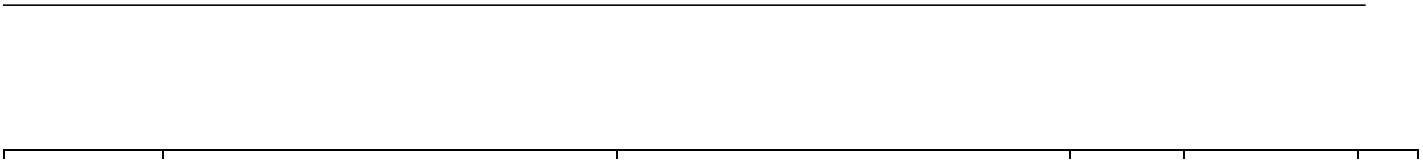
June 2015 | PH2HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
5(a)(i) mark with 5aii 5aiii	1.7		1	AO2 2.3.2	**E**
5(a)(ii) mark with 5ai 5aiii	51 **or** 30 x their (a)(i) correctly calculated coulomb / C	allow **1** mark for correct substitution i.e. 1.7 = Q/30 or their (a)(i) = Q/30 do **not** accept c	2 1	AO1/AO2 2.3.2a	**E**
5(a)(iii) mark with 5ai 5aii	612 **or** their(a)(ii)x 12 correctly calculated ***or*** their (a)(i) x 360 correctly calculated	allow **1** mark for correct substitution i.e. E = 12 x 51 or 12 x their (a)(ii) or their (a)(i) x 360	2	AO2 2.4.2d	**E**
5(b)	ions vibrate faster **or** ions vibrate with a bigger amplitude electrons collide more (frequently) with the ions **or** (drift) velocity of electrons decreases	accept atoms for ions throughout accept ions gain energy accept ions vibrate more ions start to vibrate is insufficient electrons start to collide is insufficient there are more collisions is insufficient, unless both electrons and ions are implied	1 1	AO1 2.3.2m	**E**
Total			**8**		

4.1.1.1 Energy stores and systems

Answer 86 · Mark scheme

June 2015 | PH2HP | Original Q5 | Legacy



4.1.1.1 Energy stores and systems

Answer 87 · Mark scheme

June 2015 | PH2HP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
6(a)(i)	decreases (to zero) resultant force acts in opposite direction to motion	 accept air resistance and weight for resultant force accept resultant force acts downwards do **not** accept air resistance increases	1 1	AO1 2.1.1c/e	E
6(a)(ii)	velocity includes direction **or** velocity is a vector (quantity)		1	AO1 2.1.2d	E
6(b)(i) mark with 6bii 6biii	3.6	allow **1** mark for correct substitution i.e. ½ x 0.05 x 12^2 provided no subsequent step	2	AO2 2.2.1g	E
6(b)(ii) mark with 6bi, 6biii	3.6 **or** their (b)(i)		1	AO1 2.2	E
6(b)(iii) mark with 6bi, 6bii	7.2 **or** their (b)(ii) ÷ 0.5 correctly calculated	allow **1** mark for correct substitution i.e. 3.6 or their (b)(ii) = 0.05 x 10 x h	2	AO2 2.2.1f	E
6(b)(iv)	**B**		1	AO3 2.1	A
6(c)	range increases up to 45° range decreases from 45°	 the range is a maximum at 45° gains both marks for any two angles that add up	1 1	AO3 2.1	E

4.1.1.1 Energy stores and systems

Answer 87 · Mark scheme

		to 90° the range is the same gains both marks the range increases then decreases gains **1** mark			
Total			**11**		

4.1.1.1 Energy stores and systems

Answer 88 · Mark scheme June 2016 | PH1HP | Original Q5 | Legacy

The full source mark scheme begins on page 323. Follow original question 5 in that document.

Answer 89 · Mark scheme June 2016 | PH1HP | Original Q8 | Legacy

The full source mark scheme begins on page 323. Follow original question 8 in that document.

4.1.1.1 Energy stores and systems

Answer 90 · Mark scheme

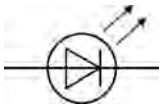
June 2017 | PH1HP | Original Q8 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)	liquid molecules / particles (next to the chiller) move closer together		1	AO1 1.1.3a
	so liquid becomes more dense	allow liquid contracts	1	
	(so cooler liquid) sinks		1	
	(and) warmer liquid rises	accept less dense liquid rises	1	
8(b)	(rate of energy transfer) decreases		1	AO1 1.1.3d
	(as) temperature difference (between chiller and liquid) decreases		1	
8(c)	the bottle cools the air (around it)	accept the air transfers energy to the bottle	1	AO1 1.1.3a
	cooler air cannot hold as many water molecules / particles **or** water molecules / particles move closer together	allow much water vapour for many water molecules / particles ignore descriptions of forces between particles	1	
	water vapour turns into a liquid		1	
Total			**9**	

4.1.1.1 Energy stores and systems

Answer 91 · Mark scheme

June 2017 | PH2HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)		as shown only	1	AO1 2.3.2c
5(a)(ii)	12 (J)	allow **2** marks for correct substitution ie $40 \times 10^{-3} = \frac{E}{300}$ allow **1** mark for obtaining value of P correctly from the graph as 40, 40 x 10^{-3}, 0.04 **or** allow **1** mark for converting time to seconds answers 12000 or 0.2 gain **2** marks an answer 200 gains **1** mark	3	AO2 2.4.2b
5(b)	ions vibrate faster **or** ions vibrate with a bigger amplitude electrons collide more (frequently) with the ions **or** (drift) velocity of electrons decreases	accept atoms for ions throughout accept ions gain energy accept ions vibrate more do not accept ions start to vibrate do not accept ions move around do not accept electrons start to collide there are more collisions is insufficient, unless both electrons and ions are implied	1 1	AO1 2.3.2m

4.1.1.1 Energy stores and systems

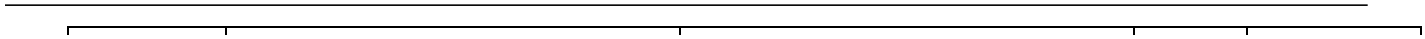
Answer 91 · Mark scheme

5(c)	any **one** from: • they use a smaller current (for the same p.d.) • they are more efficient • they have a lower power input	less energy/power is wasted accept requires less energy ignore use less electricity they last longer is insufficient	1	AO1 2.3.2o
Total			**7**	

4.1.1.1 Energy stores and systems

Answer 91 · Mark scheme

June 2017 | PH2HP | Original Q5 | Legacy



4.1.1.1 Energy stores and systems

Answer 92 · Mark scheme

June 2018 | 8463/1H | Original Q4

Question	Answers	Extra information	Mark	AO/ Spec. Ref
04.1	chemical	in this order only	1	AO1 4.1.1.1
	equal to	allow the same as	1	
04.2	power = $\frac{\text{work done}}{\text{time}}$	allow P = $\frac{W}{t}$	1	AO1 4.1.1.4
04.3	$200 = \frac{W}{1800}$	an answer of 360 000 (J) scores **3** marks	1	AO2 4.1.1.4
	W = 200 × 1800		1	
	W = 360 000 (J)		1	
04.4	11 – 9.5 = 1.5 (m/s)	an answer that rounds to 15.8 (%) scores **2** marks allow a change in speed between 1.2 and 1.5 (m/s)	1	AO2 4.1.1.1
	$\left(\frac{1.5}{9.5}\right)$ × 100 = 15.8 (%)	allow an answer consistent with their change in speed an answer of 16 (%) scores **2** marks	1	
04.5	maximum speed is lower		1	AO1 4.1.1.4
	because maximum power output of cyclist is constant	allow maximum force on pedals is constant	1	
	(but) additional work is done (against gravity) **or** gravitational potential energy (of cyclist) is increased	do **not** accept additional work done against friction or air resistance	1	
Total			**11**	

4.1.1.1 Energy stores and systems

Answer 93 · Mark scheme

June 2018 | 8463/1H | Original Q10

Question	Answers	Extra information	Mark	AO/ Spec. Ref
10.1		an answer of 27 600 (kg) scores **3** marks		AO2 4.3.1.1
	$1.2 = \frac{m}{2.3 \times 10^4}$		1	
	$m = 1.2 \times 2.3 \times 10^4$		1	
	m = 27 600 (kg) **or** $m = 2.76 \times 10^4$ (kg)	allow an answer of 28 000 (kg) or 2.8×10^4 (kg)	1	
10.2		allow power output for kinetic energy throughout		AO3 4.1.1.2
	mass of air passing the turbine blades is halved which decreases kinetic energy by a factor of two		1	
	(wind speed is halved) decreasing kinetic energy by a factor of four		1	
	so kinetic energy decreases by a factor of eight		1	
10.3		an answer that rounds to 7.50 (m/s) scores **3** marks		AO2 4.1.1.2
	$388\,000 = 0.5 \times 13\,800 \times v^2$	this mark may be awarded if P is incorrectly / not converted	1	
	$v^2 = \frac{(2 \times 388\,000)}{13\,800}$	this mark may be awarded if P is incorrectly / not converted	1	
	or			
	$v^2 = \frac{388\,000}{(0.5 \times 13\,800)}$			
	or			
	$v^2 = 56.2$			
	v = 7.50 (m/s)	an answer that rounds to 7.50 (m/s) only	1	
Total			**9**	

4.1.1.1 Energy stores and systems

Answer 94 · Mark scheme

June 2018 | 8463/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	uniform acceleration	allow constant / steady acceleration allow velocity / speed increasing at a constant rate ignore reference to direction acceleration scores **1** mark **or** velocity / speed is increasing scores **1** mark do **not** accept acceleration increases	2	AO1 4.5.6.1.5
01.2	up(wards)		1	AO1 4.5.6.1.5
01.3	a group of objects that interact		1	AO1 4.1.1.1
01.4	velocity just after bounce is less than just before bounce **or** the height at the top of the bounce is less than the height from which it was dropped	allow velocity is less / decreases allow speed for velocity velocity decreases to zero – on its own scores zero	1	AO3 4.5.6.1.5
	so the ball has lost energy		1	AO1 4.1.1.2
	correct reference to (loss of) ke or (reduced) gpe		1	AO1 4.1.2.1
	total energy of ball and Earth / ground is constant	allow 'a system' for ball and Earth allow energy is conserved	1	AO1 4.1.2.1
Total			**8**	

4.1.1.1 Energy stores and systems

Answer 95 · Mark scheme

June 2019 | 8463/1H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3.1	$41 = \frac{9.8 \times h}{0.12}$ $h = \frac{41 \times 0.12}{9.8}$ h = 0.50 (m)	an answer of 0.50 scores **3** marks allow a correct answer that rounds to 0.50 for **3** marks	1 1 1	4.1.1.2 AO2
3.2	kinetic energy = 0.5 × mass × (speed)^2 ***or*** $E_k = ½ mv^2$		1	4.1.1.2 AO1
3.3	$270 = ½ \times m \times 3^2$ $m = \frac{270}{(½ \times 3^2)}$ **or** $m = \frac{270}{4.5}$ m = 60 (kg)	an answer of 60 (kg) scores **3** marks	1 1 1	4.1.1.2 AO2

3.4	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear.		3–4	WS3.5 4.1.1.2 AO3
	Level 1: Relevant features are identified and differences noted.		1–2	
	No relevant content		0	
	Indicative content • males have a greater muscle power than females for most of their lives • males have a greater muscle power than females above 9/10 years old • males have a lower muscle power than females below 9/10 years old • there is a similar pattern for males and females as age increases • males have a peak muscle power at 25 years old whereas females have a peak muscle power at 20/21 years old • at 9/10 years old males have the same muscle power as females • peak muscle power for males (47 W/kg) is greater than peak muscle power for females (37 W/kg) • the rate of increase of muscle power is greater for males than females (between 5 and 25 years old) • the rate of decrease of muscle power is greater for males than females. Ignore comments relating to strength			
3.5	any **1** from: • maximum height reached is a better indicator of maximum muscle power • maximum / peak muscle power was being investigated, not mean / average muscle power • volunteer may not use maximum effort on the first try • performance may improve with practise • performance may get worse with tiredness	allow maximum time in the air for maximum height reached / jumped	1	WS3.7 4.1.1.4 AO3
Total			**12**	

4.1.1.1 Energy stores and systems

Answer 96 · Mark scheme

June 2019 | 8463/1H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4.1	electric car journey will take a (much) longer time (because) battery will need recharging **or** (because) the car will need to stop for 40 minutes	allow diesel car journey will take a shorter time allow diesel car will not need to be refuelled	1 1	4.1.3 AO3
4.2	energy stored in diesel = 45 × 51 = 2295 (MJ) energy stored in batteries = 0.95 × 280 = 266 (MJ) (so) the diesel stores more energy than the battery (and the diesel car has a higher range)	 this mark is dependent on correct calculations of energy stored	1 1 1	4.1.3 1AO1 1AO2 1AO3
4.3	any **2** from: • recharging is a continuous process • fewer cells needed in the car • more cars can be charged at the same time	 allow cars do not need to stop to recharge allow shorter journey times allow don't have to wait for battery to recharge allow longer time between recharges allow the range of the electric car is increased allow smaller battery needed in the car allow do not need to find a charging point allow fewer charging stations needed ignore it is quicker ignore cost of charging ignore methods of electricity generation	2	4.1.3 AO1

4.1.1.1 Energy stores and systems

Answer 96 · Mark scheme

June 2019 | 8463/1H | Original Q4

4.4	when cars are plugged in the energy from car batteries could be transferred back to the National Grid	 allow mains supply for National Grid allow energy from car batteries could be used to power household appliances	1 1	4.1.3 AO1
Total			**9**	

4.1.1.1 Energy stores and systems

Answer 97 · Mark scheme

June 2019 | 8463/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7.1		an answer of 2.5 (m) scores **3** marks		4.1.1.2 AO2
	1470 = 60 × 9.8 × h	this mark may be awarded if E_p is incorrectly/not converted	1	
	$h = \frac{1470}{60 \times 9.8}$ **or** $h = \frac{1470}{588}$	this mark may be awarded if E_p is incorrectly/not converted	1	
	h = 2.5 (m)	this answer only	1	
7.2	(work done against) air resistance **or** (work done against) friction (between zip line and pulley)		1	4.1.1.1 AO1
	causes thermal energy to be transferred to surroundings	ignore sound energy	1	
7.3	different people have different surface areas	allow streamlining allow body position body size is insufficient	1	4.1.1.1 4.1.1.2 AO1
	so would be affected by air resistance differently		1	
	OR			
	initial speed may not be zero (1)			
	which would add to the total energy (of the system) (1)			
		allow people have different masses / weights (1)		
		so people have different terminal velocities (1)		
		reference to mass changing the kinetic energy or gravitational potential energy negates both these marks		
Total			**7**	

4.1.1.1 Energy stores and systems

Answer 98 · Mark scheme

June 2019 | 8463/1H | Original Q10

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	non-contact (force)	allow electrostatic (force)	1	4.2.5.2 AO1
	attraction (between hair and balloon)	allow repulsion between the hairs on the head	1	
10.2		an answer of 2.0×10^{-6} (C) scores **3** marks an answer of 2×10^{-3} (C) scores **2** marks		4.2.4.2 AO2
	$0.0050 = Q \times 2500$	this mark may be awarded if pd is incorrectly or not converted	1	
	$Q = \frac{0.0050}{2500}$	this mark may be awarded if pd is incorrectly or not converted	1	
	$Q = 2.0 \times 10^{-6}$ (C) **or** Q = 0.0000020 (C)	these answers only	1	
10.3		an answer of 120 (Ω) scores **5** marks		4.2.1.2 4.2.1.3 AO2
	$0.16 = I \times 4.0 \times 10^{-3}$ **or** $I = \frac{0.16}{4.0 \times 10^{-3}}$	this mark may be awarded if time is incorrectly / not converted	1	
	I = 40 (A)	this value only	1	
	$4800 = 40 \times R$	allow 4800 = their calculated I × R	1	
	$R = \frac{4800}{40}$	allow R = 4800 / their calculated I	1	
	R = 120 (Ω)	allow an answer consistent with their calculated I	1	
Total			**10**	

Answer 99 · Mark scheme

June 2019 | 8463/2H | Original Q10

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	the (perpendicular) distance from the pivot / hinge to (the line of action of) the force is greater	allow distance from the rope to the pivot / hinge is greater (than distance between handle and pivot / hinge)	1	AO2/1 4.5.4
	so a smaller force is required	this mark is dependent on scoring the 1st mark an answer a smaller force is required at the rope to produce the same moment scores **2** marks	1	
10.2		an answer of 770 scores **6** marks		AO2/1 4.5.4 4.5.3
	924 = F × 0.15		1	
	F = 6160 (N)	allow use of E = ½ F e instead of k = F ÷ e and E = ½ × k × e^2	1	
	6160 = k × 0.25	allow their calculated F = k × 0.25	1	
	$k = \frac{6160}{0.25}$ **or** k = 24640 (N/m)	allow a value for k calculated using their calculated F	1	
	$E = \frac{½ \times 6160 \times 0.25 \times 0.25}{0.25}$	allow E = ½ × their calc. k × 0.25^2	1	
	E = 770 (J)	allow an answer consistent with their calculated k	1	
Total			**8**	

Answer 100 · Mark scheme

November 2020 | 8463/1H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	density = $\frac{\text{mass}}{\text{volume}}$ **or** $\rho = \frac{m}{V}$		1	AO1 4.3.1.1
03.2	998 = $\frac{\text{m}}{6\ 500\ 000}$ m = 998 × 6 500 000 m = 6 487 000 000 m = 6.487×10^9 (kg)	 allow a correct conversion of their calculated value of mass into standard form	1 1 1 1	AO2 4.3.1.1
03.3	energy transferred = power × time **or** $E = Pt$		1	AO1 4.2.4.2
03.4	t = 18 000 (s) **or** t = 5 × 60 × 60 E = $1.5 \times 10^9 \times 18\ 000$ E = 2.7×10^{13} (J)	 allow a correct substitution using an incorrectly/not converted value of t allow a correct calculation using an incorrectly/not converted value of t	1 1 1	AO2 4.2.4.2
03.5	the variation in demand is (much) greater than 1.5×10^9 W demand remains high for longer than 5 hours	allow the increase in demand is greater than the (power) output of the (hydroelectric) power station allow 04:00 to 16:00 is 12 hours allow 04:00 to 16:00 is greater than 5 hours	1 1	AO3 4.1.3
Total			**11**	

4.1.1.1 Energy stores and systems

Answer 101 · Mark scheme

November 2020 | 8463/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	Length of sled Time for sled to pass light gate		1 1	AO2 4.1.1.2
06.2	E_p = 8330 (J) 8330 = m × 9.8 × 17.0 $m = \frac{8330}{9.8 \times 17.0}$ m = 50.0 (kg)	 allow a correct substitution using an incorrectly/not converted value of E_p allow a correct rearrangement using an incorrectly/not converted value of E_p allow a correct calculation using an incorrectly/not converted value of E_p	1 1 1 1	AO2 4.1.1.2
06.3	½ mv^2 = mgh **or** decrease in E_p = increase in E_k masses cancel on both sides of the equation **or** v^2 = 2gh (final) speed only depends on vertical height (and gravitational field strength) variations will be due to air resistance/friction **or** different initial speed		1 1 1 1	AO1 4.1.1.2
Total			**10**	

4.1.1.1 Energy stores and systems

Answer 102 · Mark scheme

November 2020 | 8463/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	the heating element of the kettle takes time to heat up	allow the kettle takes time to heat up	1	AO3 4.1.1.3
07.2	ΔΘ = 78 (°C) 155 000 = m × 4200 × 78 $m = \frac{155\,000}{4200 \times 78}$ m = 0.4731 (kg) m = 0.47 (kg)	 allow a correct substitution using an incorrect value of ΔΘ allow a correct rearrangement using an incorrect value of ΔΘ allow a correct calculation of mass using an incorrect value of ΔΘ	1 1 1 1 1	AO2 4.1.1.3 4.3.2.2
07.3	Gradient = $\frac{\Delta\theta}{t}$ Pt = mcΔΘ P = gradient × mc	allow gradient = rate of temperature increase allow calculation of gradient	1 1 1	AO1 4.1.1.3 4.3.2.2 4.1.1.4
Total			**9**	

4.1.1.1 Energy stores and systems

Answer 103 · Mark scheme

November 2021 | 8463/1H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	the polarity (of the supply) does not change	allow potential difference in one direction (only)	1	AO1 4.2.3.1
01.2	energy transferred = power × time		1	AO1 4.1.1.4 4.2.4.2
01.3	162 000 000 = 7200 × t $t = \frac{162\,000\,000}{7200}$ t = 22 500 (s)		1 1 1	AO2 4.1.1.4 4.2.4.2
01.4	$V = I \times R$		1	AO1 4.2.1.3
01.5	480 = 15 × R $R = \frac{480}{15}$ R = 32 (Ω)		1 1 1	AO2 4.2.1.3
01.6	time taken using system **A** is double the time of system **B**		1	AO3 4.2.4.1
Total			**10**	

4.1.1.1 Energy stores and systems

Answer 104 · Mark scheme

November 2021 | 8463/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$E = \frac{1.25\times10^{18}}{3.16\times10^{7}}$		1	AO2 4.1.1.4
	$E = 3.96 \times 10^{10}$ (J)	an answer that rounds to 3.96×10^{10} (J) scores **1** mark	1	
05.2	t = 86 400 (s)		1	AO2 4.2.1.2
	27 000 = I × 86 400	allow a correct substitution of an incorrectly/not converted value of t	1	
	$I = \frac{27\ 000}{86\ 400}$	allow a correct rearrangement using an incorrectly/not converted value of t	1	
	I = 0.3125 (A)	allow a correct calculation using an incorrectly/not converted value of t allow a correctly calculated answer rounded to 2 or 3 sf	1	
05.3	$0.15 = \frac{\text{useful power output}}{7800}$	allow a correct substitution of an incorrectly/not converted value of total power input	1	AO2 4.1.2.2
	useful power output = 0.15 × 7800	allow a correct rearrangement using an incorrectly/not converted value of total power input	1	
	useful power output = 1170 (W)	this answer only but allow 1200 (W) if correct working shown	1	
05.4	a really large area of land would need to be covered with solar cells		1	AO2 4.1.3
	due to the low useful power output of the solar cells	allow due to the low efficiency of the solar cells	1	

4.1.1.1 Energy stores and systems

Answer 104 · Mark scheme

November 2021 | 8463/1H | Original Q5

		or number of hours of daylight is too low (in UK) **or** low solar intensity (in UK) **or** solar radiation (in UK) is too low **or** material for construction of solar cells and/or lithium batteries is in limited supply		

Total			**11**

4.1.1.1 Energy stores and systems

Answer 105 · Mark scheme

November 2021 | 8463/1H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	the total energy of the racing track and the car is constant.		1	AO1 4.1.2.1
08.2	$E_p = 0.040 \times 9.8 \times 0.90$	allow a correct substitution of an incorrectly/not converted value of h	1	AO2 4.1.1.1 4.1.1.2
	$E_p = 0.3528$ (J)	this answer only	1	
	$0.3528 = 0.5 \times 0.040 \times v^2$	allow a correct substitution of a calculated E_p	1	
	$v^2 = \frac{0.3528}{0.5 \times 0.040}$	allow a correct rearrangement using a calculated E_p	1	
	$v = 4.2$ (m/s)	allow an answer consistent with their calculated E_p	1	
08.3	more than 0.20 J		1	AO3 4.1.1.1
	(because) the car needs to be moving at the top of the loop **or** (because) the car needs to be moving to complete the loop **or** not all E_k at **B** will be transferred to E_p at **C**	this mark is dependent on scoring the first mark allow energy dissipated to the surroundings	1	
Total			**8**	

4.1.1.1 Energy stores and systems

Answer 106 · Mark scheme

November 2021 | 8463/1H | Original Q11

Question 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.1	the gradient for ice is steeper than the gradient for water (liquid) which means that less energy is needed to increase the temperature by a fixed amount	allow the temperature of the ice increased faster than the temperature of the water	1 1	AO3 4.3.2.2
11.2	water took more time to vaporise than the ice took to melt which means that less energy is needed to change the state from solid to liquid (than from liquid to vapour)		1 1	AO3 4.3.2.3
11.3	any **two** from: • ice/water would take more time to increase in temperature • ice/water would take more time to change state • the change in temperature with time would not be linear	allow gradients would be less steep allow horizontal lines would be longer	2	AO3 4.3.2.2 4.3.2.3 RPA1

4.1.1.1 Energy stores and systems

Answer 106 · Mark scheme

November 2021 | 8463/1H | Original Q11

11.4	E = 69 000 (J)		1	AO2 4.3.2.3
	69 000 = 0.030 × L	allow a correct substitution of an incorrectly/not converted value of E	1	
	$L = \frac{69\,000}{0.030}$	allow a correct rearrangement using an incorrectly/not converted value of E	1	
	L = 2 300 000 **or** L = 2.3×10^6	allow a correct calculation using an incorrectly/not converted value of E	1	
	J/kg	allow a unit consistent with their numerical answer eg 2300 kJ/kg	1	

Total			**11**

Answer 107 · Mark scheme

November 2021 | 8463/2H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO/ Spec. Ref
02.1	will return to its original shape/length when the force is removed	 allow (when) the child gets off the second mark is dependent on scoring the first mark	1 1	AO2 4.5.3

02.2	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.5.3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content • set up a clamp stand with a clamp • hang the spring from the clamp • use a second clamp and boss to fix a (half) metre rule alongside the spring • record the ruler reading that is level with the bottom of the spring • hang a 1 N / a known weight from the bottom of the spring • record the new position of the bottom of the spring • calculate the extension of the spring • measure the extension of the spring • add further weights to the spring so the force increases 1 N at a time up to 5 N • for each new force record the position of the bottom of the spring and calculate / measure the extension Indicative content continues on the next page…		

	Risk Assessment Hazard: Clamp (stand, boss and masses) might fall off desk Risk: injury to feet Precaution: Use clamp to fix apparatus to the bench **or** Ensure that the slotted masses hang over the base/foot of the stand **or** Ensure that the boss is screwed tightly into the stand and clamp **or** Put (heavy) masses on the base/foot of the stand **or** Stand up so that you can move out of the way Hazard: Spring could break / come loose Risk: damage eye Precaution: Wear safety goggles If a risk assessment / hazard is not given, the answer can still reach level 3, but not full marks. Full marks may be awarded for alternative feasible methods.			

02.3	force = spring constant × extension		1	AO1 4.5.3

02.4	5.00 0.125 $k = \frac{5.00}{0.125}$ k = 40 (N/m)	allow any correct pair of values from the graph allow a misread value(s) from the graph allow a correct calculation using their incorrect value(s)	1 1 1	AO2 4.5.3

02.5	the line is straight and passes through the origin	allow the line does not curve allow a constant gradient	1 1	AO3 4.5.3

4.1.1.1 Energy stores and systems

Answer 107 · Mark scheme

November 2021 | 8463/2H | Original Q2

02.6	e = 0.20 m $E_e = 0.5 \times 13 \times 0.20^2$ E_e = 0.26 (J)	 allow an incorrectly / not converted value of e use of two incorrectly/not converted values scores a maximum of 1 mark	1 1 1	AO2 4.5.3

Total			**17**

4.1.1.1 Energy stores and systems

Answer 108 · Mark scheme

June 2022 | 8463/1H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	independent variable: (type of) insulation / material dependent variable: time	do not accept thickness of material	1 1	AO1 4.1.2.1 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	0.1 (ºC)		1	AO3 4.1.2.1 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	viewing angle affects measurement **or** parallax error	allow judgement needed in reading the position (of the liquid in the thermometer) allow the level of the liquid may be between lines allow number of lines may be miscounted ignore harder to read ignore lines are close together ignore human error	1	AO3 4.1.2.1 RPA2

Answer 108 · Mark scheme

June 2022 | 8463/1H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	E = 10 500(J)		1	AO2 4.1.1.3 RPA2
	$m = \frac{10\ 500}{4200 \times (85\text{-}65)}$	allow a correct substitution **and** rearrangement using an incorrectly / not converted value of E	1	
	m = 0.125 (kg)	allow a correct calculation using an incorrectly / not converted value of E	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	(same) temperature decrease in a shorter time means a higher thermal conductivity	allow converse answer	1	AO1 4.1.2.1 RPA2
	(because) the rate of energy transfer is higher		1	

Total Question 4		**9**

Answer 109 · Mark scheme

June 2022 | 8463/1H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	measuring cylinder	allow burette allow beaker with scale / graduations	1	AO3 4.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	boiling water		1	AO3 4.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	change in mass = 0.009 (kg)		1	AO2
	25 200 = 0.009 L	allow a correct substitution using an incorrectly calculated value of m	1	AO2
	$L = \frac{25\,200}{0.009}$	allow a correct rearrangement using an incorrectly calculated value of m	1	AO2 AO2
	$L = 2.8 \times 10^6$ or $L = 2\,800\,000$	allow a correctly calculated answer using an incorrectly calculated value of m	1	AO1 4.3.2.3
	J/kg	if a unit other than J/kg is given it must match the numerical answer	1	

4.1.1.1 Energy stores and systems

Answer 109 · Mark scheme

June 2022 | 8463/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	less energy (than 25 200 J) was transferred to the water (so) student's value of *L* was too high	 2nd mark conditional on scoring 1st mark	1 1	AO3 4.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	the measured change in mass is too high (for the energy supplied) (so) student's value of L is too low	allow a smaller mass of water actually changed state at boiling point 2nd mark conditional on scoring 1st mark	1 1	AO3 4.3.2.3

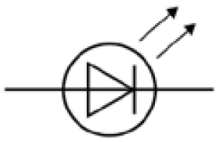
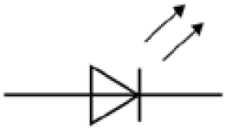
Total Question 8		**11**

Answer 110 · Mark scheme

June 2022 | 8463/1H | Original Q11

Question 11

Due to incorrect Advance Information guidance being issued for this question, and to avoid any students being disadvantaged, Question 11 was discounted and all students were awarded full marks.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.1		allow: 	1	AO1 4.2.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.2	there is a gap in the circuit **or** S_1 needs to be closed to complete the circuit **or** S_1 needs to be closed to turn the hair straighteners on		1	AO1 4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.3	E = 3600 (J)		1	AO2 4.2.4.2
	3600 = 120 × t	this mark may score if E is incorrectly / not converted	1	
	$t = \frac{3600}{120}$	this mark may score if E is incorrectly / not converted	1	
	t = 30 (s)	allow an answer consistent with their value of E	1	

4.1.1.1 Energy stores and systems

Answer 110 · Mark scheme

June 2022 | 8463/1H | Original Q11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.4	the total resistance of the circuit decreases so the current increases which increases the power output		1 1 1	AO1 4.2.4.1 4.2.2

Total Question 11		**9**

4.1.1.1 Energy stores and systems

Answer 111 · Mark scheme

June 2022 | 8463/2HR | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	there is a resultant force acting	allow weight/gravity is greater than air resistance allow (initially) weight/gravity is the only force acting	1	AO1 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	as the velocity of the hailstone increases air resistance increases until air resistance becomes equal to the weight of the hailstone so the resultant force is (equal to) zero	allow speed for velocity	1 1 1	AO1 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	as mass increases the weight of a hailstone increases		1	AO3 4.5.6.1.5

4.1.1.1 Energy stores and systems

Answer 111 · Mark scheme

June 2022 | 8463/2HR | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	kinetic energy depends on both mass and velocity	allow $E_k = ½ mv^2$	1	AO1
	as mass increases so does terminal / maximum velocity	a statement is required	1	AO1
	kinetic energy ∝ m and kinetic energy ∝ v^2 so as mass doubles kinetic energy more than doubles	this mark can be scored by relevant calculations	1	AO3 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	1 N m		1	AO3 4.5.2

4.1.1.1 Energy stores and systems

Answer 111 · Mark scheme

June 2022 | 8463/2HR | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	mass = 0.0185 (kg)	allow 0.018 to 0.019 inclusive	1	AO2 4.5.7.3
	$F = \frac{0.0185 \times 25}{0.060}$	allow a correct substitution using an incorrectly / not converted value of *m*	1	
	F = 7.708 (N)	allow 7.7 (N) allow correct calculation using an incorrectly / not converted value of *m* **if no other marks are awarded** a misreading of the scale giving a value between 15.6 and 15.7 inclusive that is then correctly converted giving an answer between 6.50 and 6.54 scores 2 marks a misreading of the scale giving a value between 15.6 and 15.7 inclusive that is then not converted giving an answer between 6500 and 6542 scores 1 mark	1	

Total Question 4		**12**

Answer 112 · Mark scheme

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	so the thermometer temperature was the same as the temperature of the iron block		1	AO3 4.1.1.3 RPA1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	$\Delta\theta = (54 - 28) = 26$ (°C) $26\,000 = 2.0 \times c \times 26$ $c = \frac{26\,000}{2.0 \times 26}$ $c = 500$ (J/kg °C)	 allow a correct substitution using an incorrect value of $\Delta\theta$ obtained from the graph allow a correct rearrangement using an incorrect value of $\Delta\theta$ obtained from the graph allow an answer consistent with their value of $\Delta\theta$ obtained from the graph	1 1 1 1	AO2 4.1.1.3 RPA1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	the calculated specific heat capacity will be more accurate the iron block will transfer thermal energy to the surroundings at a lower rate		1 1	AO3 4.1.1.3 RPA1

Total Question 2	**7**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	E_p = 367 500 000 (J)		1	AO2 4.1.1.2
	367 500 000 = 2 500 000 × 9.8 × h	allow a correct substitution using an incorrectly/not converted value of E_p	1	
	$h = \frac{367\,500\,000}{2\,500\,000 \times 9.8}$	allow a correct rearrangement using an incorrectly/not converted value of E_p	1	
	h = 15 (m)	allow an answer consistent with their value of E_p	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	3 kW = 3000 W		1	AO2 4.1.1.4
	$3000 = \frac{2.16 \times 10^7}{t}$	all subsequent marks can score using an incorrectly / not converted value of P	1	
	$t = \frac{2.16 \times 10^7}{3000}$		1	
	t = 7200 (s)		1	
	$t = 7.2 \times 10^3$ (s)	allow an answer given in standard form from a calculation using data given in the question	1	

4.1.1.1 Energy stores and systems

Answer 113 · Mark scheme

June 2023 | 8463/1H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3		allow reference to specific months eg April to September		AO3 4.1.3
	in the summer the power output from the hydroelectric generator is lower but the solar power output would be greater	allow power output of hydroelectric generator depends on rainfall **and** power output of solar power system depends on light intensity	1	
	so less variation in total power output (which improves the reliability of the supply)	allow electricity supply for total power output	1	

Total Question 4	11

4.1.1.1 Energy stores and systems

Answer 114 · Mark scheme

June 2023 | 8463/1H | Original Q6

Question 6

Question	Answers	Mark	AO / Spec. Ref.
06.1	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.2.1.4 RPA4
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content • ammeter in series with filament lamp • current measured with an ammeter • voltmeter in parallel with filament lamp • p.d. measured with a voltmeter • variable resistor (or variable power pack or variable number of cells) used to vary current in and p.d. across filament lamp • range of p.d. of 0 to 6 V • interval of p.d. of 1 V • reverse connections to power supply to obtain negative values • take repeat readings and calculate a mean • discard anomalies Indicative content may be seen in a circuit diagram. Level 3 answer: needs to include a circuit which would work (if included) and a method to obtain negative values.		

4.1.1.1 Energy stores and systems

Answer 114 · Mark scheme

June 2023 | 8463/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	3.0 = 0.16 × *R*	allow a correct substitution of an incorrect value of *I* in the range 0.15 (A) to 0.17 (A)	1	AO2 4.2.1.3
	$R = \frac{3.0}{0.16}$	allow a correct rearrangement of an incorrect value of *I* in the range 0.15 (A) to 0.17 (A)	1	
	R = 18.75 (Ω)	allow 19 (Ω) allow 18.8	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	*t* = 1800 (s)		1	AO2 4.2.4.2
	Q = 0.21 × 1800	all subsequent marks can score if an incorrectly / not converted value of *t* is used	1	4.1.1.4 4.2.1.2 4.2.4.1
	Q = 378 (C)		1	
	E = 378 × 6.0		1	
	E = 2268 (J)	allow an answer to 2 or 3 s.f.	1	
	OR			
	P = 0.21 × 6.0 (1)			
	P = 1.26 (W) (1)			
	t = 1800 (s) (1)	all subsequent marks can score if an incorrectly / not converted value of *t* is used		
	E = 1.26 × 1800 (1)			
	E = 2268 (J) (1)	allow an answer to 2 or 3 s.f.		

4.1.1.1 Energy stores and systems

Answer 114 · Mark scheme

June 2023 | 8463/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(for the power to quadruple) the current and the p.d. would both need to double		1	AO3 4.2.1.4 4.2.4.1
	(but the current doesn't double) because the resistance of the filament lamp increases **or** (but the current doesn't double because the graph shows that) current is not proportional to p.d.	allow the graph does not show direct proportionality ignore the graph is not a straight line ignore the graph is not linear	1	

Total Question 6	16

4.1.1.1 Energy stores and systems

Answer 115 · Mark scheme

June 2023 | 8463/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	spring may become permanently extended **or** extension of the spring may be too great (so the baby's feet are always on the floor)	ignore reference to limit of proportionality allow the harness / spring / chain may break ignore baby may be injured / harmed / may hit doorframe	1	AO3 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	(in position **A**) the baby has gravitational potential energy (as the baby moves down this) is transferred to kinetic energy (of the baby) and / then elastic potential energy (of the spring) (in position **B**) all the energy is elastic potential energy	allow E_p for gravitational potential energy allow E_k for kinetic energy allow E_e for elastic potential energy ignore energy dissipated to the surroundings	1 1 1	AO1 4.1.1.1

4.1.1.1 Energy stores and systems

Answer 115 · Mark scheme

June 2023 | 8463/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	e = 0.080 (m)		1	AO2 4.1.1.2
	$4.0 = ½ \times k \times 0.080^2$	allow a correct substitution using an incorrectly / not converted value of e	1	
	$k = \frac{4.0}{(0.5 \times 0.080^2)}$	allow a correct rearrangement using an incorrectly / not converted value of e	1	
	k = 1250 (N/m)	allow an answer consistent with their value of e	1	

Total Question 7	8

4.1.1.1 Energy stores and systems

Answer 116 · Mark scheme

June 2023 | 8463/2H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	perpendicular		1	AO1 4.6.1.1

Question	Answers	Mark	AO / Spec. Ref.
01.2	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5-6	AO3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3-4	AO1
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1-2	AO1
	No relevant content	0	
	Indicative content **Method:** • heat the water / kettle • add an equal volume of (hot) water to each flask • insert a thermometer into each flask • record the initial temperature from both flasks OR • place an IR detector near each flask • the distance between the IR detector and the flask should be the same each time • record initial reading from IR detectors • (and) start a stop clock • record the temperatures / readings after 10 minutes from both flasks • calculate the change in temperatures / readings during the 10 minutes • compare the results to test the hypothesis to access level 3 the method must allow the correct consideration of a temperature decrease for both flasks or the correct comparison of IR detected from both flasks		4.6.2.2

4.1.1.1 Energy stores and systems

Answer 116 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	during the 1st minute there is the greatest temperature difference (between the hot water and the surroundings)	 allow highest temperature or hottest MP 2 dependent on scoring MP 1	1 1	AO2 AO1 4.6.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	the temperature (increase / change after 10 minutes)	allow the final temperature do not allow temperature decrease	1	AO1 4.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	black surfaces absorb more (infrared than white surfaces) matt surfaces absorb more (infrared) than shiny surfaces of the same colour	allow black surfaces have a greater temperature increase (than white surfaces) allow matt surfaces have a greater temperature increase than shiny surfaces of the same colour if no other marks scored, allow 1 mark for matt black surface is the best absorber and shiny white surface is the worst absorber if no other marks scored, allow 1 mark for matt black has the greatest temperature increase and shiny white has the smallest temperature increase	1 1	AO3 4.6.2.2 4.6.3.1

Answer 116 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	pressure = $\frac{\text{force}}{\text{area}}$		1	AO1 4.5.5.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	area of base = 0.0144 (m^2)	do not allow this or subsequent marks unless base area is used	1	AO2 4.5.5.1.1
	$1500 = \frac{F}{0.0144}$	this mark may be awarded if base area is incorrectly calculated	1	
	$F = 1500 \times 0.0144$	this mark may be awarded if base area is incorrectly calculated	1	
	$F = 21.6$ (N)	this mark may be awarded if base area is incorrectly calculated allow 22 (N)	1	

Total Question 1	**17**

4.1.1.1 Energy stores and systems

Answer 117 · Mark scheme

June 2024 | 8463/1H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	thermal / internal (energy) **or** kinetic (energy of the water particles)	ignore heat allow E_k	1	AO1 4.1.1.1 4.3.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	gravitational potential (energy)	allow E_p / GPE allow kinetic / E_k	1	AO1 4.1.1.1

Question	Answers	Mark	AO / Spec. Ref.
01.3	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	3–4	AO3 4.1.1.1 4.3.2.1 4.1.1.2 4.1.2.2 4.1.3
	Level 1: Relevant features are identified and differences noted.	1–2	
	No relevant content	0	
	Indicative content **Method A:** • heated water needs insulating (to maintain high temperature) • energy stored by heating water is much greater (per 100 kg) • useful energy from heating 100 kg of water = 20 160 (kJ) • energy wasted (per 100 kg) = 13 440 (kJ) • efficiency = 60 % **Method B:** • suitable location needed to pump water uphill • pumping water efficiency is higher • useful energy from pumping 100 kg of water = 367.5 (kJ) • energy wasted (per 100kg) = 122.5 (kJ) • efficiency = 75 % A level 2 answer should use the data in a relevant calculation that compares the two methods.		

4.1.1.1 Energy stores and systems

Answer 117 · Mark scheme

June 2024 | 8463/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	**Transport examples:** don't use (petrol / diesel) cars (for transport) **or** don't burn petrol / diesel (for transport) (instead) use electric cars **or** (instead) use hydrogen-fuelled cars **or** (instead) use a bicycle **or** (instead) use public transport **or** (instead) walk **Generating Electricity examples:** don't use coal / oil / gas (to generate electricity) (instead) use renewable methods **or** (instead) use nuclear power **OR** don't use (electrical) appliances when not needed to reduce the demand for electricity (generated) using coal / oil / gas	allow don't use other transport methods e.g. (diesel) buses allow fossil fuels for petrol / diesel allow fossil fuels for coal / oil / gas allow specific examples of renewable energy resources allow specific examples e.g. lights allow fossil fuels for coal / oil / gas accept other reasonable changes with valid alternative for 2 marks each	1 1 1 1	AO3 4.1.3

Total Question 1	10

4.1.1.1 Energy stores and systems

Answer 118 · Mark scheme

June 2024 | 8463/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	elastic potential (energy)	*allow E_e / EPE*	1	AO1 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	$E_e = 0.5 \times 735 \times 8.0^2$	allow a correct substitution using k = 1470 (N/m) and e = 8 (m) **or** k = 1470 (N/m) and e = 16 (m) **or** k = 735 (N/m) and e = 16 (m)	1	AO2 4.1.1.2
	E_e = 23 520 (J)	this answer only	1	
	total E_e = 47 040 (J)	this answer only	1	
	$47\,040 = 240 \times 9.8 \times h$	allow a correct substitution of their calculated value of E_e (using $E_e = 0.5ke^2$)	1	
	$h = \dfrac{47\,040}{(240 \times 9.8)}$	allow a correct rearrangement using their calculated value of E_e (using $E_e = 0.5ke^2$)	1	
	h = 20 (m)	allow an answer consistent with their value of E_e (using $E_e = 0.5ke^2$)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	air resistance (opposes the motion of the pod upwards)		1	AO3
	(so) not all of the elastic potential energy will be transferred to gravitational potential energy	allow the energy transfer is not 100% efficient allow some energy is transferred to the surroundings allow some energy is dissipated ignore energy is wasted ignore reference to mass of person in pod	1	AO1 4.1.2.1 4.1.2.2

Total Question 6	**9**

4.1.1.1 Energy stores and systems

Answer 119 · Mark scheme

June 2024 | 8463/1H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	(air) particles are closer together	ignore reference to kinetic energy of particles ignore reference to concentration of air particles	1	AO1 4.3.3.2
	(so) frequency of collision between air particles and syringe walls increased	do not credit MP2 if linked to an increase in kinetic energy	1	
	larger (total) force on a smaller (surface) area	allow larger force per unit area	1	
		if no other marks score allow 1 mark for pressure increases because volume decreases and pV = constant		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	the mean kinetic energy of the particles increases		1	AO1 4.3.3.1

Question	Answers	Extra information	Mark	AO / Spec.
08.3	c = 1010 (J/kg °C)	allow full credit for a correct method using E = 0.0000130 (kJ)	1	AO2 4.1.1.3 4.3.2.2
	$0.0130 = 2.60\times10^{-8} \times 1010 \times \Delta\theta$	allow a correct substitution of an incorrectly / not converted value of c	1	
	$\Delta\theta = \dfrac{0.0130}{(2.60 \times 10^{-8} \times 1010)}$	allow a correct rearrangement of an incorrectly / not converted value of c	1	
	$\Delta\theta$ = 495 (°C)	allow an answer consistent with an incorrectly / not converted value of c allow a correct answer given to more than 3 sig figs	1	

Total Question 8	8

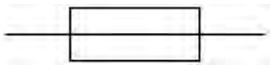
4.1.1.1 Energy stores and systems

Answer 120 · Mark scheme

June 2024 | 8463/1H | Original Q10

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	brown		1	AO1 4.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2			1	AO1 4.2.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	t = 0.400 (s)		1	AO2 4.2.1.2
	2.0 = I × 0.400	allow a correct substitution of an incorrectly / not converted value of t	1	
	$I = \frac{2.0}{0.400}$	allow a correct rearrangement using an incorrectly / not converted value of t	1	
	I = 5.0 (A)	allow an answer consistent with an incorrectly / not converted value of t	1	

4.1.1.1 Energy stores and systems

Answer 120 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.4	L = 60 000 (J/kg)	allow full credit for a correct method using E = 0.00102 (kJ)	1	AO2 4.3.2.3
	1.02 = m × 60 000	allow a correct substitution of an incorrectly / not converted value of L	1	
	$m = \frac{1.02}{60\,000}$	allow a correct rearrangement using an incorrectly / not converted value of L	1	
	m = 1.7 × 10^{-5} (kg)	allow an answer consistent with an incorrectly / not converted value of L	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.5	time taken would increase		1	AO3
	more energy would need to be transferred (in total)	MP2 dependent on scoring MP1	1	AO1 4.1.2.1 4.3.2.3

Total Question 10	**12**

4.1.1.1 Energy stores and systems

Answer 121 · Mark scheme

June 2025 | 8463/1H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	hot water / beaker **or** heater	ignore descriptions of risk allow spilt water allow broken glass / beaker	1	AO3 4.1.1.3 4.3.2.2 RPA1

Question	Answers	Mark	AO / Spec. Ref.
02.2	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.1.1.3 4.3.2.2 RPA1
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content • measure the mass of the empty beaker on the balance • fill the beaker with water and measure the total mass of beaker and water • mass of water = total mass – mass of beaker • turn power supply on so heater increases the temperature of the water • measure temperature change / increase with thermometer • use joulemeter to measure energy transferred to water • calculate SHC using $E = mc\Delta\theta$ a level 3 answer must have a clear method of how the mass of water is determined		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	insulate the beaker of water **or** add a lid	allow named insulation allow use an insulating cup eg plastic cup	1	AO3 4.1.1.3 4.3.2.2 RPA1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	difference = 4410 – 4200 **or** difference = 210 **or** % difference = $\frac{(4410 - 4200)}{4200} \times 100$ % difference = 5 (%)	 do **not** accept 4.76 (%)	1 1	AO2 4.1.1.3 4.3.2.2 RPA1

Total Question 2	**10**

4.1.1.1 Energy stores and systems

Answer 122 · Mark scheme

June 2025 | 8463/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	$8000 = 0.20 \times 1600 \times \Delta\theta$ $\Delta\theta = \frac{8000}{(0.20 \times 1600)}$ $\Delta\theta = 25$ (°C)		1 1 1	AO2 4.3.2.2 4.1.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	$E = 180\,000$ (J)	all subsequent marks can score using an incorrectly / not converted value of E	1	AO2 4.2.4.2
	$180\,000 = Q \times 5.0$		1	
	$Q = \frac{180\,000}{5.0}$		1	
	$Q = 36\,000$ (C)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	(when both switches are closed) the resistance of the circuit decreases		1	AO1 4.2.2
	(so) current increases	MP2 dependent on MP1	1	
	(so) power output is greater as potential difference across the battery remains the same and $P = IV$	ignore reference to $P = I^2R$ unless a quantitative comparison is included	1	

Total Question 6	10

Answer 123 · Mark scheme

June 2025 | 8463/1H | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	h = 0.70 (m)	all subsequent marks can score using an incorrectly / not converted value of h	1	AO2 4.1.1.2
	0.343 = m × 9.8 × 0.70		1	
	$m = \frac{0.343}{9.8 \times 0.70}$		1	
	m = 0.050 (kg)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	4.86 = I^2 × 6.0		1	AO2 4.2.1.3
	$I^2 = \frac{4.86}{6.0}$		1	4.2.4.1
	I = 0.90 (A)		1	
	t = 1800 (s)	all subsequent marks can score using an incorrectly / not converted value of t	1	
	Q = 0.90 × 1800	allow a correct substitution using their value of current	1	
	Q = 1620 (C)	allow a correct calculation using their value of current allow an answer of 1600 (C)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	greater mass / volume of water each second	allow water flow will increase ignore increased water speed	1	AO3
	(because) smaller proportion / percentage of energy is wasted	allow greater (useful) power output allow less energy / power wasted	1	AO1 4.1.2.2

Total Question 9	12

4.1.1.1 Energy stores and systems

Answer 124 · Mark scheme

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	$E_e = 0.5 \times 64 \times 0.075^2$		1	AO2 4.1.1.1
	$E_e = 0.18$ (J)	the equation $E_e = 0.5ke^2$ must have been used to score subsequent calculation marks	1	4.1.1.2
	$0.18 = 0.5 \times 0.052 \times v^2$	allow a correct substitution using their value of E_e	1	
	$v^2 = \frac{0.18}{0.5 \times 0.052}$	allow a correct rearrangement using their value of E_e	1	
	$v = 2.631\ldots$ (m/s)	allow a correct calculation using their value of E_e	1	
	$v = 2.6$ (m/s)	allow an answer given to 2 sf using **all** the data in the question alternative approach: ($F = ke$) ($F = 64 \times 0.075$) (maximum) $F = 4.8$ (N) (1) ($F = ma$) ($4.8 = 0.052 \times a$) (maximum) $a = 92.3$ (m/s^2) (1) (mean) $a = 46.2$ (m/s^2) (1) ($v^2 - u^2 = 2as$) $v^2 = 2 \times 46.2 \times 0.075$ (1) **or** $v^2 = 6.923$ $v = 2.631\ldots$ (1) $v = 2.6$ (m/s) (1)	1	

4.1.1.1 Energy stores and systems

Answer 124 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2		ignore comments about energy dissipation allow E_k for kinetic energy allow E_p for gravitational potential energy		AO1 4.1.1.1
	kinetic energy decreases moving from **A** to **B**	allow kinetic energy is transferred to gravitational potential energy while moving from **A** to **B** for MP1 and MP2	1	
	(and) gravitational potential energy increases moving from **A** to **B**		1	
	(then) gravitational potential energy decreases from **B** to **C** and kinetic energy increases	allow gravitational potential energy is transferred to kinetic energy while moving from **B** to **C**	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	length of the toy car		1	AO2 4.1.1.2
	time for toy car to pass the light gate		1	

Total Question 10	11

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2003

GCSE

Physics

3451

Foundation

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4.1.1.1 Energy stores and systems

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Examiners are reminded of the need to assess QoWC by the following statement appearing in the appropriate parts of the mark scheme:

The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.

The maximum marks available to a candidate whose answer is not well expressed will be (the number of marks available –1).

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column.

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

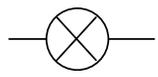
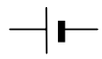
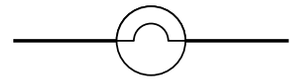
(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.10 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.1.1.1 Energy stores and systems

3451/F Q1

question	answers	extra information	mark
(a)	circuit symbol for a lamp correct   circuit symbol for a cell correct	accept  accept any standard of drawing providing circuit would work	1 1
	2 lamps drawn in parallel with 3 cells	polarity of cells must be correct (+ to –) but cells may be either way around	1
(b)	4.5		1
(c)	the same as	accept any clear indication of the correct answer	1
total			5

4.1.1.1 Energy stores and systems

3451/F Q2

question	answers	extra information	mark
(a)	gas		1
(b)	fuel burning stations produce electricity at any time / all the time wind generator can only produce when the wind is strong enough	accept fuel available all the time accept it's not always windy	1 1
(c)	no fuel is burnt **or** no fuel is used **or** uses only energy from wind **or** does not emit harmful gases / soot / smoke	do **not** accept wind is natural / environmentally friendly / renewable answer must be in terms of wind, **not** negative of fuel burning specific examples of gases CO_2, SO_2, acid rain and greenhouse gases can be accepted ozone negates credit	1
total			4

4.1.1.1 Energy stores and systems

3451/F Q3

question	answers	extra information	mark
(a)(i)	microwaves		1
(ii)	infra red		1
(iii)	ultrasonic		1
(b)(i)	B		1
(ii)	A		1
(c)	disturbance / vibration / movement direction	accept motion / force do **not** accept energy	1 1
(d)	sound wave	accept any clear indication of the correct answer	1
total			8

4.1.1.1 Energy stores and systems

3451/F Q4

question	answers	extra information	mark
(a)(i)	heat		1
(ii)	temperature increases **or** (cause) convection (currents)	accept gets warmer accept gets hotter	1
(iii)	60% **or** 0.6	60 without % scores **1** mark 0.6 with a unit scores **1** mark 60 with incorrect unit scores **1** mark **or** correct substitution $\frac{120}{200}$ for **1** mark	2
(b)	street more (energy transferred as) light **or** less (energy transferred as) heat **or** useful energy output the highest	 can only score this mark if first mark scored all efficiencies calculated correctly score 2nd mark point	1 1
total			6

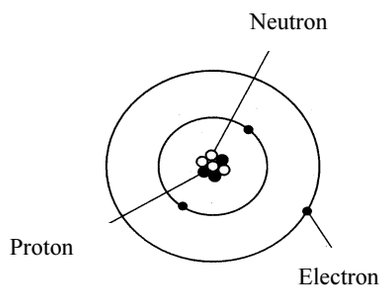
4.1.1.1 Energy stores and systems

3451/F Q5

question	answers	extra information	mark
(a)	MN	accept 5.8, 8 seconds must include unit	1
(b)	LM	accept 0.8, 5.8 seconds must include unit	1
(c)(i)	0.8		1
(ii)	drinking alcohol		1
(d)	straight (by eye) line starting at 0.8 seconds line drawn steeper than LM starting before L	 ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating	1 1
total			6

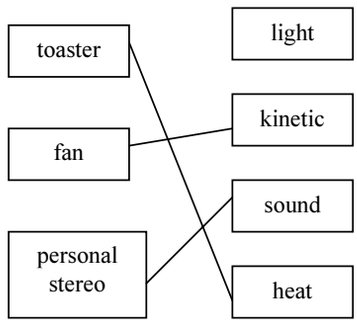
4.1.1.1 Energy stores and systems

3451/F Q6

question	answers	extra information	mark
(a)(i)	each correct label scores 1 mark  		3
(ii)	neutron		1
(iii)	7 number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus	 accept number of particles in the centre only if first answer = 7	1 1
(b)(i)	50 ± 5		1
(ii)	50 ± 5	accept their (b)(i)	1
(iii)	less	accept any way of indicating the correct answer	1
total			9

4.1.1.1 Energy stores and systems

3451/F Q7

question	answers	extra information	mark
(a)	each correct line scores 1 mark  	if more than 3 lines are drawn mark incorrect ones first, to a maximum of 3 lines	3
(b)	toaster	accept 1.2 kW	1
(c)(i)	400		1
(ii)	£24 **or** 2400p	full credit for their (c)(i) × 6p for full credit the correct numerical answer must have the correct unit an answer of 24 or 2400 with no unit or the incorrect unit scores **1** mark (c)(i) × 6 incorrectly evaluated scores **1** mark	2
(d)	6	allow 6000 for **1** mark allow 3 × 2 for **1** mark	2
total			9

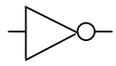
4.1.1.1 Energy stores and systems

3451/F Q8

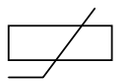
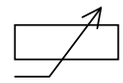
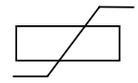
question	answers	extra information	mark
(a)(i)	point where the rays cross	do not credit if ambiguous	1
(ii)	converging (lens)	do **not** accept convex	1
(b)(i)	point where the rays appear to diverge from	this should appear to be within 10mm in front of the back of the arrows on the approximate centre line need not be accurately constructed using a ruler	1
(ii)	diverging (lens)	do **not** accept concave	1
(c)	converging film smaller than nearer to	accept any clear indication of the correct response e.g. ticking, ringing, writing in after a mistake	1 1 1 1
(d)(i)	(image) bigger than object / enlarge	accept just 'made bigger'	1
(ii)	it / real image can be put on a screen **or** real image on the opposite side of the lens to the object	accept 'not an imaginary or virtual image' assume 'it' refers to a real image do **not** credit 'it can be seen'	1
(e)	**either** (the converging lens is) thick in the middle thin(ner) at the edge **or** (both) sides bend outwards (1) in the middle (1) **or** one side bends in the middle (1) more than the other side bends inwards (in the middle) (1)	thickest in the middle gains **2** marks convex gains **2** marks suitable diagrams gains **2** marks	1 1
total			12

4.1.1.1 Energy stores and systems

3451/F Q9

question	answers	extra information	mark
(a)(i)	off off on	all correct	1
(ii)	AND (gate)	accept and (gate)	1
(iii)	on on on	all correct	1
(iv)	OR (gate)	accept or (gate)	1
(b)(i)	1 0 **or** 0 1 0 1 1 0	do **not** credit on / off responses	1
(ii)		accept mirror image accept  accept with either or both parts shaded accept line through as shading	1
(c)		accept off for 0 and on for 1 throughout	
	0 0	both correct	1
	0 1	both correct	1
	1 1	both correct	1
	1 1	both correct	1

3451/F Q9 continued

(d)(i)		accept mirror image **or** inverted do **not** credit  **or**  or similar	1
(ii)	resistance decreases / increases / changes current (through it) increases / decreases / changes **or** temperature changes / increases / decreases (1) resistance changes / decreases / increases (1) (NTC thermistor) both marks independent but must be compatible to score **2** marks	accept 'voltage across it decreases' for **2** marks but only if it is made clear that this refers to a thermistor in series	1 1
total			13

4.1.1.1 Energy stores and systems

3451/F Q10

question	answers	extra information	mark
(a)(i)	friction	accept any way of indicating the correct answer	1
(ii)	gravity	accept any way of indicating the correct answer	1
(b)(i)	accelerates **or** speed / velocity increases	accept faster and faster (**1** mark) do **not** accept faster pace / falls faster or suggestions of a greater but constant speed	1
	downwards / falls	accept towards the Earth / ground this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts	1
(ii)	constant speed / velocity **or** terminal velocity / speed **or** zero acceleration	stays in the same place negates credit	1
total			5

4.1.1.1 Energy stores and systems

3451/F Q11

question	answers	extra information	mark
(a)(i)	X – mantle		1
	Y – inner core	do **not** accept solid core	1
(ii)	different to the crust **or** contains a lot of (heavy) metals	accept iron and nickel for metals	1
	higher (average) density **or** denser	density higher than 5500 (kg/m^3) gets **2** marks	1
(b)	animals were able to move from one continent to the other		1
	(when bridge broke) animals evolved differently	accept animals adapted differently	1
(c)(i)	earthquakes occur at the boundary between plates **or** earthquakes occur where plates push against each other		1
	there are no plate boundaries running through Britain	accept Britain is not near the edge of a plate	1
(ii)	convection currents (in the mantle) **or** heat released by (natural) radioactive processes		1
total			9

4.1.1.1 Energy stores and systems

3451/F Q12

question	answers	extra information	mark
(a)(i)	outside the Earth **or** not from the Earth	accept alien accept life from / on another planet / space accept our planet for Earth	1
(ii)	radio telescope(s)	do **not** accept telescopes do **not** accept satellite dishes do **not** accept radio receivers **or** transmitters	1
(b)(i)	galaxies	do **not** accept stars	1
(ii)	any **one** from: the pulses were regular pulses from space are usually random (scientists) thought technology had been used to produce the pulses neutron stars were unknown signals from a single point	 accept signals / beats for pulses accept noise for random pulses idea of regular but not continuous	1
(iii)	neutron star is (the matter / mass) left behind after a star / red giant explodes (as a super nova)	 accept after a super nova (explosion) neutron star causing super nova gets no credit	1 1
(c)(i)	carried on the balloon / equipment	accept carried by a rocket / aircraft / satellite birds negates credit	1
(ii)	on comets or meteors	accept meteorites / shooting stars accept returning space craft accept solar wind ignore asteroids accept ufo do **not** accept solar flares do **not** accept satellites	1
total			8

3451/F Q13

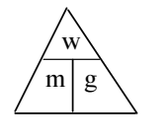
question	answers	extra information	mark
(a)	silver is a (good) reflector of <u>heat</u> (radiation) **or** silver reflects the heat (radiation)	fact heat = infra red ignore references to light accept shiny for silver good radiator negates the mark ignore references to good conductor do **not** accept bounce back	1
	less heat is lost through the board **or** more heat is retained by the shirt	explanation accept both sides of shirt heated reflects heat back up gets **1** mark only ignore mention of friction	1
(b)	metal soleplate	accept soleplate / bottom / metal do **not** accept outside / case	1
(c)	plastic **or** rubber	accept any named plastic do **not** accept wood	1
	it is a (good) insulator **or** it is a poor conductor	ignore mention of heat if in conjunction with electricity	1
(d)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*	*Maximum of **2** marks if ideas not well expressed.*	
	pulls iron bolt down **or** attracts the iron bolt **or** moves bolt out of plunger	answers in terms of charges attracting or repelling gain no credit	1
	plunger pushed / moved to the right (by spring) **or** plunger released		1
	push switch opens / goes to off / goes to right	accept circuit is broken for maximum credit the points must follow a logical sequence 3 correct points but incorrect sequence scores **2** marks only ignore reset action	1
total			8

4.1.1.1 Energy stores and systems

3451/F Q14

question	answers	extra information	mark
(a)(i)	any **one** from: the ground the air radon (gas) building materials buildings rocks / granite food cosmic rays **or** solar rays X-rays nuclear weapons testing nuclear power stations / accidents	 do **not** accept mobile phones accept from outer space accept sun but **not** sunlight accept medical uses	1
(ii)	2	allow $\frac{1200}{60\times10}$ **or** $\frac{1200}{600}$ **or** 120 for **1** mark	2
(b)	 alpha: the count rate is (greatly) reduced by the card **or** the card absorbs alphas but not betas beta: the count rate is (greatly) reduced by the metal **or** the thin metal absorbs alphas and betas **or** the thin metal absorbs all of the radiation (from the source) gamma: would pass through the thin metal but count rate is background **or** no radiation passing through **or** a higher reading would be recorded **or** to reduce the count to 2 would require much more than 3 mm of metal	answers must be comparative accept converse answers throughout accept paper for the card accept aluminium for the metal accept aluminium for the metal accept lead / aluminium for the metal	 1 1 1
total			6

3451/F Q15

question	answers	extra information	mark
(a)(i)	weight = mass × g.f.s.	accept w = m × g accept gravity for gfs accept  provided subsequent use of Δ correct do **not** accept N = kg × N/kg	1
(ii)	675	75 × 9 for **1** mark	2
(iii)	g.(f.s.) is higher (on Earth than Venus)	accept gravity for g.f.s. do **not** accept g.f.s. is lower unless answer states on Venus	1
(iv)	orbit time for Jupiter is <u>longer</u> / longest (than for the other planets)	do **not** give any credit for an answer that includes a comparison of diameter **or** a comparison of g.f.s.	1
(b)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* any **two** from: dust <u>and</u> gas **or** remnants of a super nova pulled together by (force of) <u>gravity</u> nuclear fusion starts	*Maximum of **1** mark if ideas not well expressed.* accept hydrogen for dust and gas do **not** accept hydrogen burns although candidates may include more detail these points are essential to score the credit	2
total			7

4.1.1.1 Energy stores and systems

3451/F Q16

question	answers	extra information	mark
(a)(i)	upright with the contacts at the bottom and still in place and unbent	no need for labels but incorrect label(s) cancel the mark accept a freehand drawing no need for details such as correct dimensions	1
	one blob of mercury touching <u>both</u> contacts	do **not** award mark if contacts bent to touch	1
(b)(i)	(X is a) battery	do **not** credit cell accept (set of) cells accept power supply do **not** accept power pack	1
	(Y is a) LED	**or** light emitting diode	1
(ii)	longer (time)	do **not** accept 'slower time'	1
(iii)	any **two** from: current less (so) rate of flow of charge less **or** less coulombs per second (so) discharge is slower	 do **not** accept current slower accept capacitor has charge for longer **or** charge lasts longer **or** (so total of) electrons take longer to travel round circuit	2
(c)	4200	 translation correct (= 4000) but percentage addition incorrect gains **1** mark translation incorrect but 5% addition is correct gains **1** mark accept 422.1 **or** 42.2 **or** 6.3 for **1** mark	2
	ohms **or** Ω	 4.2 kilohms **or** 4.2 kΩ gains all **3** marks	1
total			10

4.1.1.1 Energy stores and systems

3451/F Q17

question	answers	extra information	mark
(a)	point at which its mass (seems to) act **or** point at which gravity (seems to) act	accept …its weight acts accept correct statements if the intent is clear e.g. … if suspended, the centre of gravity will be directly under the point of suspension e.g. … (if the object is symmetrical), the centre of gravity is on the **or** an axis (of symmetry) do **not** credit just 'it is a point'	1
(b)	**Quality of written communication** *The answer to this question requires good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* any **five** from: clamp (steel) rod (horizontally) hang plastic / sheet by rod through (one) hole hang plumb line from rod mark ends of plumb line on the sheet and use the ruler to draw a straight line repeat with other hole centre of mass is where the lines cross check by balancing at this point	*maximum of **4** marks if ideas not well expressed* **no** marks if method quite unworkable maximum of **3** marks if no 'repeat with other hole'	5
(c)(i)	(turning) effect **or** moment force distance	all three correct accept weight accept length	1
(ii)	17.6 Nm **or** newton metre(s)	allow 44 × 0.4 **or** 0.4 × 44 for **1** mark do **not** accept N/m **or** N/cm 1760 Ncm gains all **3** marks	2 1
total			10

4.1.1.1 Energy stores and systems

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark scheme June 2003

GCSE

Science: Double Award Co-ordinated

3462

Paper 3F

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Kathleen Tattersall: *Director General*

4.1.1.1 Energy stores and systems

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Examiners are reminded of the need to assess QoWC by the following statement appearing in the appropriate parts of the mark scheme:

The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.

The maximum marks available to a candidate whose answer is not well expressed will be (the number of marks available –1).

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column.

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

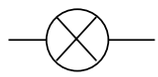
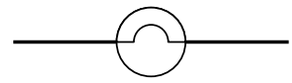
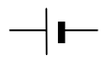
3.10 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.1.1.1 Energy stores and systems

Double Award
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)	circuit symbol for a lamp correct 	accept  accept any standard of drawing providing circuit would work	1
	circuit symbol for a cell correct 		1
	2 lamps drawn in parallel with 3 cells	polarity of cells must be correct (+ to –) but cells may be either way around	1
(b)	4.5		1
(c)	the same as	accept any clear indication of the correct answer	1
total			5

4.1.1.1 Energy stores and systems

3462/3F Q2

question	answers	extra information	mark
(a)	gas		1
(b)	fuel burning stations produce electricity at any time / all the time	accept fuel available all the time	1
	wind generator can only produce when the wind is strong enough	accept it's not always windy	1
(c)	no fuel is burnt **or** no fuel is used **or** uses only energy from wind **or** does not emit harmful gases / soot / smoke	do **not** accept wind is natural / environmentally friendly / renewable answer must be in terms of wind, **not** negative of fuel burning specific examples of gases CO_2, SO_2, acid rain and greenhouse gases can be accepted ozone negates credit	1
total			4

4.1.1.1 Energy stores and systems

3462/3F Q3

question	answers	extra information	mark
(a)(i)	microwaves		1
(ii)	infra red		1
(iii)	ultrasonic		1
(b)(i)	B		1
(ii)	A		1
(c)	disturbance / vibration / movement direction	accept motion / force do **not** accept energy	1 1
(d)	sound wave	accept any clear indication of the correct answer	1
total			8

4.1.1.1 Energy stores and systems

3462/3F Q4

question	answers	extra information	mark
(a)(i)	heat		1
(ii)	temperature increases **or** (cause) convection (currents)	accept gets warmer accept gets hotter	1
(iii)	60% **or** 0.6	60 without % scores **1** mark 0.6 with a unit scores **1** mark 60 with incorrect unit scores **1** mark **or** correct substitution $\frac{120}{200}$ for **1** mark	2
(b)	street more (energy transferred as) light **or** less (energy transferred as) heat **or** useful energy output the highest	 can only score this mark if first mark scored all efficiencies calculated correctly score 2nd mark point	1 1
total			6

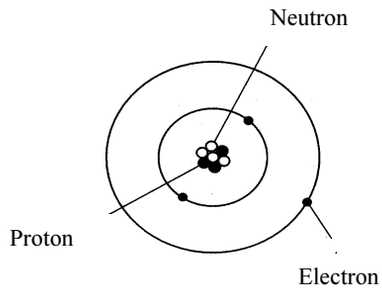
4.1.1.1 Energy stores and systems

3462/3F Q5

question	answers	extra information	mark
(a)	MN	accept 5.8, 8 seconds must include unit	1
(b)	LM	accept 0.8, 5.8 seconds must include unit	1
(c)(i)	0.8		1
(ii)	drinking alcohol		1
(d)	straight (by eye) line starting at 0.8 seconds line drawn steeper than LM starting before L	 ignore lines going beyond 2 seconds but line must exceed 2.5 metres per second before terminating	1 1
total			6

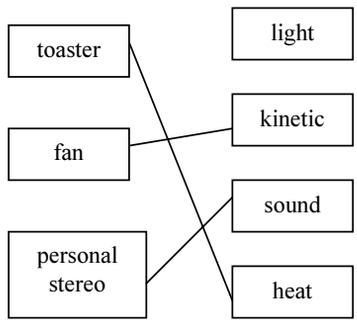
4.1.1.1 Energy stores and systems

3462/3F Q6

question	answers	extra information	mark
(a)(i)	each correct label scores 1 mark  		3
(ii)	neutron		1
(iii)	7 number of protons and neutrons **or** number of nucleons **or** number of particles in the nucleus	 accept number of particles in the centre only if first answer = 7	1 1
(b)(i)	50 ± 5		1
(ii)	50 ± 5	accept their (b)(i)	1
(iii)	less	accept any way of indicating the correct answer	1
total			9

4.1.1.1 Energy stores and systems

3462/3F Q7

question	answers	extra information	mark
(a)	each correct line scores 1 mark  	if more than 3 lines are drawn mark incorrect ones first, to a maximum of 3 lines	3
(b)	toaster	accept 1.2 kW	1
(c)(i)	400		1
(ii)	£24 **or** 2400p	full credit for their (c)(i) × 6p for full credit the correct numerical answer must have the correct unit an answer of 24 or 2400 with no unit or the incorrect unit scores **1** mark (c)(i) × 6 incorrectly evaluated scores **1** mark	2
(d)	6	allow 6000 for **1** mark allow 3 × 2 for **1** mark	2
total			9

4.1.1.1 Energy stores and systems

3462/3F Q8

question	answers	extra information	mark
(a)(i)	friction	accept any way of indicating the correct answer	1
(ii)	gravity	accept any way of indicating the correct answer	1
(b)(i)	accelerates **or** speed / velocity increases	accept faster and faster (**1** mark) do **not** accept faster pace / falls faster or suggestions of a greater but constant speed	1
	downwards / falls	accept towards the Earth / ground this may score in part (b)(ii) if it does not score here and there is no contradiction between the two parts	1
(ii)	constant speed / velocity **or** terminal velocity / speed **or** zero acceleration	stays in the same place negates credit	1
total			5

4.1.1.1 Energy stores and systems

3462/3F Q9

question	answers	extra information	mark
(a)(i)	X – mantle		1
	Y – inner core	do **not** accept solid core	1
(ii)	different to the crust **or** contains a lot of (heavy) metals	accept iron and nickel for metals	1
	higher (average) density **or** denser	density higher than 5500 (kg/m^3) gets **2** marks	1
(b)	animals were able to move from one continent to the other		1
	(when bridge broke) animals evolved differently	accept animals adapted differently	1
(c)(i)	earthquakes occur at the boundary between plates **or** earthquakes occur where plates push against each other		1
	there are no plate boundaries running through Britain	accept Britain is not near the edge of a plate	1
(ii)	convection currents (in the mantle) **or** heat released by (natural) radioactive processes		1
total			9

4.1.1.1 Energy stores and systems

3462/3F Q10

question	answers	extra information	mark
(a)(i)	outside the Earth **or** not from the Earth	accept alien accept life from / on another planet / space accept our planet for Earth	1
(ii)	radio telescope(s)	do **not** accept telescopes do **not** accept satellite dishes do **not** accept radio receivers **or** transmitters	1
(b)(i)	galaxies	do **not** accept stars	1
(ii)	any **one** from: the pulses were regular pulses from space are usually random (scientists) thought technology had been used to produce the pulses neutron stars were unknown signals from a single point	 accept signals / beats for pulses accept noise for random pulses idea of regular but not continuous	1
(iii)	neutron star is (the matter / mass) left behind after a star / red giant explodes (as a super nova)	 accept after a super nova (explosion) neutron star causing super nova gets no credit	1 1
(c)(i)	carried on the balloon / equipment	accept carried by a rocket / aircraft / satellite birds negates credit	1
(ii)	on comets or meteors	accept meteorites / shooting stars accept returning space craft accept solar wind ignore asteroids accept ufo do **not** accept solar flares do **not** accept satellites	1
total			8

4.1.1.1 Energy stores and systems

3462/3F Q11

question	answers	extra information	mark
(a)	silver is a (good) reflector of <u>heat</u> (radiation) **or** silver reflects the heat (radiation)	fact heat = infra red ignore references to light accept shiny for silver good radiator negates the mark ignore references to good conductor do **not** accept bounce back	1
	less heat is lost through the board **or** more heat is retained by the shirt	explanation accept both sides of shirt heated reflects heat back up gets **1** mark only ignore mention of friction	1
(b)	metal soleplate	accept soleplate / bottom / metal do **not** accept outside / case	1
(c)	plastic **or** rubber	accept any named plastic do **not** accept wood	1
	it is a (good) insulator **or** it is a poor conductor	ignore mention of heat if in conjunction with electricity	1
(d)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*	*Maximum of **2** marks if ideas not well expressed.*	
	pulls iron bolt down **or** attracts the iron bolt **or** moves bolt out of plunger	answers in terms of charges attracting or repelling gain no credit	1
	plunger pushed / moved to the right (by spring) **or** plunger released		1
	push switch opens / goes to off / goes to right	accept circuit is broken for maximum credit the points must follow a logical sequence 3 correct points but incorrect sequence scores **2** marks only ignore reset action	1
total			8

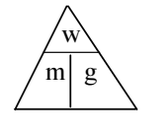
4.1.1.1 Energy stores and systems

3462/3F Q12

question	answers	extra information	mark
(a)(i)	any **one** from: the ground the air radon (gas) building materials buildings rocks / granite food cosmic rays **or** solar rays X-rays nuclear weapons testing nuclear power stations / accidents	 do **not** accept mobile phones accept from outer space accept sun but **not** sunlight accept medical uses	1
(ii)	2	allow $\frac{1200}{60\times10}$ **or** $\frac{1200}{600}$ **or** 120 for **1** mark	2
(b)	 alpha: the count rate is (greatly) reduced by the card **or** the card absorbs alphas but not betas beta: the count rate is (greatly) reduced by the metal **or** the thin metal absorbs alphas and betas **or** the thin metal absorbs all of the radiation (from the source) gamma: would pass through the thin metal but count rate is background **or** no radiation passing through **or** a higher reading would be recorded **or** to reduce the count to 2 would require much more than 3 mm of metal	answers must be comparative accept converse answers throughout accept paper for the card accept aluminium for the metal accept aluminium for the metal accept lead / aluminium for the metal	 1 1 1
total			6

4.1.1.1 Energy stores and systems

3462/3F Q13

question	answers	extra information	mark
(a)(i)	weight = mass × g.f.s.	accept w = m × g accept gravity for gfs accept  provided subsequent use of Δ correct do **not** accept N = kg × N/kg	1
(ii)	675	75 × 9 for **1** mark	2
(iii)	g.(f.s.) is higher (on Earth than Venus)	accept gravity for g.f.s. do **not** accept g.f.s. is lower unless answer states on Venus	1
(iv)	orbit time for Jupiter is <u>longer</u> / longest (than for the other planets)	do **not** give any credit for an answer that includes a comparison of diameter **or** a comparison of g.f.s.	1
(b)	**Quality of written communication** *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.* any **two** from: dust <u>and</u> gas **or** remnants of a super nova pulled together by (force of) <u>gravity</u> nuclear fusion starts	*Maximum of **1** mark if ideas not well expressed.* accept hydrogen for dust and gas do **not** accept hydrogen burns although candidates may include more detail these points are essential to score the credit	2
total			7

GCSE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Physics Specification B
3451/F

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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4.1.1.1 Energy stores and systems

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4.1.1.1 Energy stores and systems

GCSE PHYSICS

INFORMATION FOR EXAMINERS

1. General

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- the total marks available for the question;
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The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

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where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

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2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Where *Quality of written communication* appears in the mark scheme, one mark is to be awarded for either of the following points:

- Using correct scientific terms
- Correct sequencing or linking of ideas or points

The mark scheme will specify which of the points is to be awarded in a particular question. A QoWC mark can be awarded for a scientific answer, even if it is not accurate. It cannot be awarded for a nonsensical or non-scientific answer.
On the script, the QoWC tick should be identified by a 'q' written next to it.

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

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Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.
However:

- if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column;
- if the answer is correct, but an incorrect relationship is written in the working, then no marks can be awarded (see 3.5.2).

3.5.2 Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

3.6 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

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3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.8 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.9 Brackets

(…..) is used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.10 Interpretation of marginal points

There will be times when the answer is almost, but not quite, correct. Some examiners would award a mark while others would not. In any one script, an attempt should be made to balance these nearly correct answers by giving the mark on some occasions but not on others. If this is not done, the marking would end up being too lenient or too harsh.

3.11 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

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4.1.1.1 Energy stores and systems

GCSE Physics
Foundation Tier 3451/F

3451F Q1

question	answers	extra information	mark
(a)	comet	correct order only	1
	elliptical		1
	Milky Way		1
	Universe		1
(b)(i)	D A C B	allow **2** marks for two letters in the correct place allow **1** mark for one letter in the correct place	3
(ii)	A		1
total			8

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4.1.1.1 Energy stores and systems

3451F Q2

question	answers	extra information	mark
(a)	95		1
(b)	alpha	accept correct symbol	1
(c)	any **two** from: • radiation is outside the body • radiation will not reach (living) cells • radiation absorbed by the air	 accept detector is on ceiling or high up the wall accept radiation cannot pass through the body / skin accept cannot pass through the plastic casing do **not** accept because it is alpha radiation – unless qualified do **not** accept does not give off harmful substance do **not** accept cannot pass through building materials etc.	2
(d)	less (than)		1
total			5

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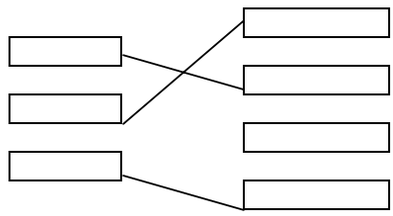
4.1.1.1 Energy stores and systems

3451F Q3

question	answers	extra information	mark
(a)	generator	accept dynamo accept alternator	1
(b)(i)	1400	ignore units	1
(ii)	0.3 or 30%	any incorrect unit penalise **1** mark allow **1** mark for the correct use of 600 **or** 0.3% **or** 30	2
(c)	**1** mark for each correct link 	if more than 3 lines are drawn, mark only 3 lines starting with those that are incorrect	3
(d)(i)	110	no tolerance	1
(ii)	12	no tolerance	1
(iii)	wind speed may be too low to operate the generator	accept wind may not always blow accept power depends on wind speed accept does not generate if wind speed is too high accept does not generate if wind speed is above 12 (m/s) accept does not generate if wind speed is below 1.6 (m/s) accept it is unreliable do **not** accept answers referring to cost only	1
total			10

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4.1.1.1 Energy stores and systems

3451F Q4

question	answers	extra information	mark
(a)	B E A D	allow **1** mark for each letter in the correct place, to a maximum of **3** marks	3
(b)	(a spark) may cause the (petrol vapour) to explode / ignite	accept petrol for (petrol vapour) accept catch fire for explode	1
	connect tanker to earth with a (conducting) wire / chain **or** earth the tanker	accept ground for earth	1
(c)	**Quality of written communication**	for a logical sequence	1
	any **two** from:		2
	• when current greater than fuse rating / value	accept when current too great for appliance do **not** accept 'if there is too much current' do **not** accept voltage or electricity	
	• fuse (becomes hot and) melts / burns out	accept fuse blows / breaks	
	• circuit is broken	accept circuit switched off this cannot score credit on its own	
total			8

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4.1.1.1 Energy stores and systems

3451F Q5

question	answers	extra information	mark
(a)(i)	crust		1
(ii)	inner core is <u>solid</u> outer core is liquid	do **not** accept just rock inner core is denser / hotter than outer core gets **2** marks accept one is solid and one is liquid for **1** mark accept they are different densities for **1** mark wrong way round = **0** marks	1 1
(b)	seismograph		1
(c)	difficult to measure (slow) movement (1) of plates (1) dependent mark **or** difficult to measure friction / forces (1) between plates (1) dependent mark		1 1
(d)	geothermal		1
(e)(i)	5000		1
(ii)	2500		1
total			9

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4.1.1.1 Energy stores and systems

3451F Q6

	answers	extra information	mark
(a)	converging image object image object shorter		1 1 1 1 1 1
(b)(i)	(Earth's) gravity	accept centripetal accept minor misspellings, however, do **not** credit any response which could be 'centrifugal'	1
(ii)	to(wards) (the centre of the) Earth	allow inwards do **not** accept downwards	1
(c)(i)	**either** friction (force) **or** centripetal force between the tyres / wheels and (the surface of) the road	 allow grip allow on the tyres / wheels **or** towards the centre of the bend / arc / circle	 1 1
(ii)	mass **or** speed **or** momentum radius / diameter	allow weight allow velocity do **not** credit 'curvature' or 'circumference'	1 1
(d)	centripetal	accept minor misspellings (see above)	1
total			13

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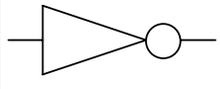
4.1.1.1 Energy stores and systems

3451F Q7

	answers	extra information	mark
(a)(i)	two switches in series **and** circuit complete	ignore small imperfections	1
(ii)	two switches in parallel **and** circuit complete	ignore small imperfections	1
(iii)	one switch in parallel with the cell / lamp (but **not** both)	ignore small imperfections	1
(iv)	(i) AND (ii) OR (iii) NOT	accept 'and' accept 'or' accept 'not'	1 1 1
(b)(i)	when it is light the sensor sends on / high / 1 signal to the gate off / low / 0 sent to the lamp **or** when it is dark the sensor sends off / low / 0 signal to the gate (1) on / high / 1 sent to the lamp (1)		1 1
(ii)	any suitable application	e.g. to switch a security light on (and off) e.g. to switch a light on when it is dark do **not** credit just '… to switch a light on / off'	1
(c)(i)		accept shading-in of either or both parts end connections are not required accept any orientation	1
(ii)	1 0 **or** 0 1 0 1 1 0	all correct	1
(iii)	truth (table)		1
total			12

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4.1.1.1 Energy stores and systems

3451F Q8

question	answers	extra information	mark
(a)	60		1
(b)	$5\frac{1}{2}$ hours	must include unit	1
(c)	30		1
(d)	30 minutes or $\frac{1}{2}$ hour	must include unit	1
(e)	D **and** E least steep part of the graph	accept finish for E accept correct numbers from axes with units accept covers smallest distance in a set time accept only moves 5 km in $1\frac{1}{2}$ hours (accept anything between 5 and 6) ignore horse is tired	1 1
total			6

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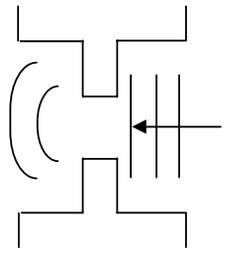
4.1.1.1 Energy stores and systems

3451F Q9

question	answers	extra information	mark
(a)(i)	any **one** from: • (doctors) to see inside a patients body **or** endoscope • telephone cables • optical fibre / fibre optic lamps **or** (artificial) Christmas trees • data transfer **or** internet connection	 accept keyhole surgery do **not** accept flex **or** wires for cable accept decorative / ornamental lighting accept any feasible practical suggestion for taking light to a difficult to access place do **not** accept lighting unqualified do **not** accept lamp unqualified do **not** accept communications unless clarified	1
(ii)	(incident) ray angle greater than critical angle total internal reflection occurs	either order accept (incident) ray greater than 42° accept TIR do **not** accept just description of TIR	1 1
(b)(i)	waves shown diffracting in the correct direction 	ignore wavelength	1
(ii)	diffraction	accept diffract / diffracted	1
total			5

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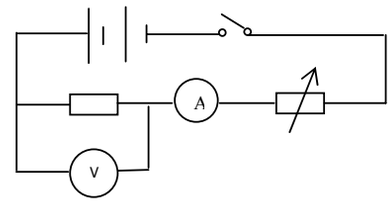
4.1.1.1 Energy stores and systems

3451F Q10

question	answers	extra information	mark
(a)	all symbols correct	 accept push switch symbol switch may be open or closed any lines through symbols = **0** marks	1
	correct circuit drawn voltmeter must be across resistor only	polarity of cells not relevant provided they are joined correctly two cells are required in the diagram ignore the order of the components allow small gaps in circuit omission of any component = **0** marks	1
(b)(i)	potential difference = current × resistance	accept voltage or p.d. for potential difference accept $V = I \times R$ accept  provided subsequent use correct do **not** accept C for current	1
(ii)	2	 allow **1** mark for correct substitution wrong working loses both marks	2
(iii)	straight line drawn <u>through the origin</u> straight line passes through $I = 0.4, V =$ their (b)(ii) / 2 **and** 0.0	judge by eye this mark may be awarded if all points shown including these points are correct even if no line is drawn N.B. a curve scores **0** marks	1 1 dep
(c)	temperature <u>increases</u>	accept filament lamp / it gets <u>hotter</u> allow heat for temperature	1
total			8

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4.1.1.1 Energy stores and systems

3451F Q11

question	answers	extra information	mark
(a)(i)	gamma rays	accept gamma accept correct symbol	1
(ii)	infra red	accept IR	1
(b)	ultraviolet <u>absorbed</u> by ink (energy) given out as light	 accept glows / luminous accept for **both** marks the ink is fluorescent do **not** accept answers in terms of uv being reflected	1 1
(c)	any **two** from: • UV can damage / kill / ionise / alter (normal) cells • change DNA structure **or** mutate • (normal) cells may become cancerous	 do **not** accept attacks cells **or** burns skin accept may cause (skin) cancer accept abnormal cell multiplication	2
(d)(i)	microwaves **and** infra red	both answers needed in either order do **not** accept heat for IR	1
(ii)	0.9	allow **1** mark for the <u>correct</u> use of 1.8 (kW) ($1.8 \times \frac{1}{2}$ or 1.8×30) i.e. adding the correct 2 power values	2
total			9

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4.1.1.1 Energy stores and systems

3451F Q12

question	answers	extra information	mark
(a)(i)	accelerating	accept getting faster accept speed / velocity increasing	1
(ii)	acceleration <u>increases</u>	accept velocity / speed increases <u>more</u> rapidly do **not** accept velocity / speed increases	1
(b)(i)	$\text{acceleration} = \frac{\text{change in velocity}}{\text{time (taken)}}$	accept $a = \frac{v - u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ do **not** accept velocity for change in velocity do **not** accept change in speed do **not** accept $a = \frac{v}{t}$	1
(ii)	15	allow **1** mark for an answer of 900 **or** for <u>correct</u> use of 540 seconds	2
(iii)	velocity includes direction	accept velocity is a vector (quantity) accept converse answer	1
(c)	force of gravity (between <u>shuttle</u> and Earth) plus correct orbital speed (makes <u>shuttle</u> move in a curve)	accept gravitational pull if used correctly accept forward motion **or** constant speed for orbital speed accept it is travelling fast enough accept for **2** marks the force of gravity provides the <u>centripetal</u> force	1 1
(d)	black is a good emitter of radiation **or** to limit the temperature rise inside the shuttle	accept heat for radiation accept the tiles are good insulation do **not** accept black absorbs heat on its own do **not** accept tiles are heat proof	1
total			9

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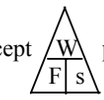
4.1.1.1 Energy stores and systems

3451F Q13

question	answers	extra information	mark
(a)(i)	work (done) = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1
(ii)	240 000 joules	allow **1** mark for correct substitution **or** correct use of 1200 (N) accept J do **not** accept j / Nm	2 1
(b)	800 (watts)	accept 0.8 kW accept their (a)(ii) ÷ 300 correctly evaluated for **2** marks allow **1** mark for correct substitution (a)(ii) ÷ 5 correctly evaluated for **1** mark	2
(c)(i)	any **one** from: • needs to raise the chair / lift • lifting more than one chair • energy transfer to the surroundings correctly qualified	 allow lifting more than 2 people implication of a heavier weight accept loss for transfer do **not** accept motor inefficient do **not** accept motor gets hot do **not** accept friction unless the location is specified as external to the motor	1
(ii)	electrical potential	accept electric **both** answers required for the mark	1
total			8

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4.1.1.1 Energy stores and systems

3451F Q14

	answers	extra information	mark
(a)(i)	current		1
(ii)	resistance decreases	 accept 'the flow of electrons / current (through it) increases' for **1** mark do **not** credit just '… it will get warmer'	1 1
(b)	input sensor → controlled by the processor processor → detects changes in the environment output device → decides what action is needed	all pairs correct one pair correct for **1** mark	2
(c)(i)	potential divider	accept voltage divider	1
(ii)	4 (volts)	$6 \times \frac{30}{45}$ for **1** mark	2
(iii)	across the new resistor…(will) increase across R_2 … (will) decrease	 N.B. independent marks	1 1
total			10

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4.1.1.1 Energy stores and systems

3451F Q15

	answers	extra information	mark
(a)	relay (normally open) (switch)	each mark is independent	1
	… switch on a (larger) current (in another circuit) **or** switch on a higher voltage circuit	do **not** accept switch on another circuit **or** smaller / equal current	1
	light emitting diode / LED	do **not** credit LDR	1
	… in one / direct / certain direction **or** from left to right	**or** when the cathode is connected to the negative terminal / side **or** when the left-hand side is connected to the positive terminal / side do **not** credit just '… is big enough' do **not** accept 'positive direction'	1
	AND gate	accept 'and' gate	1
	… (both) inputs are on / high / 1 **or** current flows in both inputs	do **not** accept numerical values unless expanded	1
(b)	**Quality of written communication**	If in a sensible order which clearly indicates advantages or disadvantages, including answers in the form of a table **or** as bullet points Q ✓ Q X	1
	any **three** from: • advantage of mobile phones • drawback of mobile phones • benefit of the Internet • drawback of the Internet	e.g. more convenient for service engineers e.g. calls can be received away from base e.g. privacy can be more easily invaded e.g. drivers can be distracted e.g. microwaves / radio waves can / may cause damage to the brain e.g. access to educational material e.g. some material is salacious e.g. spam (on external e-mail) these are examples candidates may be credited for a variety of responses	3
total			10

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4.1.1.1 Energy stores and systems

3451F Q16

question	answers	extra information	mark
(a)	**Y** and **Z**		1
	they have the same number of protons **or** same atomic number	accept they have the same number of electrons **or** same number of protons **and** electrons allow only different in number of neutrons N.B. independent marks	1
(b)	**Quality of written communication**	for correct use of terms underlined in B **or** C Q ✓ Q X	1
	A – alpha particle passes straight through the empty space of the atom **or** it is a long way from the nucleus B – alpha particle <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> by the (positive) <u>nucleus</u> C – alpha particle heading straight for the <u>nucleus</u> is <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> backwards	describes 3 tracks correctly for **2** marks describes 2 or 1 track correctly for **1** mark do **not** accept hits the nucleus do **not** accept answers referring to refraction do **not** accept answers in terms of reflected backwards unless qualified in terms of repulsion mention of difference in charge on nucleus negates that track	max 2
total			5

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GCSE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Science: Double Award
Specification B (Co-ordinated)
3462/3F

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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4.1.1.1 Energy stores and systems

Further copies of this Mark Scheme are available from:

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4.1.1.1 Energy stores and systems

SCIENCE: DOUBLE AWARD CO-ORDINATED

INFORMATION FOR EXAMINERS

1. General

The mark scheme for each question shows:

- the marks available for each part of the question;
- the total marks available for the question;
- the typical answer or answers which are expected;
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example:
where consequential marking needs to be considered in a calculation;
or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.)

3. Marking points

3.1 Marking of Quality of Written Communication

Where *Quality of written communication* appears in the mark scheme, one mark is to be awarded for either of the following points:

- Using correct scientific terms
- Correct sequencing or linking of ideas or points

The mark scheme will specify which of the points is to be awarded in a particular question. A QoWC mark can be awarded for a scientific answer, even if it is not accurate. It cannot be awarded for a nonsensical or non-scientific answer.
On the script, the QoWC tick should be identified by a 'q' written next to it.

3.2 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

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Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.3 Use of chemical symbols/formulae

If a candidate writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

3.5 Marking procedure for calculations

3.5.1 Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.
However:

- if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column;
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Examples

(a) A candidate who calculates average speed using speed = time/distance **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.

(b) A candidate who incorrectly calculates average speed using speed = distance/time and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

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The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

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The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

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4.1.1.1 Energy stores and systems

Double Award
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)	comet	correct order only	1
	elliptical		1
	Milky Way		1
	Universe		1
(b)(i)	D A C B	allow **2** marks for two letters in the correct place allow **1** mark for one letter in the correct place	3
(ii)	A		1
total			8

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4.1.1.1 Energy stores and systems

3462/3F Q2

question	answers	extra information	mark
(a)	95		1
(b)	alpha	accept correct symbol	1
(c)	any **two** from: • radiation is outside the body • radiation will not reach (living) cells • radiation absorbed by the air	 accept detector is on ceiling or high up the wall accept radiation cannot pass through the body / skin accept cannot pass through the plastic casing do **not** accept because it is alpha radiation – unless qualified do **not** accept does not give off harmful substance do **not** accept cannot pass through building materials etc.	2
(d)	less (than)		1
total			5

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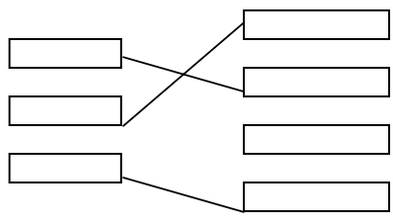
4.1.1.1 Energy stores and systems

3462/3F Q3

question	answers	extra information	mark
(a)	generator	accept dynamo accept alternator	1
(b)(i)	1400	ignore units	1
(ii)	0.3 or 30%	any incorrect unit penalise **1** mark allow **1** mark for the correct use of 600 **or** 0.3% **or** 30	2
(c)	**1** mark for each correct link 	if more than 3 lines are drawn, mark only 3 lines starting with those that are incorrect	3
(d)(i)	110	no tolerance	1
(ii)	12	no tolerance	1
(iii)	wind speed may be too low to operate the generator	accept wind may not always blow accept power depends on wind speed accept does not generate if wind speed is too high accept does not generate if wind speed is above 12 (m/s) accept does not generate if wind speed is below 1.6 (m/s) accept it is unreliable do **not** accept answers referring to cost only	1
total			10

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4.1.1.1 Energy stores and systems

3462/3F Q4

question	answers	extra information	mark
(a)	B E A D	allow **1** mark for each letter in the correct place, to a maximum of **3** marks	3
(b)	(a spark) may cause the (petrol vapour) to explode / ignite	accept petrol for (petrol vapour) accept catch fire for explode	1
	connect tanker to earth with a (conducting) wire / chain **or** earth the tanker	accept ground for earth	1
(c)	**Quality of written communication**	for a logical sequence	1
	any **two** from:		2
	• when current greater than fuse rating / value	accept when current too great for appliance do **not** accept 'if there is too much current' do **not** accept voltage or electricity	
	• fuse (becomes hot and) melts / burns out	accept fuse blows / breaks	
	• circuit is broken	accept circuit switched off this cannot score credit on its own	
total			8

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4.1.1.1 Energy stores and systems

3462/3F Q5

question	answers	extra information	mark
(a)(i)	crust		1
(ii)	inner core is <u>solid</u> outer core is liquid	do **not** accept just rock inner core is denser / hotter than outer core gets **2** marks accept one is solid and one is liquid for **1** mark accept they are different densities for **1** mark wrong way round = **0** marks	1 1
(b)	seismograph		1
(c)	difficult to measure (slow) movement (1) of plates (1) dependent mark **or** difficult to measure friction / forces (1) between plates (1) dependent mark		1 1
(d)	geothermal		1
(e)(i)	5000		1
(ii)	2500		1
total			9

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4.1.1.1 Energy stores and systems

3462/3F Q6

question	answers	extra information	mark
(a)	60		1
(b)	$5\frac{1}{2}$ hours	must include unit	1
(c)	30		1
(d)	30 minutes or $\frac{1}{2}$ hour	must include unit	1
(e)	D **and** E least steep part of the graph	accept finish for E accept correct numbers from axes with units accept covers smallest distance in a set time accept only moves 5 km in $1\frac{1}{2}$ hours (accept anything between 5 and 6) ignore horse is tired	1 1
total			6

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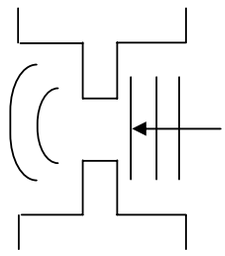
4.1.1.1 Energy stores and systems

3462/3F Q7

question	answers	extra information	mark
(a)(i)	any **one** from: • (doctors) to see inside a patients body **or** endoscope • telephone cables • optical fibre / fibre optic lamps **or** (artificial) Christmas trees • data transfer **or** internet connection	 accept keyhole surgery do **not** accept flex **or** wires for cable accept decorative / ornamental lighting accept any feasible practical suggestion for taking light to a difficult to access place do **not** accept lighting unqualified do **not** accept lamp unqualified do **not** accept communications unless clarified	1
(ii)	(incident) ray angle greater than critical angle total internal reflection occurs	either order accept (incident) ray greater than 42° accept TIR do **not** accept just description of TIR	1 1
(b)(i)	waves shown diffracting in the correct direction 	ignore wavelength	1
(ii)	diffraction	accept diffract / diffracted	1
total			5

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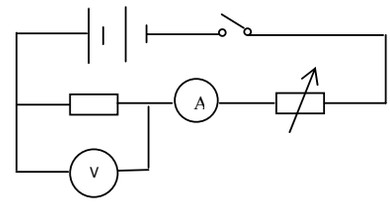
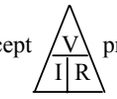
4.1.1.1 Energy stores and systems

3462/3F Q8

question	answers	extra information	mark
(a)	all symbols correct	 accept push switch symbol switch may be open or closed any lines through symbols = **0** marks	1
	correct circuit drawn voltmeter must be across resistor only	polarity of cells not relevant provided they are joined correctly two cells are required in the diagram ignore the order of the components allow small gaps in circuit omission of any component = **0** marks	1
(b)(i)	potential difference = current × resistance	accept voltage or p.d. for potential difference accept $V = I \times R$ accept  provided subsequent use correct do **not** accept C for current	1
(ii)	2	allow **1** mark for correct substitution wrong working loses both marks	2
(iii)	straight line drawn <u>through the origin</u> straight line passes through $I = 0.4, V =$ their (b)(ii) / 2 **and** 0.0	judge by eye this mark may be awarded if all points shown including these points are correct even if no line is drawn N.B. a curve scores **0** marks	1 1 dep
(c)	temperature <u>increases</u>	accept filament lamp / it gets <u>hotter</u> allow heat for temperature	1
total			8

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4.1.1.1 Energy stores and systems

3462/3F Q9

question	answers	extra information	mark
(a)(i)	gamma rays	accept gamma accept correct symbol	1
(ii)	infra red	accept IR	1
(b)	ultraviolet <u>absorbed</u> by ink (energy) given out as light	 accept glows / luminous accept for **both** marks the ink is fluorescent do **not** accept answers in terms of uv being reflected	1 1
(c)	any **two** from: • UV can damage / kill / ionise / alter (normal) cells • change DNA structure **or** mutate • (normal) cells may become cancerous	 do **not** accept attacks cells **or** burns skin accept may cause (skin) cancer accept abnormal cell multiplication	2
(d)(i)	microwaves **and** infra red	both answers needed in either order do **not** accept heat for IR	1
(ii)	0.9	allow **1** mark for the <u>correct</u> use of 1.8 (kW) $(1.8 \times \frac{1}{2}$ or $1.8 \times 30)$ i.e. adding the correct 2 power values	2
total			9

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4.1.1.1 Energy stores and systems

3462/3F Q10

question	answers	extra information	mark
(a)(i)	accelerating	accept getting faster accept speed / velocity increasing	1
(ii)	acceleration increases	accept velocity / speed increases more rapidly do **not** accept velocity / speed increases	1
(b)(i)	$\text{acceleration} = \frac{\text{change in velocity}}{\text{time (taken)}}$	accept $a = \frac{v - u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ do **not** accept velocity for change in velocity do **not** accept change in speed do **not** accept $a = \frac{v}{t}$	1
(ii)	15	allow **1** mark for an answer of 900 **or** for correct use of 540 seconds	2
(iii)	velocity includes direction	accept velocity is a vector (quantity) accept converse answer	1
(c)	force of gravity (between shuttle and Earth) plus correct orbital speed (makes shuttle move in a curve)	accept gravitational pull if used correctly accept forward motion **or** constant speed for orbital speed accept it is travelling fast enough accept for **2** marks the force of gravity provides the centripetal force	1 1
(d)	black is a good emitter of radiation **or** to limit the temperature rise inside the shuttle	accept heat for radiation accept the tiles are good insulation do **not** accept black absorbs heat on its own do **not** accept tiles are heat proof	1
total			9

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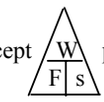
4.1.1.1 Energy stores and systems

3462/3F Q11

question	answers	extra information	mark
(a)(i)	work (done) = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1
(ii)	240 000 joules	allow **1** mark for correct substitution **or** correct use of 1200 (N) accept J do **not** accept j / Nm	2 1
(b)	800 (watts)	accept 0.8 kW accept their (a)(ii) ÷ 300 correctly evaluated for **2** marks allow **1** mark for correct substitution (a)(ii) ÷ 5 correctly evaluated for **1** mark	2
(c)(i)	any **one** from: • needs to raise the chair / lift • lifting more than one chair • energy transfer to the surroundings correctly qualified	 allow lifting more than 2 people implication of a heavier weight accept loss for transfer do **not** accept motor inefficient do **not** accept motor gets hot do **not** accept friction unless the location is specified as external to the motor	1
(ii)	electrical potential	accept electric **both** answers required for the mark	1
total			8

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4.1.1.1 Energy stores and systems

3462/3F Q12

question	answers	extra information	mark
(a)	**Y** and **Z**		1
	they have the same number of protons **or** same atomic number	accept they have the same number of electrons **or** same number of protons **and** electrons allow only different in number of neutrons N.B. independent marks	1
(b)	**Quality of written communication**	for correct use of terms underlined in B **or** C Q ✓ Q X	1
	A – alpha particle passes straight through the empty space of the atom **or** it is a long way from the nucleus B – alpha particle deflected / repelled / repulsed by the (positive) nucleus C – alpha particle heading straight for the nucleus is deflected / repelled / repulsed backwards	describes 3 tracks correctly for **2** marks describes 2 or 1 track correctly for **1** mark do **not** accept hits the nucleus do **not** accept answers referring to refraction do **not** accept answers in terms of reflected backwards unless qualified in terms of repulsion mention of difference in charge on nucleus negates that track	max 2
total			5

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics 3451/F
Specification B

Mark Scheme

2005 examination – June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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Physics (Specification B)
Foundation Tier 3451/F

3451/F Q1

question	answers	extra information	mark
(a)(i)	less than	accept any correct indication	1
(ii)	more than	accept any correct indication	1
(b)	any **two** from: stays above the same place above the equator one orbit takes 24 hours	 do **not** accept stays in the same place do **not** accept goes around equator unless qualified do **not** accept orbit at same speed as Earth do **not** accept orbit at a constant speed accept has same angular speed / velocity as Earth	2
total			4

3451/F Q2

question	answers	extra information	mark
(a)	comet		1
(b)	large group / number / collection of stars	ignore reference to planets accept millions of stars do **not** accept thousands of stars do **not** accept loads of stars	1
(c)	giant supernova neutron		1 1 1
total			5

4.1.1.1 Energy stores and systems

3451/F Q3

question	answers	extra information	mark
(a)(i)	radio		1
(ii)	gamma	accept microwave accept infrared	1
(iii)	ultra violet		1
(iv)	microwaves		1
(b)	the same as		1
(c)	X-rays do not go through lead	references to gamma rays are incorrect accept lead protects them from the X-rays accept not exposed to X-rays	1
	lead stops / reduces risk of X-rays harming / damaging / killing (persons) <u>cells</u>	accept X-rays (may) cause cancer accept organs for cell do **not** accept references to electric shock do **not** accept stops bones of people showing on X-ray answers involving the horse wearing an apron are incorrect	1
	Quality of written communication	award for a sensible sequence of **two** points	1
total			8

Physics B – AQA GCSE Mark Scheme, 2005 June series

3451/F Q4

question	answers	extra information	mark
(a)	light electrical		1 1
(b)	15% **or** 0.15	correct substitution gains **1** mark only an answer of 15 with no unit **or** an incorrect unit gains **1** mark an answer of 0.15 given with a unit gains **1** mark	2
(c)	the ticket machine is a long way from other electricity supplies		1
(d)	any figure between 5 and 10 inclusive	unit not required but if given must match numerical answer	1
total			6

3451/F Q5

question	answers	extra information	mark
(a)(i)	radon (gas)	do **not** accept gas	1
(ii)	background		1
(b)	bigger	accept any word which means bigger	1
(c)	**Z** alpha will not pass through aluminium or lead	if Z is not given, the reason does not score accept alpha cannot go through metals / dense material accept there is nothing to stop the radiation accept alpha will not pass through aluminium do **not** accept alpha will not pass through lead do **not** accept alpha stopped by air	1 1
total			5

4.1.1.1 Energy stores and systems

3451/F Q6

question	answers	extra information	mark
(a)	loses negative charge / electrons	do **not** accept positive charge transfers to the comb do **not** accept friction	1
(b)	**A** attract		1
	B repel		1
	C attract		1
(c)	**F A D E**	allow **2** marks for 2 letters in the correct place allow **1** mark for 1 letter in the correct place	3
total			7

4.1.1.1 Energy stores and systems

Physics B – AQA GCSE Mark Scheme, 2005 June series

3451/F Q7

question	answers	extra information	mark
(a)	all points correctly plotted	tolerance ± $\frac{1}{2}$ square on y axis only allow **1** mark for 3 correctly plotted points	2
	attempt made to draw a smooth curve	do **not** accept dot-to-dot line	1
(b)(i)	3 days ± 0.2 **or** any value correctly obtained using their graph line	if no line drawn in (a), answer must be exactly 3	1
(ii)	3 days or their (b)(i)		1
(c)	radon-222	accept radon **or** 222 accept alpha or 3.8 correct isotope required for reason to score	1
	has the shortest half-life	accept the others have longer half-lives	1
total			7

4.1.1.1 Energy stores and systems

3451/F Q8

question	answers	extra information	mark
(a)	fossils of Cynognathus are found in Africa and South America		1
	the shapes ……. almost fit together	only two boxes should be ticked deduct **1** mark for each additional box to a minimum mark of **0**	1
(b)	continental		1
	crust		1
	tectonic		1
total			5

4.1.1.1 Energy stores and systems

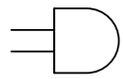
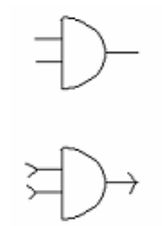
3451/F Q9

question	answers	extra information	mark
(a)	capacitor	accept condenser	1
	LDR	**or** light dependent resistor accept 'ldr', 'Ldr' etc.	1
	relay (normally open)	do **not** accept 'relay normally closed'	1
(b)(i)	battery	accept '(battery of) cells' do **not** accept 'battery / cell'	1
(ii)	LED	**or** light emitting diode accept 'led' or 'Led' do **not** accept just 'diode'	1
(iii)	B will light (but C will not)	accept '(only) B will work' accept 'one is on the other is off' do **not** accept 'C is on and B is off'	1
(iv)	any **one** from: B is connected the right way round (and C is not) a (light emitting) diode only allows (a significant) current to flow in one direction B's anode is connected to the positive side of the supply B's cathode is connected to the negative terminal	N.B. the candidate's answer to part (b)(iii) may include this mark but do **not** credit if the response to part (b)(iii) is incorrect or there is any other contradiction if (iv) is completely consistent with (iii) which is wrong, allow **1** mark	1
(c)(i)	first input / second input / output 0 / 0 / **0** 1 / 0 / **0** 0 / 1 / **0** 1 / 1 / **1**	**all** correct allow: OFF NO OFF NO OFF NO ON YES	1
(ii)	truth (table)		1

cont…

4.1.1.1 Energy stores and systems

3451/F Q9 cont…

(iii)		a Roman upper case D in any orientation without contacts is acceptable but if contacts are shown do **not** give the mark if there is any ambiguity or contradiction allow 	1
(d)	light sensor	**or** light dependent resistor **or** LDR accept 'ldr', Ldr' etc allow solar cell, photo cell	1
	NOT gate	accept 'Not gate' **or** 'not gate' if both correct but in the wrong order credit with **1** mark	1
total			12

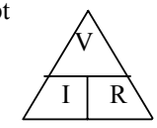
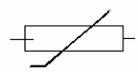
4.1.1.1 Energy stores and systems

3451/F Q10

question	answers	extra information	mark
(a)(i)	rays continued to meet on the right hand side of the lens and beyond	must be straight lines from the right hand side of the lens ignore details through the lens allow if no arrows	1
	meet exactly on the axis	negate mark if contradictory arrow(s) added do not need to go beyond the focus for this mark	1
(ii)	(principal) focus	**or** focal (point)	1
(iii)	converging	**or** convex	1
(b)(i)	**A**		1
(ii)	rays seem to come from this point	**or** words to this effect **or** shows this on the diagram	1
(iii)	diverging	**or** concave	1
(c)	film	accept any unambiguous method of showing the correct response	1
	smaller than		1
	further away from		1
(d)	any **three** from: • real image can be put on a screen • virtual image cannot be put on a screen / film • virtual image is imaginary • real image is formed where (real) rays cross / converge • virtual image is where virtual / imaginary rays (seem to) come from • virtual image formed where virtual rays intersect / cross	allow film allow real image has light travelling through it **or** virtual image is where rays seem to come from	3
total			13

4.1.1.1 Energy stores and systems

3451/F Q11

question	answers	extra information	mark
(a)(i)	$A_1 = 0.5$	ignore any units	1
	$A_4 = 0.5$	allow **1** mark for $A_1 = A_4 \neq 0.5$	1
(ii)	the resistance of **P** is more than 20 Ω		1
	a smaller current goes through P / A_2 (than 20 Ω)	dependent on getting 1st mark correct accept converse	1
(b)(i)	potential difference = current × resistance	accept pd / voltage for potential difference accept V = I × R, correct symbols and correct case only accept volts = amps × ohms accept  provided subsequent method is correct allow combination of physical quantities and named units allow voltage = I × R	1
(ii)	6	allow **1** mark for correct substitution	2
(iii)	6	accept their (b)(ii)	1
(c)	<u>thermistor</u> or 	accept correct circuit symbol allow phonetic spelling	1
	<u>resistance</u> goes down (as temperature of thermistor goes up)	do **not** accept changes for goes down do **not** accept an answer in terms of current only answers in terms of other components are incorrect	1
total			10

4.1.1.1 Energy stores and systems

Physics B – AQA GCSE Mark Scheme, 2005 June series

3451/F Q12

question	answers	extra information	mark
(a)(i)	larger the distance, greater the time	accept 'they are proportional' accept converse	1
(ii)	any value between 6 and 9 years inclusive		1
(b)(i)	carbon dioxide		1
(ii)	(Venus) has high**er** temperature (than Mercury)	accept has the high**est** temperature accept Venus is hotter / hottest do **not** accept has a high / very high temperature	1
	(Venus) further from the Sun than Mercury	accept 'Venus is not the closest planet to the Sun' answer in terms of greenhouse effect only, scores **0** marks	1
total			5

4.1.1.1 Energy stores and systems

3451/F Q13

question	answers	extra information	mark
(a)(i)	20		1
(ii)	convection		1
(iii)	fit draughtproof strips	accept lay carpet accept fit curtains accept close doors / windows / curtains accept any reasonable suggestion for reducing a draught 'double glazing' alone is insufficient	1
(b)	air is (a good) insulator **or** air is a poor conductor	accept air cavity / 'it' for air	1
	reducing heat transfer by <u>conduction</u>	accept stops for reduces ignore convection do **not** accept radiation do **not** accept answers in terms of heat being trapped	1
(c)(i)	most cost effective	accept it is cheaper or low<u>est</u> cost accept shortest payback time accept in terms of reducing heat loss by the largest amount do **not** accept it is easier ignore most heat is lost through the roof	1
(ii)	4		1
total			7

4.1.1.1 Energy stores and systems

3451/F Q14

question	answers	extra information	mark
(a)(i)	constant speed	do **not** accept normal speed do **not** accept it is stopped / stationary	1
	in a straight line	accept any appropriate reference to a direction constant velocity gains **2** marks 'not accelerating' gains **2** marks terminal velocity alone gets **1** mark	1
(ii)	goes down owtte	accept motorbike (it) slows down	1
(b)(i)	20 (m/s)	ignore incorrect units	1
(ii)	acceleration = change in velocity / time (taken)	do **not** accept velocity for change in velocity accept change in speed accept $a = \frac{v-u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ **or** $a = \frac{\Delta v}{t}$ do **not** accept $a = \frac{v}{t}$	1
(iii)	4 **or** their (b)(i) ÷ 5	allow **1** mark for correct substitution	2
	m/s^2	m/s/s **or** ms^{-2} **or** metres per second squared **or** metres per second per second	1
(c)	vehicle may skid / slide	loss of control / brakes lock / wheels lock accept greater stopping distance **or** difficult to stop	1
	due to reduced friction (between tyre(s) and road)	accept due to less grip do **not** accept no friction	1

cont…

3451/F Q14 cont…

(d)	any **three** from: • <u>increased</u> speed • <u>reduced</u> braking force • <u>slower</u> (driver) reactions • <u>poor</u> vehicle maintenance • <u>increased</u> mass / weight of vehicle • <u>poor</u> road surface • <u>more</u> streamlined	do **not** accept night time / poor vision N.B. specific answers may **each** gain credit eg tiredness (1), drinking alcohol (1), using drugs (1), driver distracted (1) etc specific examples may **each** gain credit eg worn brakes or worn tyres etc accept large mass / weight of vehicle if candidates give three answers that affect stopping distance but not specific to <u>increase</u> award **1** mark only	3
total			13

4.1.1.1 Energy stores and systems

3451/F Q15

question	answers	extra information	mark
(a)(i)	arrow from centre of the ball **and** at right angles to the string **and** in the correct direction	arrow should point to the student's belt accept free-hand 'straight' line do **not** accept curved line	1
(ii)	increase increase increase	accept 'be stronger / bigger' accept 'be stronger / bigger' accept 'be stronger / bigger'	1 1 1
(b)	speed velocity direction	all **three** correct any two correct for **1** mark otherwise **0** marks	2
(c)(i)	centripetal	accept 'centripedal' and other minor misspellings do **not** accept anything which could be 'centrifugal'	1
(ii)	gravity	accept 'weight' accept 'force of attraction due to mass(es) (of the Moon and the Earth)'	1
(iii)	electron(s)		1
(iv)	electrostatic	accept 'electrical' do **not** accept just 'centripetal'	1
total			10

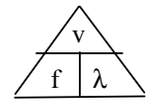
4.1.1.1 Energy stores and systems

3451/F Q16

question	answers	extra information	mark
(a)(i)	**X** at the centre of the lifebelt	measuring from the centre of **X**, allow 2 mm tolerance in any direction	1
(ii)	any **two** from: below the point of suspension at the centre (of the lifebelt) (because) the lifebelt / it is symmetrical	if X is on vertical line below the hanger (but not at centre) can gain the first point only accept '(vertically) below **Y**' accept 'in the middle' **or** (because) the mass / weight is evenly distributed	2
(b)	Nm **or** newton metre(s) 750	accept Newton metre(s) do **not** accept any ambiguity in the symbol ie NM, nM or nm (moment) = force × (perpendicular) distance (between line of action and pivot) **or** (moment) = 500 × 1.5 gains **1** mark	1 2
(c)	**Quality of written communication**: any **three** connected points from: low(er) <u>centre of mass / gravity</u> (more) <u>stable</u> less likely to fall over the <u>turning effect / moment</u> (of the weight of case) is less so the pull on her arm is less	for **2** of the underlined terms used in the correct context **or** <u>centre of mass / gravity</u> will be close(r) to the wheels / axle / ground **or** less <u>unstable</u> accept 'less likely to overturn' do **not** accept 'will not fall over' **or** so less effort is needed to hold the case ignore references to pulling the case	1 3
total			10

4.1.1.1 Energy stores and systems

3451/F Q17

question	answers	extra information	mark
(a)	any **two** from: • **amplitude** decreasing • **wavelength** increasing • **frequency** decreasing **Quality of written communication**	accept siren / sound getting quieter do **not** accept sound decreases accept pitch decreasing ignore reference to transverse wave ignore reference to speed contradictory statements within each point lose the mark all emboldened terms in candidate's answer used correctly	2 1
(b)(i)	ultrasound **or** ultrasonic		1
(ii)	wave speed = frequency × wavelength	accept speed / velocity for wave speed accept $v = f \times \lambda$ do **not** accept w for λ do **not** accept s for v accept  provided subsequent calculation shows a correct method	1
(iii)	339.2 **or** 340 **or** 339	allow **1** mark for using 212 000 allow **1** mark for correct substitution an answer of 0.3392 **or** 0.34 **or** 0.339 gains **1** mark only award full credit for a correct numerical answer with the unit changed to km/s	3
total			8

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science: Double Award 3462/3F
Specification B (Co-ordinated)

Mark Scheme

2005 examination - June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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Double Award
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)(i)	less than	accept any correct indication	1
(ii)	more than	accept any correct indication	1
(b)	any **two** from: stays above the same place above the equator one orbit takes 24 hours	 do **not** accept stays in the same place do **not** accept goes around equator unless qualified do **not** accept orbit at same speed as Earth do **not** accept orbit at a constant speed accept has same angular speed / velocity as Earth	2
total			4

3462/ 3F Q2

question	answers	extra information	mark
(a)	comet		1
(b)	large group / number / collection of stars	ignore reference to planets accept millions of stars do **not** accept thousands of stars do **not** accept loads of stars	1
(c)	giant supernova neutron		1 1 1
total			5

4.1.1.1 Energy stores and systems

3462/3F Q3

question	answers	extra information	mark
(a)(i)	radio		1
(ii)	gamma	accept microwave accept infrared	1
(iii)	ultra violet		1
(iv)	microwaves		1
(b)	the same as		1
(c)	**Quality of written communication**	award for a sensible sequence of **two** points	1
	X-rays do not go through lead	accept lead protects them from the X-rays accept not exposed to X-rays	1
	lead stops / reduces risk of X-rays harming / damaging / killing (persons) <u>cells</u>	accept X-rays (may) cause cancer accept organs for cell do **not** accept references to electric shock do **not** accept stops bones of people showing on X-ray answers involving the horse wearing an apron are incorrect references to gamma rays are incorrect	1
total			8

4.1.1.1 Energy stores and systems

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q4

question	answers	extra information	mark
(a)	light electrical		1 1
(b)	15% **or** 0.15	correct substitution gains **1** mark only an answer of 15 with no unit **or** an incorrect unit gains **1** mark an answer of 0.15 given with a unit gains **1** mark	2
(c)	the ticket machine is a long way from other electricity supplies		1
(d)	any figure between 5 and 10 inclusive	unit not required but if given must match numerical answer	1
total			6

4.1.1.1 Energy stores and systems

3462/3F Q5

question	answers	extra information	mark
(a)(i)	radon (gas)	do **not** accept gas	1
(ii)	background		1
(b)	bigger	accept any word which means bigger	1
(c)	**Z** alpha will not pass through aluminium or lead	if Z is not given, the reason does not score accept alpha cannot go through metals / dense material accept there is nothing to stop the radiation accept alpha will not pass through aluminium do **not** accept alpha will not pass through lead do **not** accept alpha stopped by air	1 1
total			5

4.1.1.1 Energy stores and systems

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q6

question	answers	extra information	mark
(a)	loses negative charge / electrons	do **not** accept positive charge transfers to the comb do **not** accept friction	1
(b)	**A** attract		1
	B repel		1
	C attract		1
(c)	**F A D E**	allow **2** marks for 2 letters in the correct place allow **1** mark for 1 letter in the correct place	3
total			7

4.1.1.1 Energy stores and systems

3462/3F Q7

question	answers	extra information	mark
(a)	all points correctly plotted	tolerance ± $\frac{1}{2}$ square on y axis only allow **1** mark for 3 correctly plotted points	2
	attempt made to draw a smooth curve	do **not** accept dot-to-dot line	1
(b)(i)	3 days ± 0.2 **or** any value correctly obtained using their graph line	if no line drawn in (a), answer must be exactly 3	1
(ii)	3 days or their (b)(i)		1
(c)	radon-222	accept radon **or** 222 accept alpha or 3.8 correct isotope required for reason to score	1
	has the shortest <u>half-life</u>	accept the others have longer <u>half-lives</u>	1
total			7

4.1.1.1 Energy stores and systems

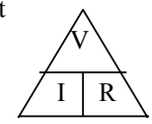
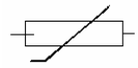
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q8

question	answers	extra information	mark
(a)	fossils of Cynognathus are found in Africa and South America		1
	the shapes ……. almost fit together	only two boxes should be ticked deduct **1** mark for each additional box to a minimum mark of **0**	1
(b)	continental		1
	crust		1
	tectonic		1
total			5

4.1.1.1 Energy stores and systems

3462/3F Q9

question	answers	extra information	mark
(a)(i)	$A_1 = 0.5$ $A_4 = 0.5$	ignore any units allow **1** mark for $A_1 = A_4 \neq 0.5$	1 1
(ii)	the resistance of **P** is more than 20 Ω a smaller current goes through P / A_2 (than 20 Ω)	 dependent on getting 1st mark correct accept converse	1 1
(b)(i)	potential difference = current × resistance	accept pd / voltage for potential difference accept V = I × R, correct symbols and correct case only accept volts = amps × ohms accept  provided subsequent method is correct allow combination of physical quantities and named units allow voltage = I × R	1
(ii)	6	allow **1** mark for correct substitution	2
(iii)	6	accept their (b)(ii)	1
(c)	thermistor or  resistance goes down (as temperature of thermistor goes up)	accept correct circuit symbol allow phonetic spelling do **not** accept changes for goes down do **not** accept an answer in terms of current only answers in terms of other components are incorrect	1 1
total			10

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q10

question	answers	extra information	mark
(a)(i)	larger the distance, greater the time	accept 'they are proportional' accept converse	1
(ii)	any value between 6 and 9 years inclusive		1
(b)(i)	carbon dioxide		1
(ii)	(Venus) has high**er** temperature (than Mercury)	accept has the high**est** temperature accept Venus is hotter / hottest do **not** accept has a high / very high temperature	1
	(Venus) further from the Sun than Mercury	accept 'Venus is not the closest planet to the Sun' answer in terms of greenhouse effect only, scores **0** marks	1
total			5

4.1.1.1 Energy stores and systems

3462/3F Q11

question	answers	extra information	mark
(a)(i)	20		1
(ii)	convection		1
(iii)	fit draughtproof strips	accept lay carpet accept fit curtains accept close doors / windows / curtains accept any reasonable suggestion for reducing a draught 'double glazing' alone is insufficient	1
(b)	air is (a good) insulator **or** air is a poor conductor	accept air cavity / 'it' for air	1
	reducing heat transfer by <u>conduction</u>	accept stops for reduces ignore convection do **not** accept radiation do **not** accept answers in terms of heat being trapped	1
(c)(i)	most cost effective	accept it is cheaper or low<u>est</u> cost accept shortest payback time accept in terms of reducing heat loss by the largest amount do **not** accept it is easier ignore most heat is lost through the roof	1
(ii)	4		1
total			7

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q12

question	answers	extra information	mark
(a)(i)	constant speed	do **not** accept normal speed do **not** accept it is stopped / stationary	1
	in a straight line	accept any appropriate reference to a direction constant velocity gains **2** marks 'not accelerating' gains **2** marks terminal velocity alone gets **1** mark	1
(ii)	goes down owtte	accept motorbike (it) slows down	1
(b)(i)	20 (m/s)	ignore incorrect units	1
(ii)	acceleration = change in velocity / time (taken)	do **not** accept velocity for change in velocity accept change in speed accept $a = \frac{v-u}{t}$ **or** $a = \frac{v_1 - v_2}{t}$ **or** $a = \frac{\Delta v}{t}$ do **not** accept $a = \frac{v}{t}$	1
(iii)	4 **or** their (b)(i) ÷ 5	allow **1** mark for correct substitution	2
	m/s^2	m/s/s **or** ms^{-2} **or** metres per second squared **or** metres per second per second	1
(c)	vehicle may skid / slide	loss of control / brakes lock / wheels lock accept greater stopping distance **or** difficult to stop	1
	due to reduced friction (between tyre(s) and road)	accept due to less grip do **not** accept no friction	1

cont…

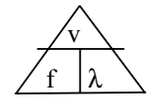
3462/3F Q12 cont…

(d)	any **three** from: • <u>increased</u> speed • <u>reduced</u> braking force • <u>slower</u> (driver) reactions • <u>poor</u> vehicle maintenance • <u>increased</u> mass / weight of vehicle • <u>poor</u> road surface • <u>more</u> streamlined	do **not** accept night time / poor vision NB specific answers may **each** gain credit eg tiredness (1), drinking alcohol (1), using drugs (1), driver distracted (1) etc specific examples may **each** gain credit eg worn brakes or worn tyres etc accept large mass / weight of vehicle if candidates give three answers that affect stopping distance but not specific to <u>increase</u> award **1** mark only	3
total			13

4.1.1.1 Energy stores and systems

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2005 June series

3462/3F Q13

question	answers	extra information	mark
(a)	**Quality of written communication**	all emboldened terms in candidate's answer used correctly	1
	any **two** from: • **amplitude** decreasing • **wavelength** increasing • **frequency** decreasing	accept siren / sound getting quieter do **not** accept sound decreases accept pitch decreasing ignore reference to transverse wave ignore reference to speed contradictory statements within each point lose the mark	2
(b)(i)	ultrasound **or** ultrasonic		1
(ii)	wave speed = frequency × wavelength	accept speed / velocity for wave speed accept $v = f \times \lambda$ do **not** accept w for λ do **not** accept s for v accept  provided subsequent calculation shows a correct method	1
(iii)	339.2 **or** 340 **or** 339	allow **1** mark for using 212 000 allow **1** mark for correct substitution an answer of 0.3392 **or** 0.34 **or** 0.339 gains **1** mark only award full credit for a correct numerical answer with the unit changed to km/s	3
total			8

Version 1.0: 0906

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics 3451/F
Specification B

Mark Scheme

2006 examination - June series

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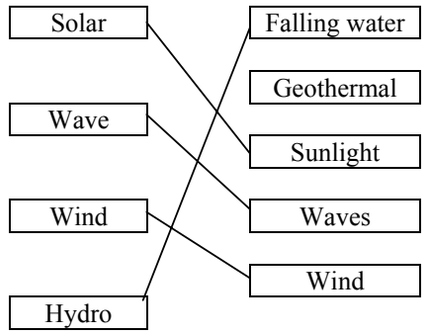
Physics (Specification B)
Foundation Tier 3451/F

3451/F Q1

question	answers	extra information	mark
(a)	4 correct lines drawn  	**1** mark for each correct line if more than 4 lines are drawn mark incorrect ones first. Mark only 4 lines	4
(b)	4		1
(c)(i)	nuclear		1
(ii)	(natural) gas	do **not** accept natural	1
total			7

4.1.1.1 Energy stores and systems

3451/F Q2

question	answers	extra information	mark
(a)(i)	ultra violet		1
(ii)	kill the cells	accept destroys the cells accept makes cells cancerous accept damage cells accept harms cells accept changes DNA accept cause cells to mutate accept skin cells for cells accept cause cancer do **not** accept skin for cells do **not** accept burns the cells	1
(b)(i)	the sunbed uses an alternating current (a.c.) supply		1
(ii)	10.8	accept **1** mark for correct substitution of power in W or kW and time in hours or seconds	2
total			5

4.1.1.1 Energy stores and systems

3451/F Q3

question	answers	extra information	mark
(a)(i)	M		1
(ii)	K		1
(iii)	J		1
(iv)	O		1
(b)(i)	billions of years		1
(ii)	red giant	any answer in terms of explosion or supernova is **incorrect**	1
	contracts / shrinks to	incorrect reference to black hole negates **1** mark	1
	white dwarf		1
total			8

4.1.1.1 Energy stores and systems

3451/F Q4

question	answers	extra information	mark
(a)(i)	A and C	**both** answers must be correct in either order	1
(ii)	A and B	**both** answers must be correct in either order	1
(iii)	same number of protons plus neutrons **or** same number of nucleons	accept number of particles in nucleus the same do **not** accept they add up to 6 unless qualified	1
(b)(i)	any **two** from: • boron - 12 • carbon - 14 • oxygen - 15 • lead - 209	**both** required both name **and** number must be given	1
(ii)	any **two** from: • boron - 11 • carbon - 12 • oxygen - 16 • lead - 207	**both** required both name **and** number must be given	1
(c)	alpha		1
total			6

4.1.1.1 Energy stores and systems

3451/F Q5

question	answers	extra information	mark
(a)	(good) insulator	accept does not conduct (electricity) accept does not conduct heat or electricity do **not** accept does not conduct heat outside is tough is insufficient	1
(b)	fuse		1
(c)	connect the green and yellow / earth wire	accept wires must be connected to screws	1
	swap the brown and blue wires round		1
total			4

3451/F Q6

question	answers	extra information	mark
(a)	fossils	answers can be in either order	1
	water		1
(b)	increased		1
(c)	radio telescope		1
total			4

4.1.1.1 Energy stores and systems

3451/F Q7

question	answers	extra information	mark
(a)(i)	electrical		1
	kinetic	accept movement	1
(ii)	heat	answers can be in either order	1
	sound		1
(b)(i)	360	accept **1** mark for correct substitution	2
(ii)	watt		1
(c)	the stairlift is not moving the stairlift is moving at constant speed	**both** answers are required for the mark	1
total			8

3451/F Q8

question	answers	extra information	mark
(a)(i)	(up) further **or** (up) faster	any reference to downwards movement loses credit accept <u>with</u> more force accept motion would increase	1
(ii)	down	accept the opposite way accept drop	1
(b)(i)	direct current		1
(ii)	Z		1
total			4

4.1.1.1 Energy stores and systems

3451/F Q9

question	answers	extra information	mark
(a)	level of radiation (detected) will not change	ignore reference to particles	1
	if thickness of aluminium changes	accept for **both** marks a specific example eg if the aluminium gets thicker the level of radiation detected stays the same. accept for **1** mark gamma will pass through aluminium	1
	QoWC for 2 points in a sensible sequence		1
(b)	S W T V	all in correct order accept **2** marks for 2 correct accept **1** mark for 1 correct	3
total			6

3451/F Q10

<table>
<tr><th>question</th><th>answers</th><th>extra information</th><th>mark</th></tr>
<tr><td>(a)</td><td>thermistor(s)
LDR(s)
switch(es)
LED(s)
buzzer(s)
motor(s)</td><td>1 mark each
or light dependent resistor(s)
or light emitting diode(s)</td><td>6</td></tr>
<tr><td>(b)(i)</td><td><table><tr><th>1st input</th><th>2nd input</th><th>Output</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td><td>all correct</td><td>1</td></tr>
<tr><td>(ii)</td><td><table><tr><th>Input</th><th>Output</th></tr><tr><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td></tr></table></td><td>both correct</td><td>1</td></tr>
<tr><td>(iii)</td><td><table><tr><th>1st input</th><th>2nd input</th><th>Output</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td><td>all correct</td><td>1</td></tr>
<tr><td>(c)(i)</td><td></td><td>do not credit any attempt which could equally well be a poorly drawn attempt at the symbol for a cell</td><td>1</td></tr>
<tr><td>(ii)</td><td>charge

increases</td><td>accept ‘electrons’
accept ‘energy
or gets bigger/larger</td><td>1

1</td></tr>
<tr><td>total</td><td></td><td></td><td>12</td></tr>
</table>

3451/F Q11

question	answers	extra information	mark
(a)(i)	A		1
(ii)	B		1
(iii)	mass is larger	credit if the response is clear by some other means e.g. it is ringed	1
	wire is shorter	credit if the response is clear by some other means e.g. it is ringed	1
(b)	moment		1
	distance		1
(c)(i)	1		1
(ii)	5		1
(iii)	any **two** from • remove slotted mass(es) • slide (slotted) masses / weights nearer pivot • slide forcemeter away from the pivot • slide rod to the left	 **or** ….. to the left **or** ….. to the right **or** …. so that the slotted masses side is shorter **or** …. so that the forcemeter side is longer	2
(d)	centre of the rectangle	accept *2*mm tolerance any direction	1
	centre of the circle	accept *2*mm tolerance any direction	1
	on centre line and 10mm above base	accept *2*mm tolerance any direction	1
total			13

4.1.1.1 Energy stores and systems

3451/F Q12

question	answers	extra information	mark
(a)	0.05 (A)	ignore incorrect units if given accept 'the same' / 'the same as K' / 'the same as the other ammeter' do **not** accept 'same as the other meter'	1
(b)(i)	any **two** from: • two cells are joined + to +	answers in terms of current gain no marks accept one cell in the wrong way accept two cells are joined back-to-back accept two cells are joined – to – accept battery for cell do **not** accept answers in terms of all the cells or in terms of energy only	2
	• some of the cells potential difference is across the diode / ammeters / wires **or** the pd of the cells is shared by all components	accept voltage for pd do **not** accept using up pd	
	• the other components have a resistance	accept a named component / components / wire has a resistance	
	• cells not fully charged **or** cells partially run down	do **not** accept voltage of cells is less than 1.5 unless explained do **not** accept cells are not as powerful unless explained	
	• cells have an internal resistance		
(ii)	the diode has a (very) high resistance (in the reverse direction)		1
	a diode only conducts / allows current to flow in one direction	accept little / no current flows do **not** accept blocks / cuts flow	1

Continued

4.1.1.1 Energy stores and systems

3451/F Q12

question	answers	extra information	mark
(c)	**QoWC** for the use of the word resistance	annotate Q✓ Q✗ accept resistant	1
	accept increase / change / decrease throughout question but a contradiction loses **one** mark with change as neutral		
	as the pd / current increases / changes	accept voltage for pd must be correctly linked to at least one of the following points accept	1
	the temperature of the filament increases / changes	lamp / bulb for filament accept filament becomes hotter	1
	increasing / changing the **resistance** of the lamp		1
		accept for **1** mark only the filament lamp does not obey Ohm's law	
total			9

4.1.1.1 Energy stores and systems

3451/F Q13

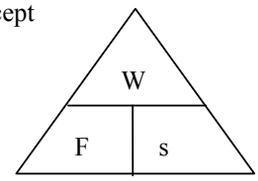
question	answers	extra information	mark
(a)	0.5		1
	hertz	accept Hz but **not** HZ / hz / hZ accept (waves) per second **or** / sec **or** / s **or** s^{-1} **or** sec^{-1}	1
(b)	any **one** from: • any named part of the electromagnetic spectrum • S – waves / secondary waves • wave on a rope	 do **not** accept seismic waves / earthquake do **not** accept slinky unless clearly described	1
(c)	transverse – disturbance / vibration is perpendicular to the direction of energy transfer / wave travel	accept a correctly labelled diagram	1
	longitudinal – disturbance / vibration is parallel to the direction of energy transfer / wave travel	accept a correctly labelled diagram part explanation of the difference between transverse **and** longitudinal gains **1** mark	1
(d)(i)	TIR shown	needs to stay inside water jet ignore number of reflections **or** arrow heads lines straight by eye	1
(ii)	bigger than	any indication of correct answer	1
total			7

4.1.1.1 Energy stores and systems

3451/F Q14

question	answers	extra information	mark
(a)	W		1
	has only two states **or** is either on or off	accept discrete values only do **not** credit answer purely in terms of shape	1
(b)	any **one** from:		1
	• higher quality	accept clearer do **not** accept easier to read ignore faster accept <u>less</u> distortion **or** <u>less</u> weakening of signal strength do **not** accept no distortion / weakening on its own	
	• increased carrying capacity	accept more information can be sent **or** more channels	
	• errors can be rectified		
total			3

3451/F Q15

question	answers	extra information	mark
(a)(i)	all points plotted accurately	accept **1** mark for 5 correct plots ± ½ small square on stopping distance	2
	line of best fit must be continuous	accept attempt at a reasonable curve does not need to go through 0 0 do **not** accept a straight line do **not** accept dot-to-dot	1
(ii)	4 to 6 (metres)	accept ecf from (a)(i) accept **1** mark for value taken correctly from graph at 25mph **or** correct method shown	2
(b)(i)	0.7 (s)	incorrect unit = 0 marks	1
(ii)	constant speed / velocity	accept (continued as) 30mph accept did not change / stayed the same accept no acceleration	1
(iii)	3.3(s)	penalise incorrect unit once only	1
(iv)	reaction time increases / is longer **or** thinking distance increases	do **not** accept reaction time slower **or** reactions are slower	1
	stopping distance / it increases	do **not** accept travels at constant speed for longer	1
(c)(i)	work done = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1

Continued

4.1.1.1 Energy stores and systems

3451/F Q15

question	answers	extra information	mark
(ii) **E**	2100	accept 2.1 kilo accept **1** mark for using 7000 N	2
(iii)	2100 (joules)	accept their (c)(ii)	1
total			14

4.1.1.1 Energy stores and systems

3451/F Q16

question	answers	extra information	mark
(a)(i)	refraction		1
(ii)	it changes speed **or** change in density	accept it speeds up do **not** accept it slows down do **not** accept air is more dense than glass	1
(b)(i)	sound / waves <u>diffract</u> through the gap (in the wall) **or** over the wall **or** because the gate is open	do **not** accept reflection this only scores if first marking point is given accept for **1** mark only sound / waves go through the gap and <u>spread out</u> **or** diagram showing wave fronts spreading out from open gates if diagram is labelled as diffraction both marks can be scored	1 1
(ii)	less diffraction	accept no diffraction accept gates <u>absorb</u> sound / noise / waves accept gates <u>reflect</u> sound / noise / waves do **not** accept rebounds / stops / blocks out	1
total			5

3451/F Q17

question	answers	extra information	mark
(a)	both rays brought to a focus at F on the right	do **not** have to be continued beyond F	1
	lines have been drawn **accurately** with a ruler	only credit if 1st mark credited do **not** credit if contradictory arrow(s) added	1
(b)	rays seem to come from a focus at G on the left and continued to the right of the lens	this mark is for the current idea of divergence	1
	lines have been drawn **accurately** with a ruler	only credit if 1st mark credited do **not** credit if contradictory arrow(s) added	1
(c)	…lens… …image… …object… …image… ...object… …lens…	lens as 1st and 6th words (1) image and object in the correct order 2nd and 3rd words (1) image and object in correct order 4th and 5th words (1)	max 3
(d)(i)	correct statement about real image real rays intersect / cross to form a real image **or** a real image can be formed on a screen **or** real image is (always) on the opposite side (of the lens) **or** real image is (always) upside down (to the object)	may be credited from a correct diagram	1
	correct statement about virtual / imaginary image virtual / imaginary rays intersect / cross to form a virtual image **or** a virtual / imaginary image cannot **or** virtual / imaginary image is (always) on the same side (of the lens) **or** virtual / imaginary image is (always) same way up (as the object)	may be credited from a correct diagram	1

Continued

4.1.1.1 Energy stores and systems

3451/F Q17

question	answers	extra information	mark
(ii)	**either** image needs to fall on / affect the film **or** image needs to fall on / affect the light sensors / charged coupled devices (CCDs) (in a digital camera / mobile phone) **or** image needs to cause a chemical reaction (in / on the film)		1
total			10

4.1.1.1 Energy stores and systems

3451/F Q18

<table>
<tr><th>question</th><th>answers</th><th>extra information</th><th>mark</th></tr>
<tr><td>(a)</td><td>AND (gate)

OR (gate)

NOT (gate)

LED or light emitting diode</td><td>accept ‘and’

accept ‘or’

accept ‘not’ or invert gate

accept ‘led’</td><td>1

1

1

1</td></tr>
<tr><td>(b)(i)</td><td>NOT (gate) and AND (gate)</td><td>both in either order or ‘(the) gates’

any additions lose the mark</td><td>1</td></tr>
<tr><td>(ii)</td><td><table><tr><th>Switch for fire</th><th>Tilt switch</th><th>Signal to relay</th></tr><tr><td>0</td><td>0</td><td>…0…</td></tr><tr><td>0</td><td>1</td><td>…0…</td></tr><tr><td>1</td><td>0</td><td>…1…</td></tr><tr><td>1</td><td>1</td><td>…0…</td></tr></table></td><td>all correct

allow off or no
off no
on yes
off no</td><td>1</td></tr>
<tr><td>(iii)</td><td>(relay) acts as / is a switch

either
small current from the electronic / control circuit / system (1)

large current through the output / (electric) fire (1)

or

full current through electronic control system (1)

may damage components / lead to overheating / electric shock (1)

QoWC for correct use of the scientific term ‘current’</td><td>accept implication that it works as a switch e.g. ‘turns on fire’

or ‘small current through the coil (of the relay)’

do not accept small current is turned into a large current

annotate Q✓ Q×

if answer in terms of voltage isolation / voltage/ p.d. accept QoWC mark for correct use</td><td>1

1

1

1</td></tr>
<tr><td>total</td><td></td><td></td><td>10</td></tr>
</table>

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science: Double Award 3462/3F
Specification B

Mark Scheme

2006 examination - June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

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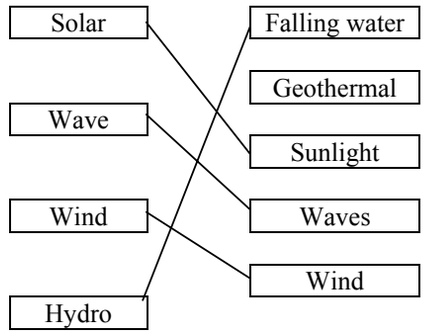
Double Award (Co-ordinated)
Foundation Tier 3462/3F

3462/3F Q1

question	answers	extra information	mark
(a)	4 correct lines drawn  	**1** mark for each correct line if more than 4 lines are drawn mark incorrect ones first. Mark only 4 lines	4
(b)	4		1
(c)(i)	nuclear		1
(ii)	(natural) gas	do **not** accept natural	1
total			7

4.1.1.1 Energy stores and systems

3462/3F Q2

question	answers	extra information	mark
(a)(i)	ultra violet		1
(ii)	kill the cells	accept destroys the cells accept makes cells cancerous accept damage cells accept harms cells accept changes DNA accept cause cells to mutate accept skin cells for cells accept cause cancer do **not** accept skin for cells do **not** accept burns the cells	1
(b)(i)	the sunbed uses an alternating current (a.c.) supply		1
(ii)	10.8	accept **1** mark for correct substitution of power in W or kW and time in hours or seconds	2
total			5

4.1.1.1 Energy stores and systems

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q3

question	answers	extra information	mark
(a)(i)	M		1
(ii)	K		1
(iii)	J		1
(iv)	O		1
(b)(i)	billions of years		1
(ii)	red giant	any answer in terms of explosion or supernova is **incorrect**	1
	contracts / shrinks to	incorrect reference to black hole negates **1** mark	1
	white dwarf		1
total			8

4.1.1.1 Energy stores and systems

3462/3F Q4

question	answers	extra information	mark
(a)(i)	A and C	**both** answers must be correct in either order	1
(ii)	A and B	**both** answers must be correct in either order	1
(iii)	same number of protons plus neutrons **or** same number of nucleons	accept number of particles in nucleus the same do **not** accept they add up to 6 unless qualified	1
(b)(i)	any **two** from: • boron - 12 • carbon - 14 • oxygen - 15 • lead - 209	**both** required both name **and** number must be given	1
(ii)	any **two** from: • boron - 11 • carbon - 12 • oxygen - 16 • lead - 207	**both** required both name **and** number must be given	1
(c)	alpha		1
total			6

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q5

question	answers	extra information	mark
(a)	(good) insulator	accept does not conduct (electricity) accept does not conduct heat or electricity do **not** accept does not conduct heat outside is tough is insufficient	1
(b)	fuse		1
(c)	connect the green and yellow / earth wire	accept wires must be connected to screws	1
	swap the brown and blue wires round		1
total			4

3462/3F Q6

question	answers	extra information	mark
(a)	fossils	answers can be in either order	1
	water		1
(b)	increased		1
(c)	radio telescope		1
total			4

4.1.1.1 Energy stores and systems

3462/3F Q7

question	answers	extra information	mark
(a)(i)	electrical		1
	kinetic	accept movement	1
(ii)	heat	answers can be in either order	1
	sound		1
(b)(i)	360	accept **1** mark for correct substitution	2
(ii)	watt		1
(c)	the stairlift is not moving the stairlift is moving at constant speed	**both** answers are required for the mark	1
total			8

3462/3F Q8

question	answers	extra information	mark
(a)(i)	(up) further **or** (up) faster	any reference to downwards movement loses credit accept <u>with</u> more force accept motion would increase	1
(ii)	down	accept the opposite way accept drop	1
(b)(i)	direct current		1
(ii)	Z		1
total			4

4.1.1.1 Energy stores and systems

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q9

question	answers	extra information	mark
(a)	level of radiation (detected) will not change	ignore reference to particles	1
	if thickness of aluminium changes	accept for **both** marks a specific example eg if the aluminium gets thicker the level of radiation detected stays the same. accept for **1** mark gamma will pass through aluminium	1
	QoWC for 2 points in a sensible sequence		1
(b)	S W T V	all in correct order accept **2** marks for 2 correct accept **1** mark for 1 correct	3
total			6

4.1.1.1 Energy stores and systems

3462/3F Q10

question	answers	extra information	mark
(a)	0.05 (A)	ignore incorrect units if given accept 'the same' / 'the same as K' / 'the same as the other ammeter' do **not** accept 'same as the other meter'	1
(b)(i)	any **two** from: • two cells are joined + to +	answers in terms of current gain no marks accept one cell in the wrong way accept two cells are joined back-to-back accept two cells are joined – to – accept battery for cell do **not** accept answers in terms of all the cells or in terms of energy only	2
	• some of the cells potential difference is across the diode / ammeters / wires **or** the pd of the cells is shared by all components	accept voltage for pd do **not** accept using up pd	
	• the other components have a resistance	accept a named component / components / wire has a resistance	
	• cells not fully charged **or** cells partially run down	do **not** accept voltage of cells is less than 1.5 unless explained do **not** accept cells are not as powerful unless explained	
	• cells have an internal resistance		
(ii)	the diode has a (very) high resistance (in the reverse direction)		1
	a diode only conducts / allows current to flow in one direction	accept little / no current flows do **not** accept blocks / cuts flow	1

Continued

4.1.1.1 Energy stores and systems

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q10

question	answers	extra information	mark
(c)	**QoWC** for the use of the word resistance	annotate Q✓ Q✗ accept resistant	1
	accept increase / change / decrease throughout question but a contradiction loses **one** mark with change as neutral		
	as the pd / current increases / changes	accept voltage for pd must be correctly linked to at least one of the following points accept	1
	the temperature of the filament increases / changes	lamp / bulb for filament accept filament becomes hotter	1
	increasing / changing the **resistance** of the lamp	accept for **1** mark only the filament lamp does not obey Ohm's law	1
total			9

4.1.1.1 Energy stores and systems

3462/3F Q11

question	answers	extra information	mark
(a)	0.5		1
	hertz	accept Hz but **not** HZ / hz / hZ accept (waves) per second **or** / sec **or** / s **or** s^{-1} **or** sec^{-1}	1
(b)	any **one** from: • any named part of the electromagnetic spectrum • S – waves / secondary waves • wave on a rope	 do **not** accept seismic waves / earthquake do **not** accept slinky unless clearly described	1
(c)	transverse – disturbance / vibration is perpendicular to the direction of energy transfer / wave travel	accept a correctly labelled diagram	1
	longitudinal – disturbance / vibration is parallel to the direction of energy transfer / wave travel	accept a correctly labelled diagram part explanation of the difference between transverse **and** longitudinal gains **1** mark	1
(d)(i)	TIR shown	needs to stay inside water jet ignore number of reflections **or** arrow heads lines straight by eye	1
(ii)	bigger than	any indication of correct answer	1
total			7

4.1.1.1 Energy stores and systems

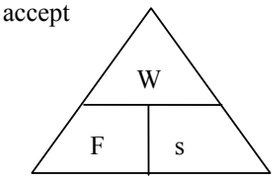
Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q12

question	answers	extra information	mark
(a)	W		1
	has only two states **or** is either on or off	accept discrete values only do **not** credit answer purely in terms of shape	1
(b)	any **one** from:		1
	• higher quality	accept clearer do **not** accept easier to read ignore faster accept <u>less</u> distortion **or** <u>less</u> weakening of signal strength do **not** accept no distortion / weakening on its own	
	• increased carrying capacity	accept more information can be sent **or** more channels	
	• errors can be rectified		
total			3

4.1.1.1 Energy stores and systems

3462/3F Q13

question	answers	extra information	mark
(a)(i)	all points plotted accurately	accept **1** mark for 5 correct plots ± ½ small square on stopping distance	2
	line of best fit must be continuous	accept attempt at a reasonable curve does not need to go through 0 0 do **not** accept a straight line do **not** accept dot-to-dot	1
(ii)	4 to 6 (metres)	accept ecf from (a)(i) accept **1** mark for value taken correctly from graph at 25mph **or** correct method shown	2
(b)(i)	0.7 (s)	incorrect unit = 0 marks	1
(ii)	constant speed / velocity	accept (continued as) 30mph accept did not change / stayed the same accept no acceleration	1
(iii)	3.3(s)	penalise incorrect unit once only	1
(iv)	reaction time increases / is longer **or** thinking distance increases	do **not** accept reaction time slower **or** reactions are slower	1
	stopping distance / it increases	do **not** accept travels at constant speed for longer	1
(c)(i)	work done = force (applied) × distance (moved)	accept W = F × s or W = F × d accept  provided subsequent method is correct	1
(ii)	2100	accept 2.1 kilo accept **1** mark for using 7000 N	2
(iii)	2100 (joules)	accept their (c)(ii)	1
total			14

4.1.1.1 Energy stores and systems

Science: Double Award (Co-ordinated) – AQA GCSE Mark Scheme, 2006 June series

3462/3F Q14

question	answers	extra information	mark
(a)(i)	refraction		1
(ii)	it changes speed **or** change in density	accept it speeds up do **not** accept it slows down do **not** accept air is more dense than glass	1
(b)(i)	sound / waves <u>diffract</u> through the gap (in the wall) **or** over the wall **or** because the gate is open	do **not** accept reflection this only scores if first marking point is given accept for **1** mark only sound / waves go through the gap and <u>spread out</u> **or** diagram showing wave fronts spreading out from open gates if diagram is labelled as diffraction both marks can be scored	1 1
(ii)	less diffraction	accept no diffraction accept gates <u>absorb</u> sound / noise / waves accept gates <u>reflect</u> sound / noise / waves do **not** accept rebounds / stops / blocks out	1
total			5

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science B 4462 / Physics 4451

PHY1H Unit Physics 1

Mark Scheme

2007 examination - June series

4.1.1.1 Energy stores and systems

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Dr Michael Cresswell, Director General.

4.1.1.1 Energy stores and systems

MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.1.1.1 Energy stores and systems

PHY1H Question 1

	answers	extra information	mark
(a)(i)	electromagnetic (wave / radiation)	accept em (wave / radiation) ignore reference to frequency	1
(ii)	gamma can penetrate the crate / box / packaging	accept converse (but must relate to both alpha and beta) ignore just gamma radiation kills bacteria accept can get through to food	1
(iii)	neutrons		1
(b)(i)	absorb gamma / radiation	accept it stops / reduces the radiation	1
(ii)	any **one** from: • slow down the conveyor belt • food does more than one circuit • stay on the conveyor belt longer • food closer to the source / radiation	ignore larger doses / use more of the source ignore thinner packaging	1

Continued on next page

Question 1 continued

	answers	extra information	mark
(c)(i)	idea of testing food on humans / animals		1
	no (measured) ill effects **or** monitor their health	accept monitor people that have eaten the food accept a measurement / comparison for **1** mark eg measure the amount of radiation in treated food comparison plus a reason for the comparison would get **2** marks eg idea of measuring level of radiation in treated food **with** no measurable increase in level = **2** marks **or** comparing it to untreated food = **2** marks	1
(ii)	so can make own decision about eating or not eating treated food	accept may be against their religious / moral views accept some people prefer food that hasn't been tampered with ignore in case they don't like the idea of eating treated food accept don't want to eat treated food ignore might be allergic to the food eg think it will give them cancer = **0** marks think it will give you cancer so I need to know so that I can choose = **1** mark	1
total			8

4.1.1.1 Energy stores and systems

PHY1H Question 2

	answers	extra information	mark
(a)	the outside colour of the cans		1
(b)(i)	18 (°C) **or** 88 to 70	ignore negative sign	1
(ii)	8 (°C) **or** 70 to 62	ignore negative sign	1
(c)	greater temperature difference between water and surroundings (at start)	must mention temperature difference ignore just water hotter accept energy used to heat cans initially	1
(d)	black temperature falls the fastest (in L) black is a good / the best / better emitter (of heat / radiation)	 accept (can L) loses more heat / cools quicker accept heat for temperature accept converse ignore black is best absorber	1 1 1
total			7

4.1.1.1 Energy stores and systems

PHY1H Question 3

	answers	extra information	mark
(a)(i)	national grid		1
(ii)	increases voltage / potential difference	accept decrease current accept step-up / boosts the voltage do **not** accept increases energy / power / current ignore reference to voltage going through	1
(iii)	any **two** from: • reduce current • reduces energy loss / power loss (from cables) • increases efficiency (of distribution)	ignore increased voltage / pd accept reduces heat loss do **not** accept stops energy loss	2
(b)	any **one** from: • produces pollutant gases • produces solid waste / ash / smoke	accept produces carbon dioxide / sulfur dioxide / nitrogen oxides accept global warming / greenhouse effect / carbon emissions / air pollution / acid rain ignore ozone layer do **not** accept carbon monoxide accept global dimming ignore produces pollution	1

Continued on next page

Question 3 continued

	answers	extra information	mark
(c)(i)	any **two** from: • using renewable energy • make non-renewable fuels last longer • non-renewable fuels can be used for other processes • no pollutant gases produced • land can still be used for farming	any two valid points gains the marks accept don't use up non-renewable / fossil fuels accept named fuels accept the opposite of (b) ignore no pollution ignore economic issues	2
(ii)	any **two** from: • cause <u>noise</u> pollution • cause <u>visual</u> pollution • may interfere with TV / radio / mobile phone signals • need to put in new infrastructure • not reliable owtte • dangerous to birds • lots of concrete needed for the bases **or** producing cement is environmentally damaging	 accept spoils the landscape accept sunlight flicker accept new roads needed accept reduces house prices ignore any references to cost / jobs / number required ignore takes up a lot of land accept reference to obstruction of shipping etc. if clear reference to offshore wind farm	2
total			9

4.1.1.1 Energy stores and systems

PHY1H Question 4

	answers	extra information	mark
(a)	wavelength increases	accept the crests are further apart ignore waves are further apart	1
	frequency decreases	accept pitch decreases ignore references to amplitude	1
(b)	stars / galaxies / sources emit all / different types of electromagnetic waves / radiation	accept two or more named electromagnetic waves accept answers in terms of frequencies / wavelengths	1
(c)(i)	wavelength (of light) increases **or** light moves to red end of spectrum	accept frequency decreases accept redder but do **not** accept red alone	1
(ii)	it is the star (detected) <u>furthest</u> from the Earth **or** it is moving <u>away</u> the fast<u>est</u>	accept galaxy for stars ignore reference to universe expanding	1
(d)(i)	all matter compressed to / starts at / comes from a single point	do **not** accept increasing gravitational pull accept everything / the universe for all matter	1
	(massive) <u>explosion</u> sends matter outwards	accept <u>explosion</u> causes universe to expand ignore explosion creates the universe **or** further reference to star / Earth formation	1

Continued on next page

4.1.1.1 Energy stores and systems

Question 4 continued

(ii)	check validity / reliability of the evidence **or** change the theory to match the new evidence	accept comparison of new and old evidence	1
total			8

PHY1H Question 5

	answers	extra information	mark
(a)(i)	a signal that has only two states / only discrete states	accept can only be on or off accept made up of 1 and 0 only accept high and low accept diagram with all amplitudes equal	1
(ii)	400 000 000 **or** correct equivalent	allow **1** mark for correct transformation **and** substitution (of 75) answer 4 000 000 gains **1** mark only	2

Continued on next page

Question 5 continued

	answers	extra information	mark
(b)(i)		any mention of alpha, beta, gamma waves scores **0** marks	
	emit / uses / transmit / receive microwaves	accept radiation for microwaves throughout ignore radio waves	1
	some microwave / energy absorbed by / enters the body	ecf for their given electromagnetic wave do **not** accept goes through the body	1
	raises temperature of (body) cells / tissue / water	accept reference to water molecules vibrating faster accept it could cause mutation / harm / kill cells do **not** accept answers in terms of ionisation ignore references to cancer	1
(ii)	any **two** from: • research (may be) biased **or** may have been misled in the past • some research suggests a link • long-term effect not proven / studied • residents may not have seen the research	accept not independent **or** may be lying accept not studied for long enough	2
total			8

4.1.1.1 Energy stores and systems

PHY1H Question 6

	answers	extra information	mark
(a)	four calculations correctly shown	200 × 10 – 1800 = £200 100 × 10 – 2400 = –£1400 50 × 10 – 600 = –£100 20 × 10 – 75 = 125 accept four final answers only **or** obvious rejection of solar water heater and underfloor heating, with other two calculations completed any 1 complete calculation correctly shown **or** showing each saving × 10 of all four calculations = **1** mark answers in terms of savings as a percentage of installation cost **may** score savings mark only	2
	hot water boiler	correct answers only	1
(b)	less electricity / energy to be generated / needed from power stations	accept less demand	1
	reduction in (fossil) fuels being burnt	accept correctly named fuel accept answer in terms of: fewer light bulbs required because they last longer (1 mark) less energy used / fuels burnt in production / transport etc. (1 mark) ignore reference to CO_2 or global warming ignore reference to conservation of energy	1
total			5

AQA

GCSE

Science A / Physics

PH1HP

Mark scheme

4405/4403
June 2015

Version/Stage: 1.0 Final

4.1.1.1 Energy stores and systems

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

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Mark Scheme

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.1 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.2 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.3 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.4 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.5 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.6 Brackets

(.....) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.2 Ignore / Insufficient / Do not allow

Ignore of insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

4. Quality of Communication and levels marking

In Question **2a** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear
- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed
- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar

4.1.1.1 Energy stores and systems

Question	Answers	Extra information	Mark	AO / Spec. ref.
1(a)	chemical kinetic sound	correct order only	1 1 1	AO1 P1.2.1a
1(b)	37.5% or 0.375	an answer rounded to 0.38 or 38% scores both marks an answer of 0.375 with a unit gains **1** mark an answer of 0.375% gains **1** mark an answer of 37.5 with or without a unit gains **1** mark allow **1** mark for an answer 3/8 3/8 with a unit scores 0	2	AO2 P1.2.1d
Total			**5**	

4.1.1.1 Energy stores and systems

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
2 (a)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 4 and apply a 'best-fit' approach to the marking.		6	AO2 AO3 P1.2 HSW	E

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant information	There is a relevant statement about an energy saving method	There is at least one clear comparison of energy saving methods and their cost effectiveness with an appropriate calculation	There is a comparison of energy saving methods and their cost effectiveness with appropriate calculations. Comparison to include further detail.

examples of physics points made in the response	extra information
examples of relevant statements • energy efficient boiler saves the most (energy / money) per year • loft insulation costs the least to install • double-glazing costs the most to install **examples of statements that include cost effectiveness** • loft insulation is the most cost effective in the long term • double-glazing is the least cost effective • loft insulation has the shortest payback time • double-glazing has the longest payback time • payback time calculated for any method **examples of further detail** • for cost effectiveness install in the following order: loft, cavity wall, boiler, double-glazing • for reducing energy use install in the following order: boiler, loft, cavity wall, double glazing • don't install double-glazing for insulation purposes • double-glazing won't pay for itself in your lifetime • justified choice of best / worst method	payback times: energy efficient boiler: 6.25 years loft insulation: 2 years double glazing: 100 years cavity wall insulation: 2.86 years

Question 2 continued . . .

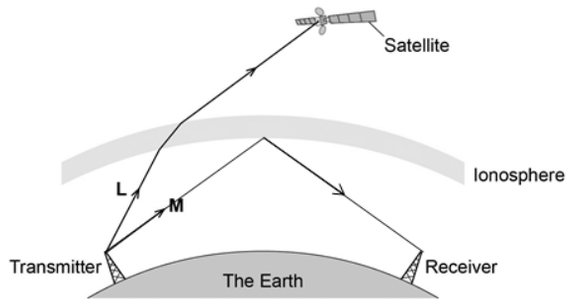
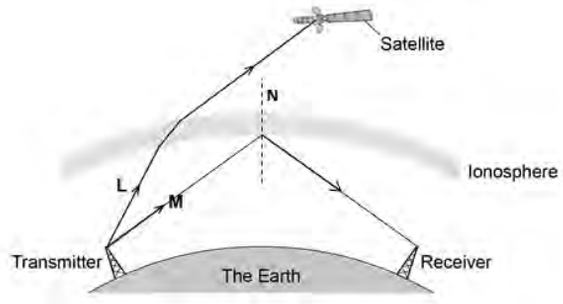
Question	Answers	Extra information	Mark	AO / Spec. ref.
2(b)(i)	how effective a material is as an insulator	accept 'heat' for energy accept how effective a material is at keeping energy in accept the lower the U-value the better the insulator accept the lower the U-value the lower the rate of energy transfer	1	AO1 P1.1.4a
2(b)(ii)	(the U-value) decreases		1	AO1 P1.1.4b
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. ref.
3(a)(i)	0.5 °C		1	AO3 P1.1
3(a)(ii)	data is continuous **or** both variables are continuous **or** independent variable is continuous **or** time is continuous	accept results / measurements for data accept data is not categoric one variable is continuous is insufficient air temperature is continuous is insufficient	1	AO3 P1.1
3(b)(i)	20.5 (°C)		1	AO2 P1.1
3(b)(ii)	60 (minutes)	accept 1 hour	1	AO2 P1.1
3(c)(i)	so a comparison can be made **or** outside temperature is a control variable	accept: (outside) temperature would affect energy required (to maintain temperature of the house) **or** (outside) temperature would affect internal temperature (of the house) **or** heat loss will be faster on a cold day outside temperature will affect the results is insufficient fair test is insufficient	1	AO3 P1.1

Question 3 continues on the next page . . .

4.1.1.1 Energy stores and systems

Question	Answers	Extra information	Mark	AO / Spec. ref.
3(c)(ii)	the cost is equal to the number of kWh x the cost per kWh calculation 0.8 / 8.0 = 0.1 or 10%	accept (heating) bill depends on (number of) kWh used accept energy for kWh allow 7.2 / 8.0 = 0.9 or 90%	1 1	AO3 AO2 P1.1
3(c)(iii)	heating is on for more / less time (than anticipated) because some days it is cooler / warmer (than anticipated)	 accept other sensible suggestions an answer giving two sensible situations gains **2** marks possible examples: • some houses have different amounts of insulation • there are different styles of house temperature (inside / outside) is always changing is insufficient	1 1	AO3 P1.1
Total			**9**	

Question	Answers	Extra information	Mark	AO / Spec. ref.
4(a)(i)	microwave		1	AO1 P1.5.1k
4(a)(ii)	refraction		1	AO1 P1.5.1g
4(b)(i)	wave M continues as a straight line to the ionosphere and shown reflected correctly reflected wave shown as a straight line reaching the top of the receiver  	accept reflection at or within the ionosphere if more than 2 rays shown 1 mark maximum ignore arrows	1 1	AO2 P1.5.2b
4(b)(ii)	normal drawn at point where their **M** meets the ionosphere  		1	AO1 P1.5.2a

Question 4 continues on the next page. . .

Question 4 continued…

Question	Answers	Extra information	Mark	AO / Spec. ref.
4(c)	any **two** from: • transverse • same speed (through air) • can be reflected • can be refracted • can be diffracted • can be absorbed • transfer energy • can travel through a vacuum • can be polarised • show interference	accept speed of light **or** 3×10^8 m/s an answer travel at the same speed though a vacuum scores **2** marks travel in straight lines is insufficient	2	AO1 P1.5.1a,bc, d,g
Total			**7**	

Question	Answers	Extra information	Mark	AO / Spec. ref.
5(a)(i)	infrared (radiation)	accept IR (radiation)	1	AO1 P1.1.1b
5(a)(ii)	(heated) water turns to steam	ignore reference to fossil fuels do **not** accept water evaporates to steam	1	AO1 P1.4.1a
	steam turns a turbine		1	
	turbine turns a generator	accept turbine connected to a generator	1	
5(b)(i)	(so the molten salts) can store large amounts of energy	accept there is a small temperature change for a large energy transfer accept heat for energy	1	AO2 P1.1.4d
5(b)(ii)	16 (hours)	an answer that rounds to 16 gains **2** marks eg 15.71 allow **1** mark for a correct substitution ie 2 200 000 = 140 000 x t	3	AO2 AO1 P1.3.1c
5(b)(iii)	the number of daylight hours varies	less sunlight is insufficient	1	AO2 AO3 P1.4
	the (mean) power (received from the Sun per square metre) varies	accept an answer in terms of maximum possible electrical output only possible during Summer for **1** mark	1	

Question 5 continues on the next page . . .

Question 5 continued . . .

Question	Answers	Extra information	Mark	AO / Spec. ref.
5(c)(i)	non-renewable power stations have higher Capacity Factors than renewable power stations		1	AO1 AO3 P1.4
	fuel (for non-renewable power stations) is always available	reference to non-renewable power stations operating all the time is insufficient non-renewable energy sources are reliable is insufficient	1	
	(most) renewable energy sources are unpredictable / unreliable	accept (most) renewable energy sources depend on the weather	1	
5(c)(ii)	the (proportion of) time that solar storage power stations can generate electricity is greater (than for other renewable energy sources)		1	AO1 P1.4
Total			**14**	

4.1.1.1 Energy stores and systems

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP – JUNE 2015

Question	Answers	Extra information	Mark	AO/Spec ref.
6(a)	Doppler (effect)		1	AO1 P1.5.4a
6(b)	(reflected microwaves) wavelength decreased (reflected microwaves) frequency increased (reflected microwaves) have same speed		1 1 1	AO1 P1.5.4a P1.5.1d
Total			4	

Question	Answers	Extra information	Mark	AO / Spec. ref.
7(a)	4200	allow **2** marks for correct substitution ie 6930 = 0.330 x c x 5.0 answers of 1050 **or** 840 **or** correctly calculated answer from correct substitution of incorrect temperature change **or** identification of temperature change ie 5 ˚C gain **1** mark	3	AO2 AO1 P1.1.4d
	J/kg˚C	accept J/kg K	1	
7(b)	(in a metal) free electrons	to gain full credit the answer must be in terms of free electrons	1	AO1 P1.1.3a
	gain kinetic energy	accept move faster	1	
	(free electrons) transfer energy to other electrons / ions / atoms	do **not** accept particles	1	
	by collision		1	
		allow a maximum of **2** marks for answers in terms of atoms / ions / particles • gaining kinetic energy or vibrating faster / more • transferring energy by collisions		
7(c)	(air) particles spread out		1	AO1 P1.1.3a
	(which causes the) air to become less dense / expand	do **not** accept particles become less dense	1	
	(so the) warm air rises	do **not** accept heat rises particles rise is insufficient	1	
7(d)	large surface area	ignore references to type of metal or external conditions	1	AO1 P1.1.3c
	black / dark (colour)		1	
Total			**13**	

4.1.1.1 Energy stores and systems

AQA

GCSE

Science A / Physics

PH1HP

Mark scheme

4405/4403
June 2016

Version 1.0: Final Mark Scheme

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PMT

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

Mark Scheme

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

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In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of errors / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

PMT

MARK SCHEME – GCSE SCIENCE A / PHYSICS – PH1HP– JUNE 2016

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown.

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(.....) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Accept / allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore / Insufficient / Do not allow

Ignore of insufficient is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

4. Quality of Communication and levels marking

In Question **2(b)** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear
- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed
- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

4.1.1.1 Energy stores and systems

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)	frequency		1	AO1 1.5.3b
1(b)	echo(es)		1	AO1 1.5.3c
1(c)	spreading (out) equal to	changing direction is insufficient moving apart is insufficient bending is insufficient accept: similar to same (order of magnitude) as slightly smaller than slightly larger than	1 1	AO1 1.5.1g
1(d)	340 (m/s)	allow **1** mark for correct substitution ie 25 000 x 0.0136 provided no subsequent step **or** allow **1** mark for a correct calculation showing an incorrect value from conversion to hertz x 0.0136 an answer of 0.34 gains **1** mark	2	AO2 1.5.1j
1(e)	(a wave where the) oscillations are parallel to the direction of energy transfer causing (areas of) compression and rarefaction	both marking points may appear as labels on a diagram accept vibrations for oscillations accept in same direction as for parallel to allow direction of wave (motion) for direction of energy transfer accept correct description in terms of particles mechanical wave is insufficient needs a medium to travel through is insufficient	 1 1	AO1 1.5.1b
Total			**8**	

4.1.1.1 Energy stores and systems

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)	any **one** from: • high cost of installing overhead power lines or underground cables or pylons • high cost as (very) long cables needed • amount of electricity required is too low	allow not enough (surplus) electricity would be generated	1	AO1 1.4.1e

Question 2 continues on the next page . . .

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(b)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.		6	3 AO1 2 AO2 1 AO3 1.4.1b

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant information	at least **one** advantage **or one** disadvantage of either method	at least **one** advantage **and one** disadvantage is stated for **one** method **and** a different advantage **or** disadvantage is stated for the other method	clear comparison of advantages **and** disadvantages of **each** method

examples of physics points made in the response	extra information
Advantages of both methods:	
• both renewable sources of energy	
• both have no fuel (cost)	accept carbon neutral
• both have very small (allow 'no') running costs	accept no greenhouse gases
• no carbon dioxide produced	accept doesn't contribute to global warming
Advantages of wind:	
• higher average power output	produces more energy is insufficient
Advantages of hydroelectric:	
• constant / reliable power (output)	
• lower (installation) cost	
Disadvantages of wind:	
• higher (installation) cost	
• variable / unreliable power output	
• (may) kill birds / bats	
Disadvantages of hydroelectric:	
• lower power output	
• (may) kill fish or (may) damage habitats	
• more difficult to set up (within river)	
Disadvantages of both methods	
• (may be) noisy	
• visual pollution	ignore payback time unless no other relevant points made ignore time to build for both

Total			7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)	a proportion / percentage of the energy is wasted	allow heat for energy allow some energy is wasted	1	AO2 1.2.1b 1.2.1c
	(wasted) energy is transferred to surroundings **or** energy is needed to heat pan (before food is heated)		1	
3(b)	(fins have a) large(r) surface area	accept fins increase the surface area	1	AO1 1.1.1c 1.1.1e 1.1.3c
	(black metal surface is a) good / better absorber of infrared radiation	allow 'heat' or 'energy' for infrared radiation ignore good emitter of infrared radiation not a good reflector is insufficient	1	
3(c)	the higher the temperature (of the saucepan) the greater the rate at which infrared radiation is emitted	accept converse answer allow the higher the temperature the more infrared radiation is emitted allow there is a positive correlation	1	AO2 1.1.1b
Total			**5**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)(i)	**use of infrared:** remote controls fibre optic (communications) **use of microwaves:** mobile/cell phones satellite (communications/TV) wi-fi Bluetooth	 accept mobiles accept phone signals	1 1	AO1 1.5.1k
4(a)(ii)	any **two** from • same speed **or** travel at the speed of light (in a vacuum) • transverse • transfer energy (from one place to another) • can be reflected • can be refracted • can be diffracted • can be absorbed / transmitted • can travel through a vacuum/space • can be polarised	 accept a full description of a transverse wave travels in straight lines is insufficient	2	AO1 1.5.1c 1.5.1d 1.5.1e 1.5.1g
4(b)(i)	Cosmic Microwave Background (Radiation)	accept CMBR	1	AO1 1.5.4d
4(b)(ii)	 the Big Bang (theory) predicted the existence of CMBR **or** only the Big Bang (theory) supports the existence of CMBR	allow microwave radiation for CMBR throughout allow it supports / proves the Big Bang (theory) accept CMBR disproved other theories, eg steady state	 1	AO1 1.5.4e
Total			**6**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	no particles (in a vacuum) (so) no / reduced conduction and no / reduced convection	 both energy transfer methods needed for the mark	1 1	AO1 1.1.3a
5(b)(i)	78 (°C)	allow **2** marks for correct temperature change ie 22 ˚C allow **1** mark for correct substitution ie 46 200 = 0.5 x 4200 x θ **or** $\frac{46200}{0.5\times4200}=\theta$	3	AO2 1.1.4d
5(b)(ii)	6.4 (W)	allow **2** marks for an answer that rounds to 6.4 allow **1** mark for correct substitution ie 46 200 = P x 7200 an answer of 23 000 or 23 100 or 385 gains 1 mark	2	AO2 1.3.1c
Total			**7**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	any **two** from: • cost per kWh is lower (than all other energy resources) • infrastructure for nuclear power already exists • more reliable (than renewable energy resources)	allow it is cheaper ignore fuel cost ignore energy released per kg of nuclear fuel accept cost of setting up renewable energy resources is high accept many renewable power stations would be needed to replace one nuclear power station accept (France in 2011 already had a) surplus of nuclear energy, so less need to develop more renewable capacity for increased demand in the future accept France benefits economically from selling electricity accept (nuclear) fuel is readily available ignore destruction of habitats for renewables	2	AO1 AO2 1.4
6(b)	any **two** from: • non-renewable • high decommissioning costs • produces radioactive / nuclear waste • long start-up time • nuclear accidents have widespread implications	allow nuclear fuel is running out accept high commissioning costs allow waste has a long half-life allow for nuclear accident a named nuclear accident eg Fukushima, Chernobyl ignore visual pollution	2	AO1 1.4.1f

Question 6 continues on the next page . . .

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(c)	0.48 (kW)	allow **1** mark for correct substitution ie 0.15 = P / 3.2 an answer of 480 W gains **2** marks an answer of 48 or 480 scores **1** mark	2	AO2 1.2.1d
6(d)	the higher the efficiency, the higher the cost (per m^2 to manufacture)	accept a specific numerical example	1	AO2 AO3 1.4.1c
	more electricity could be generated for the same (manufacturing) cost using lower efficiency solar panels **or** (reducing the cost) allows more solar panels to be bought	accept a specific numerical example	1	
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	surface area **or** duration of experiment	accept shape of beaker size of beaker is insufficient	1	AO3 1.1.3b
7(b)	any **two** from: • takes readings automatically • takes readings more frequently • reduces / no instrument reading error • higher resolution • don't need to remove probe to take reading • more accurate	ignore easier **or** takes readings for you ignore human error allow better resolution	2	AO3 1.1.3
7(c)(i)	0.07 (°C/s)	allow **1** mark for obtaining a temperature drop of 7(ºC) allow **1** mark for an answer between 0.068 and 0.069 (°C/s)	2	AO2 1.1.3d
7(c)(ii)	rate of temperature change is greater at the start **or** rate of temperature change decreases	accept rate of evaporation is greater at the start allow rate of evaporation decreases allow temperature decreases faster at the start	1	AO3 1.1.3b

Question 7 continues on the next page . . .

4.1.1.1 Energy stores and systems

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(c)(iii)	A lower temperature decrease (over 200 seconds)	reason only scores if A is chosen accept lower gradient	 1	AO3 1.1.3b
7(c)(iv)	no effect (as rate of evaporation is unchanged)	allow larger temperature change (per second as mass of liquid is lower)	1	AO3 1.1.3b
7(d)	particles with more energy leave the (surface of the) liquid (which) reduces the average (kinetic) energy (of the remaining particles)	accept particles with higher speeds allow reference to the total energy of the liquid reducing	1 1 1	AO1 1.1.3b
Total			**11**	

4.1.1.1 Energy stores and systems

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(a)	any **two** factors: • surface area (of mug in contact with cup warmer) • thickness of mug • temperature of heater / coffee • power of the heater	 accept temperature difference (between heater and coffee) accept power of the laptop ignore efficiency of the heater	2	AO3 1.1.3c
8(b)	 atoms (gain kinetic energy and) vibrate faster / more energy is passed on from atom to atom by collision	allow particles / molecules for atoms allow bigger / faster vibrations do not accept start to vibrate accept vibrations for energy an answer in terms of free electrons scores zero	 1 1	AO1 1.1.3a
8(c)	 the particles spread out (so) coffee becomes less dense (so) the heated coffee rises (and) cooler / denser coffee falls	allow fluid / liquid / water for coffee throughout answer allow particles move further apart allow (coffee) expands particles rise is insufficient particles fall is insufficient	 1 1 1 1	AO1 1.1.3a
Total			8	

Answer 94 · Examiner comments
June 2018 | 8463/2H | Original Q1

Question 1 (Standard demand)

01.1 Most of the students realised that the falling ball was accelerating or speeding up, but few wrote that the ball was accelerating at a constant rate. Some students did try to explain this, however they were often unable to express this uniform acceleration clearly. Phrases such as “accelerating at a constant speed” were common and did not score any marks.

01.2 Just over 70% of the students understood that the ball would be moving upwards.

01.3 Most of the students understood what is meant by ‘a system’ with nearly 90% choosing the correct answer.

01.4 Only about half of the students realised that the velocity of the ball was reduced after the bounce or that the ball would not reach the height it was dropped from. If this was written it was generally followed by a statement that repeated the stem of the question; the energy was transferred to the ground. Those students that did state that energy was lost from the ball did often refer to this as kinetic energy. Students often stated that as the velocity became more and more negative, the ball was continuing to slow down.

Answer 99 · Examiner comments
June 2019 | 8463/2H | Original Q10

Question 10 (Standard/high and high demand)

10.1 There were a number of good answers here, though some students referred to momentum instead of moment, or work done = force × distance. A few students wrote about the distance between the rope and the spring (or the ramp) instead of the pivot.

10.2 Almost a third of the students scored all 6 marks and showed their working in a clear and logical sequence. Where students did not score all 6 marks, the equation for elastic potential energy was often correctly selected, but they did not appear to know how to use the other quantities given to find the spring constant correctly. Most students were able to use the moment and distance to calculate the force.

4.1.1.1 Energy stores and systems

Answer 99 · Examiner comments

June 2019 | 8463/2H | Original Q10

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

Question 3 (Standard demand)

03.1 91% of students answered this question correctly. The equation was acceptable using symbols or words. Students should be encouraged not to give multiple answers due to the list principle being applied: right + wrong = 0 marks. eg ρ = m/V and m = ρ /V would score zero.

03.2 78% of students scored 4 marks. Most students who knew the equation were able to perform the calculation correctly. A significant number made transcription errors, eg putting the density as 988 kg / m^3 instead of 998 or adding / subtracting a 0 to the given volume. The majority of students were able to express their answer in standard form, even if their calculation was incorrect,.

03.3 85% of students answered this question correctly. The equation was acceptable using symbols or words. Students should be encouraged not to give multiple answers due to the list principle being applied: right + wrong = 0 marks. eg E = Pt and P = t/E would score zero.

03.4 59% of students scored 3 marks. Some students struggled to convert 5 hours into seconds, converting it into minutes instead. A correct calculation using minutes instead of seconds would score 2 marks.

03.5 Only 4% of students scored 2 marks, while 43% of students scored 1 mark. Many students failed to realise that they needed to take data from the graph and compare it with the stated output from the hydroelectric power station. Instead, they gave explanations in terms of people using more energy during the day and / or weather conditions affecting the supply of water. In many cases, despite the diagram showing the power station with a brief explanation of how it works, students referred to unreliable waves and wind, or varying tides. Of the students who took information from the graph, the most common answer was comparing the times involved. Although some students compared the peak demand with the power station output, not many referred to the increase in the demand, which was the relevant point.

4.1.1.1 Energy stores and systems

Answer 101 · Examiner comments

November 2020 | 8463/1H | Original Q6

Question 6 (Standard/High demand)

06.1 This question proved more challenging than expected with only 30% of students identifying two measurements and 51% of students identifying one.

06.2 73% of students scored all 4 marks for this question. A common mistake was not to convert the energy into J. This meant that the mass of the boy was much lower than the expected value (0.05 kg). Weaker students then rearranged the equation incorrectly to get a more believable answer, a common response was 20 kg ((17 x 9.8) / 8.33). Another common calculation error was to divide 8330 by 9.8 then multiply by 17.0 resulting in a mass of 1445 kg, which apparently didn't strike students as being a high value for the mass of a boy.

06.3 Very few students scored 3 or 4 marks for this question. Since the acceleration down the slide is unlikely to be uniform due to the changing gradient this question could not be answered by consideration of equations of uniform acceleration, therefore an approach using energy transfers was the only appropriate answer. A discussion involving terminal velocity didn't score as the slide height is not sufficiently high for terminal velocity to be reached. The first marking point was the most likely to be scored by students. 25% of students scored 1 mark, while 67% of students scored zero.

4.1.1.1 Energy stores and systems

Answer 102 · Examiner comments November 2020 | 8463/1H | Original Q7

Question 7 (High demand)

07.1 31% of students answered this question correctly. 'Takes time for electrical energy store to transfer to thermal energy store' was a common answer but insufficient. 'The charge flow takes time' or 'the current is slow to start with' were also insufficient. 'Water has a high specific heat capacity' was also insufficient.

07.2 49% of students scored all 5 marks, while 22% of students scored 4 marks for this calculation. A common answer was 0.37 using the temperature change of 100 °C. This answer would score 4 marks for an incorrect temperature change. An answer given to 2 s.f. scored 1 mark as long as students had used the values in the question to calculate something. At grade 6-7, students are expected to be able to convert units and rearrange equations.

07.3 Very few students scored 2 or 3 marks on this question, 10% of students scored 1 mark. Weaker students misunderstood which straight section the question referred to thinking it was the horizontal section. Only the highest-scoring students understood that the rate of temperature increase (from the gradient of the diagonal line) could be used in conjunction with the equations for specific heat capacity and $E = Pt$ to calculate useful power output. A lot of students thought that the efficiency equation could be used, but usually failed to score any marks.

Answer 103 · Examiner comments November 2021 | 8463/1H | Original Q1

Question 1 (Common Question)
Very few students answered **01.1** correctly, but students were much more successful with equation recall and the subsequent calculations that followed, with around 80% answering **01.2** and **01.3** correctly and over 90% answering **01.4** and **01.5** correctly.

Answer 104 · Examiner comments November 2021 | 8463/1H | Original Q5

Question 5
Calculations in question **05** were well answered, but students often failed to convert units, converted units incorrectly or made 'power of ten' errors, so did not gain full marks. Students found **05.4** difficult with almost no students scoring 2 marks and only 25% of students scoring 1 mark.

Answer 105 · Examiner comments November 2021 | 8463/1H | Original Q8

Question 8
This question was well attempted, with the multistep calculation in **08.2** discriminating well between students. Many students calculated the change in gravitational potential energy but couldn't take the next step in the calculation, so scored 2 marks only.

4.1.1.1 Energy stores and systems

Answer 106 · Examiner comments

November 2021 | 8463/1H | Original Q11

Question 11

Question **11.1** was answered poorly, with many students mixing up specific heat capacity and specific latent heat in their answers, and referring to incorrect parts of the graph. Around a third of students scored a mark on **11.2** and **11.3**. Question **11.4** discriminated well with a good spread of marks. The unit conversion was often performed incorrectly, which led to a 'power of ten' error and prevented students gaining a mark. Few students gave the correct unit, even though the equation needed is on the equations sheet.

Concluding Remarks

This paper was broadly similar to papers from previous series. The errors that students made in calculations were common errors, usually involving incorrect unit conversions or failing to convert units.

An area of the specification that stood out as being particularly poorly answered was section 4.2 which was tested in the Required Practical Activity in question 3 and again in question 10.

Most of the students understand the importance of showing clear working out when completing a calculation. This is crucial in the more complex calculations.

Similar to previous series, a significant number of the students were unable to read values from graphs accurately and failed to realise when numerical values were not given in standard SI units.

4.1.1.1 Energy stores and systems

Answer 106 · Examiner comments

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.1.1.1 Energy stores and systems

Answer 107 · Examiner comments November 2021 | 8463/2H | Original Q2

Question 2 (Common Question)
Students seemed unfamiliar with the term 'elastically deformed' and in **02.1** described an object that was 'inelastically deformed'. When describing a method to obtain given results, students must include what measuring instruments are used, how each quantity is obtained and the interval and range of the given results. Most of the students understood the term 'risk assessment'. Answers to part **02.5** that simply stated 'positive correlation' or 'extension increases with force' were insufficient to gain credit. A minority of the students gave a very succinct answer worth two marks. In part **02.6** the most common errors were a failure to convert 20 cm to metres or failing to square the extension.

Answer 110 · Examiner comments June 2022 | 8463/1H | Original Q11

Question 11

Due to incorrect Advance Information guidance being issued for this question, and to avoid students being disadvantaged, Question 11 was discounted and all students were awarded full (9) marks.

Levels of demand

Questions are set at three levels of demand for this paper:

- **Standard demand** questions are designed to broadly target grades 4–5.
- **Standard/high demand** questions are designed to broadly target grades 6–7.
- **High demand** questions are designed to broadly target grades 8–9.

A student's final grade, however, is based on their attainment across the qualification as a whole, not just on questions that may have been targeted at the level at which they are working.

Answer 110 · Examiner comments

Question 1 (Standard demand)

01.1 About 55% of students scored 2 marks. The unit conversion caused a problem for many students and powers of 10 errors were frequently seen. A correct calculation using an incorrectly or not converted value for power would score 1 mark.

01.2 Students were generally successful at answering this question with approximately 40% scoring 2 marks and about 50% scoring 1 mark. Most students wrote variations of the first and third bullet points in the markscheme. A number of students wrote that the turbines may be broken, which was enough to score a mark for the idea of maintenance.

01.3 'Turbine will rotate faster' was insufficient to score a mark. 'Rotate more smoothly' was not enough to score the 'less friction' mark. Students who stated that 'no energy was wasted' did not score the second marking point. Approximately 35% of students scored 3 marks, 35% of students scored 2 marks and 20% of students scored 1 mark.

01.4 About 30% of students scored 2 marks, while approximately 50% of students scored 1 mark. Many students answered in terms of 'saving energy' which was insufficient. Other students answered in terms of absolute statements which did not score, 'energy efficient appliances waste no energy' for example.

Question 2 (Standard demand)

02.1 Generally very well answered with about 35% of students gaining 6 marks and 25% scoring 5 marks. Students were told that this required practical would appear in the 2022 series via the Advance Information. A number of students quoted the density equation incorrectly, although this was given on the Equations Sheet for the 2022 series. There were extremely few students who didn't attempt the question and less than 1% of students who attempted the question scored zero.

02.2 Approximately 85% of students answered this question correctly. Of the incorrect answers seen, a significant proportion gave the maximum and minimum values the wrong way round. Another common mistake was to write maximum: 2.55 and minimum 0.10, which showed a clear misunderstanding of expressing an uncertainty.

02.3 About 95% of students answered this question correctly.

02.4 Approximately 45% of students scored 2 marks and 40% scored 1 mark. 'In case an error / mistake was made the first time' was insufficient. 'To check the repeatability of the data' was ignored, as this wouldn't improve the accuracy of the data. 'Get rid of anomalies' was assumed to mean 'remove anomalies', but 'stops anomalies from occurring' did not score. Likewise 'stops random errors' did not score.

Question 3 (Standard demand)

03.1 Over 99% of students answered this question correctly as they had all the Physics equations on the Equations Sheet for the 2022 series.

03.2 Nearly 95% of students answered this question correctly. In this series all students were given all the equations on the Equations Sheet. The first mark is for the substitution into the equation as it appears on the equations sheet. Some students failed to score any marks by incorrectly rearranging the equation, then substituting into the incorrectly rearranged equation.

03.3 Over 99% of students answered this question correctly as they had all the Physics equations on the Equations Sheet for the 2022 series.

03.4 95% of students answered this question correctly. In this series all students were given all the equations on the Equations Sheet. The first mark is for the substitution into the equation as it appears on the Equations Sheet. Some students failed to score any marks by incorrectly rearranging the equation, then substituting into the incorrectly rearranged equation.

Question 4 (Standard/High demand)

04.1 A large number of students found it difficult to identify the independent and dependent variables in the investigation that was described. Control variables appeared often in students' answers. 'Temperature change' seemed to be the most common incorrect answer for the dependent variable. About 50% of students scored 2 marks and approximately 35% of students scored 1 mark.

04.2 65% of students answered correctly. The most common incorrect answer was 87.4 °C.

04.3 About 35% of students answered this question correctly. Common incorrect answers referred to the resolution, or just repeated the question and said 'difficult to read' which was insufficient.

04.4 Approximately 75% of students scored 3 marks and about 10% of students scored 2 marks. Power of 10 errors were common and usually resulted in 2 marks being scored for an incorrectly or not converted value of energy.

04.5 Many students found relating the time for the temperature to decrease to thermal conductivity difficult. About 15% of students scored 2 marks, while 40% scored 1 mark. Answers in terms of good / bad insulators were insufficient to score a mark.

Question 5 (Standard/High demand)

05.1 Approximately 45% of students scored 1 mark, with about 5% of students scored 3 marks. Around 30% of students scored no marks. The first marking point of this explanation was most likely to score, the third marking point was least likely to score.

05.2 About 30% of students scored all 3 marks for this explanation. 10% of students scored 2 marks and 10% scored 1 mark. A lot of student answers were not creditworthy, with mixed up descriptions of ion transfer, electron transfer, proton transfer, protons weighing more than electrons and transfer of electrons increasing the mass of the rod on the balance. As a result about 50% of students scored zero.

05.3 Approximately 60% of students scored the mark. Some students evidently did not know what a zero error was. Answers like 'it means there is no error' being a good example of this. Some answers were insufficient, 'the actual mass of the rod is not required' being not enough to score the mark. 'Weight' was allowed for 'mass' when used correctly as the reading on the balance does depend on the weight of the object. An answer of 'only the change in weight was needed' would have scored the mark.

05.4 Some very good explanations were seen and about 10% of students scored all 3 marks. The first marking point was least likely to score. The third marking point needed to be linked to the second marking point before it could be scored.

Question 6 (Standard/High demand)

06.1 This question discriminated well between students. About 15% scored 4 marks with 20% gaining 3 marks. The first two marking points were most commonly scored. Students who said that 'no energy was lost' as a consequence of the step-up transformer's effect did not score the third marking point.

06.2 Approximately 55% of students scored 2 marks, while 15% of students scored 1 mark. Students who scored no marks usually confused the quantity that was decreased (pd) with the quantity that increased (current). Some student answers lacked technical accuracy referring to energy, power or charge incorrectly.

06.3 Two thirds of students scored 4 marks for this calculation, whereas about 20% of students scored 3 marks. A common mistake was to try to multiply the answer by the number of seconds in a day, which would probably only score the significant figure mark if correct, as the Physics equations were applied incorrectly.
Common mistakes were to round the answer to 1 400 000 000 C, which would score 3 marks if the full s.f. answer was seen, or round the answer to 141, which would score 3 marks for the supporting calculations if seen. A common error was to miscount the number of zeroes, so would only score 3 marks.

Answer 110 · Examiner comments

June 2022 | 8463/1H | Original Q11

Question 7 (Standard/High demand)

07.1 54% of students could state what an alpha particle consists of. The list principle was applied when students wrote '2 protons and 2 neutrons – a helium atom', which did not score.

07.2 65% of students completed the nuclear equation correctly, scoring 2 marks, whereas 24% scored just 1 mark.

07.3 Students generally made good attempts to answer this question and marking points 1, 2 and 4 were seen most often. To score the 5th marking point students need to make a comparative statement, internal versus external damage. The third marking point was least likely to score, as students rarely referred to dose or the living cells / tissues / organs inside the body. Some students incorrectly thought that ionisation was a process that happened to cells, rather than atoms, so often didn't score the fifth marking point for this reason. Very few students scored 5 marks and the question discriminated well between students of differing ability.

Question 8 (Standard/High demand)

08.1 About 90% of students gave the correct measuring instrument. While it wasn't seen often, an answer of a 'volumetric pipette' was also creditworthy. 'Pipette' was insufficient.

08.2 Around 90% of students correctly identified the hazard in the investigation.

08.3 For this calculation, about 45% of students scored 5 marks and 20% of students scored 4 marks. A common mistake was to calculate *L* using one of the masses given in the question, rather than the change in mass. The resulting numerical answer would score zero as the equation was not being used correctly.

08.4 About 15% of students scored 2 marks for this explanation and 10% of students scored 1 mark. Many students reached incorrect conclusions and many students simply reworded the information given in the question.

08.5 7% of students scored 2 marks and 3% of students scored 1 mark. Many students reached incorrect conclusions and many students reworded the information given in the question without adding to it.

Question 9 (High demand)

09.1 Approximately 55% of students scored 5 marks, but in the 2022 series students were provided with an Equations Sheet with all the equations. A commonly seen answer was 73 500, which scored 4 marks for not converting the height into metres.

09.2 5% scored 2 marks and about 30% scored 1 mark. Many students failed to score a mark by pointing to the 'inaccuracy of the measured mass / height / gravitational field strength', or referring to the measurements as being 'low resolution'. 'Mass may have been greater than 60 kg' or 'time may have been longer / shorter than 1.40 seconds' were other common incorrect answers.

09.3 About 75% of students identified the correct conclusion.

Question 10 (High demand)

10.1 About 45% of students scored 6 marks for this extended calculation, but in the 2022 series students were provided with an Equations Sheet with all the equations. Therefore, students were supported when it came to attempting this question. With an alternative approach using equations from paper 2, students' answers were marked on whichever approach brought them closest to the correct final answer. An answer of 6 m/s with no supporting working did not score full marks as students could achieve this answer by multiplying the spring constant and the extension together, which would give them the maximum force acting on the toy aeroplane.

10.2 About 65% of students scored the mark. The most common incorrect answers seen were gravitational potential or elastic potential.

10.3 Approximately 20% of students scored a mark. Many students failed to score a mark because they gave a factor without a specific change e.g. 'extension of spring', rather than 'increase the extension of the spring'.

Question 11 (High demand)

Due to incorrect Advance Information guidance being issued for this question, and to avoid students being disadvantaged, Question 11 was discounted and all students were awarded full (9) marks.

4.1.1.1 Energy stores and systems

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account of how students have performed for each question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.1.1.1 Energy stores and systems

Answer 112 · Examiner comments — June 2023 | 8463/1H | Original Q2

Question 2 (Standard Demand)

02.1 The answer needed to refer to the iron block's temperature rather than the room temperature. 'To allow the thermometer time to reach the iron block's temperature' would be creditworthy. 'To allow the iron block to reach room temperature' was insufficient. 36% of students scored a mark for this question.

02.2 70% of students scored all 4 marks. 17% of students scored 3 marks for using a temperature change other than the correct one. An answer of 216.7 was commonly seen

Answer 112 · Examiner comments — June 2023 | 8463/1H | Original Q2

using the total temperature change, which scored 3 marks. If an incorrect temperature change was used it needed to be clear from the graph and subsequent calculation why an incorrect value had been used.

02.3 72% of students scored 2 marks, while 27 % of students scored 1 mark for identifying the effect of adding insulation.

Answer 113 · Examiner comments — June 2023 | 8463/1H | Original Q4

Question 4 (Standard/high Demand)

04.1 In this exam series students were provided with all the equations on an Equations Sheet. 57% of students scored 4 marks, while 32 % of students scored 3 marks, usually for incorrectly or not converting the gravitational potential energy. Changing the mass to grams was counted as a Physics error on Higher Tier questions so scored zero for subsequent calculations. A student could still score the mark for the unit conversion of E_p, however.

04.2 In this exam series students were provided with all the equations on an Equations Sheet. 67% of students scored 5 marks, while 18 % of students scored 4 marks, for either not converting or incorrectly converting the power, or failing to put their answer in standard form. The standard form mark scored independently as long as the student had given a calculated value using data from the question in standard form.

04.3 6% of students scored 2 marks, while 33% of students scored 1 mark. Many students did not use technical vocabulary to express themselves, giving responses which were insufficient. Students needed to make comparison statements about both solar power and

4.1.1.1 Energy stores and systems

Answer 113 · Examiner comments June 2023 | 8463/1H | Original Q4

hydroelectric, using the graph to score the first marking point. Statements repeating the questions stem 'meaning the electricity supply is more reliable' were insufficient to score the second mark.

Answer 114 · Examiner comments June 2023 | 8463/1H | Original Q6

Question 6 (High Demand)

06.1 Question **06.1** was generally well attempted and students who had carried out the current-potential difference characteristics required practical would have had an advantage over those who hadn't. For this question, 14 % of students scored 5 or 6 marks and 36 % of students scored 3 or 4 marks.
A circuit diagram wasn't necessary for 6 marks, but students benefitted from drawing a circuit diagram as they didn't then need to describe the circuit, although many students still did. In their circuit diagram minor errors, like gaps between components and minor slips in circuit symbols, were ignored as long as the meaning was clear. However, a voltmeter in series means that the circuit would not work, so limited any written answer to Level 1. For Level 2 a student needed to make it clear how the p.d. and current could be varied, several methods are given in the mark scheme. For Level 3, students needed to have a method to achieve negative results. Students were often quite vague about how this was done, some thought it sufficient to reverse the connections to the ammeter or the voltmeter.. For 6 marks, students also needed to refer to the correct interval and range of readings from the graph.

06.2 91% of students scored 3 marks on this question. In this exam series students were provided with all the equations on an Equations Sheet.

06.3 77 % of students scored 5 marks on this question. 16% of students scored 4 marks, usually for mis-converting or not converting time into seconds. In this exam series, students were provided with all the equations on an Equations Sheet which improved their success at answering calculation questions.

06.4 Only 2 % of students scored 2 marks and 11 % of students scored 1 mark. This question was targeted at grade 8-9 students so required a precisely worded answer. Most students thought that the student believed that power and p.d. were directly proportional but had done the calculation incorrectly, so the power should be 2.0 W not 4.0 W. Statements like 'if power was proportional to p.d. then the power should be 2 W not 4 W' were commonly seen and scored zero.

4.1.1.1 Energy stores and systems

Answer 115 · Examiner comments — June 2023 | 8463/1H | Original Q7

Question 7 (Standard/high Demand)

07.1 64% of students scored the mark. 'Over extend was insufficient', but 'exceed elastic limit' was allowed as it is correct but not on the specification.

07.2 The second marking point was for the idea that the baby had kinetic energy at some point in the movement and the spring had some elastic potential energy. So, the following ways of wording this would be creditworthy:
The baby's kinetic energy is transferred to the spring's elastic potential energy.
As the baby's kinetic energy decreases, the spring's elastic potential energy increases.
For the third marking point, the mark was given for saying that at position B all the energy is elastic potential energy as the baby is stationary. But if a student said that all the energy is elastic potential energy, apart from some energy dissipated / transferred to the surroundings, this would still score the mark. An answer indicating that the final elastic potential energy is equal to the initial gravitational potential energy would be acceptable for this marking point. 'Gravitational potential energy is transferred to kinetic energy then

Answer 115 · Examiner comments — June 2023 | 8463/1H | Original Q7

elastic potential energy' would score 2 marks, as the student hasn't stated that all the energy was elastic potential. 'Gravitational potential energy in position **A** is transferred to elastic potential energy in position **B**' would score 1 mark.
Abbreviations like KE, GPE and EPE were creditworthy. If types of energy were written in words, 'potential' must be included, i.e. not just 'gravitational energy' or 'elastic energy'.
3% of students scored 3 marks, while 32 % scored 2 marks and 39 % scored 1 mark.

07.3 45% of students scored 4 marks, while 36% of students scored 3 marks. Most students either mis-converted or did not convert the extension into metres.

4.1.1.1 Energy stores and systems

Answer 116 · Examiner comments

June 2023 | 8463/2H | Original Q1

01.1

72% scored a mark on this question. The most frequent incorrect response was ‘parallel’.

01.2

Most responses were levels 1 and 2. Many failed to gain marks because they did not think it was necessary to explain the need for additional equipment. Very few students explained the need to calculate the temperature change or to compare the readings on infrared detectors, which was a requirement to get into level 3. A number of students suggested using cold water, or even described a different practical. Students were not penalised for using tiny volumes of water, but it is clear that students have no concept of how much 50 ml is, for example. There was a lot of confusion relating to use of infra red detectors and what they measured.
Many students stated they would take readings every minute, and lots suggested repeating to get averages, or producing graphs. This was not required by the question.
There were some pleasing summaries referring to the evidence and the hypothesis.

01.3

80 % of students scored the first mark, but only 47% scored both marks. Some students simply reworded the stem. There was a small amount of confusion with radioactivity, because of the use of the word radiation, and a number who seemed to think a chemical reaction was taking place.

01.4

A majority of students gained this mark, but there seemed to be some confusion as to what is meant by the dependent variable.

01.5

The most common response related to the matt black surface and the shiny white surface. This was awarded 1 mark. Some did mention that black was the best absorber but failed to adequately describe the relative absorbance of matt versus shiny surfaces, as they did not explain this only applied for the same colour surface. In addition, some gave their response in terms of emission or reflection of IR radiation, both of which scored zero. Only 3% of students successfully gave both conclusions.

01.6

99% of students identified the equation for calculating pressure.

Answer 116 · Examiner comments

June 2023 | 8463/2H | Original Q1

01.7

78% of students scored all 4 marks for this calculation. Some scored zero, as they calculated the total surface area, the volume or used the length of the cube.

4.1.1.1 Energy stores and systems

Answer 118 · Examiner comments June 2024 | 8463/1H | Original Q6

Question 6 (High Demand)

06.1 90% of students scored this mark, for identifying that the elastic potential energy store increases as the bungee cords are stretched.

06.2 A challenging grade 8-9 calculation question. A common incorrect answer was '10' which scored 5 marks because the only mistake the student made was not doubling the elastic potential energy calculated for one bungee cord. Due to the various ways students approached the question it discriminated well between different abilities. 14% of students scored 6 marks, while 34% scored 5 marks and 28% scored 4 marks. As long as a student had used the elastic potential energy equation calculating a value of E_e using a value of k and e^2 they could score the marks for using the E_p equation.

06.3 12% of students scored 2 marks, while 46% of students scored 1 mark, in this question for identifying the ways in which energy was dissipated.

Answer 119 · Examiner comments June 2024 | 8463/1H | Original Q8

Question 8 (High Demand)

08.1 Questions about the microscopic causes of pressure are difficult for GCSE students and this question was no exception. Many students repeated information given in the question which did not score any marks. A minority of students scored the first mark point, many students simply stating that the volume decreased which was insufficient. Students made a good attempt at explaining that there were more collisions between the particles and the container walls, but failed to score because they didn't refer to a specified time period e.g. per second, or rate or more frequent, etc. Some students stated that the kinetic energy of the particles had increased, which stopped them from scoring the second mark point. Very few students scored the third mark point which was the most demanding of the three. 9% of students scored 2 or 3 marks, while 43% of students scored 1 mark.

08.2 94% of students scored this mark, linking temperature increase to mean kinetic energy of particles.

08.3 A grade 6-7 calculation question which discriminated well between students. Many students failed to convert the specific heat capacity so scored 3 marks instead of 4. Some students tried to convert the energy into kJ but very few did this successfully, usually ending with a 'power of 10' error. 22% of students scored 3 marks while 62% of students scored 4 marks.

4.1.1.1 Energy stores and systems

Answer 120 · Examiner comments

Question 10 (Standard/High Demand)

10.1 72% of students correctly identified the colour of the live wire insulation.

10.2 66% of students scored the mark on this question. Students who made the box for the answer into a fuse symbol did not score the mar nor did a fuse symbol added to any side of the box .

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10.3 A grade 6-7 calculation of current. 57% of students scored all 4 marks. 36% of students scored 3 marks, usually for incorrectly converting, or not converting, the unit.

10.4 A grade 6-7 calculation of mass. 61% of students scored 4 marks. 31% of students scored 3 marks for either incorrectly converting, or not converting, the unit.

10.5 40% of students scored 2 marks on this question recognising that the time would be longer because more energy in total would need to be transferred. An answer of 'less energy is melting the wire' was just enough to score the second mark. 15% of students scored zero on this question.

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4.1.1.1 Energy stores and systems

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

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Answer 121 · Examiner comments June 2025 | 8463/1H | Original Q2

Question **02.2** was well attempted and students who had carried out the specific heat capacity required practical would have had an advantage over those who had not. For this question, just fewer than 40% of the students scored 5 or 6 marks and a further 46% of the students scored 3 or 4 marks.

Handwriting continues to be a problem for a number of students, making it very difficult for examiners to read what has been written. An increasing number of students are using computers to word process their answers for extended response questions, which is helpful for examiners in awarding credit for student responses. However, students must use the question number as printed in the question paper e.g. 04.3 rather than 4(c) to ensure that their work is matched and marked with the corresponding question part.

Many students did not cross out the work they did not want to be marked. This results in the 'list principle' being applied which means if there are two sets of working or answers and they conflict, the student scores zero.

Levels of demand

Questions are set at three levels of demand for this paper:

- **Standard demand** questions are designed to broadly target grades 4–5.
- **Standard/high demand** questions are designed to broadly target grades 6–7.
- **High demand** questions are designed to broadly target grades 8–9.

A student's final grade, however, is based on their attainment across the qualification as a whole, not just on questions that may have been targeted at the level at which they are working.

01.1

Common answers which were insufficient included 'running out', 'not running out', 'sustainable', 'not sustainable'. The specification uses the word 'replenished' so words equivalent to this were needed, so 'replaced' or 'more of the energy resource is produced' were just able to score a mark. For non-renewable the idea that the resource is finite, or there is a limited amount was needed to score the mark. It was not enough to just state the exact

Answer 121 · Examiner comments

opposite of the renewable energy resources mark point. Just fewer than 20 % of the students scored 2 marks, while just over 50 % of the students scored 1 mark.

01.2

Almost all of the students scored this mark for writing down the equation linking density, mass and volume using the equation sheet provided in this exam series.

01.3

The vast majority of the students scored 3 marks for this grade 4-5 calculation of mass using the density equation.

01.4

This question was poorly answered with fewer than 10 % of the students scoring 2 marks. About 30 % of the students scored 1 mark. Students who said that tidal power output was greater than wind power did not score a mark without reference to a particular flow speed. If wind flow speed was a consistent 2 m/s and tidal flow speed never reached 0.75 m/s the wind turbine's power output would be greater.

01.5

A good range of environmental impacts were described by many students. To score within level 2, students needed to make at least one comparative statement about a factor for both turbines. The simplest way of doing this was to compare relative size.
An answer; 'The wind turbine is larger, but harms birds. The tidal turbine harms fish but does not cause visual pollution' would score 4 marks.
Nearly all of the students scored some marks with nearly 50% scoring 3 or 4 marks.

02.1

Answers such as 'electrical devices near water' were insufficient, as was 'wires in the water'. A low p.d. power supply also is not a hazard, unless water was spilled on it, in which case it would score for the 'spilled water' which in a typical science laboratory is a hazard by itself. Risks by themselves like electrocution, electric shock or burns did not score but were ignored if given with an appropriate hazard. About 75 % of the students scored this mark usually for identifying 'hot water' or the 'heater' as the hazard. While in this experiment it is unlikely that water is at boiling point, 'boiling water' was creditworthy for 'hot water'.

02.2

To score 5 or 6 marks, students needed to be clear how the mass of the water should be determined. There were some very good, straightforward methods seen to calculate specific heat capacity, a graphical approach scored no additional credit. Some students who had more complex methods often became confused with the significance of what the gradient of their graph represented. It was possible for a student to score 6 marks for measuring the energy needed to increase the temperature of a suitable volume of water by just 1°C as the method would work, even if the temperature change is not as large as may be needed to obtain an accurate value.

4.1.1.1 Energy stores and systems

Answer 121 · Examiner comments June 2025 | 8463/1H | Original Q2

02.3

Almost all of the students scored this mark for identifying that the beaker of water needed insulation and/or a lid. Any named insulation was allowed for this question. Aluminium / tin foil was also allowed as it would reduce energy transfer by infrared radiation. Place the beaker on a 'heatproof' mat was also creditworthy as it would decrease energy transfer through the base of the beaker by conduction.

02.4

Nearly three quarters of the students scored 2 marks for this percentage difference calculation. The most common mistake was to calculate the percentage difference between 4200 and 4410 which didn't score marks, unless they had set out the top of the equation correctly, (4410 – 4200) or (4200 – 4410) or calculated the difference of 210. Many students calculated 105 or 1.05, which scored no marks unless the working out was shown.

An answer of 4.76% or working showing a calculation of this figure, rounded to 5% scored no marks.

Answer 122 · Examiner comments June 2025 | 8463/1H | Original Q6

06.1

Just over 90 % of the students scored 3 marks on this grade 4-5 calculation of temperature increase using the specific heat capacity equation.

06.2

Just over 80 % of the students scored 4 marks for this calculation of charge flow using the equation $E = QV$. About 15 % of the students scored 3 marks as they had either not converted or converted incorrectly the energy into Joules.

06.3

Students found this question difficult with very few scoring marks because of incorrect assumptions about how potential difference, current and resistance are affected by series and parallel circuits. Marking point 2 was dependent on marking point 1 so that students who stated that the current was increased without a valid reason would not score. The third mark was demanding in requiring an understanding of how $P = IV$ related to the circuit being considered. Just over 80% of the students scored no marks.

4.1.1.1 Energy stores and systems

Answer 123 · Examiner comments June 2025 | 8463/1H | Original Q9

09.1

Many of the students did not convert the 70 cm into metres and some students converted the energy unnecessarily. Not converting the height stopped marking point 1 from scoring and converting the energy unnecessarily stopped 1 marking point from being scored too. Some students, despite setting out their calculations correctly, did not use brackets around the denominator and arrived at an answer of 0.0245 or 2.45. Nearly 80 % of the students scored full marks on this question.

09.2

Many students found it easy to score full marks on this multi-step calculation. The most common mistake was not to convert the time which resulted in an answer of 27 and scored 5 marks. Converting the time incorrectly e.g. converting time into 0.5 hours also scored 5 marks. About 90% of the students scored either 5 or 6 marks.

Answer 123 · Examiner comments June 2025 | 8463/1H | Original Q9

09.3

Many students understood that the flow rate would increase. This was often correctly linked to either more useful energy transferred or less wasted energy. Some students expressed their ideas in terms of power. Just over 40 % of the students scored 2 marks, while just over 40 % scored 1 mark.

4.1.1.1 Energy stores and systems

Answer 124 · Examiner comments June 2025 | 8463/1H | Original Q10

10.1

Many students were successful with this multi-step calculation question. Nearly 60% of the students scored 6 marks, while almost 10 % scored 5 marks. A significant number of students tried to answer the question using equations from paper 2, which was creditworthy, but virtually no students arrived at the correct answer using this method. Some students scored the significant figures mark by completing an incorrect calculation using all the data provided in the question. The most common mistake was not squaring the extension in the elastic potential energy equation. Ensuring that students substitute first before rearranging is a good way of scoring method marks in calculations, even if the final answer is incorrect.

10.2

Students who stated the names of energy stores didn't score any marks unless they stated how the amount of energy changed or stated that kinetic energy was transferred to gravitational potential energy, for example. Mention of elastic potential energy from the spring in Q10.1 was ignored for this question. E_k and *KE* were acceptable abbreviations for kinetic energy; E_p and *GPE* were acceptable abbreviations for gravitational potential energy. Just over 60 % of the students scored 3 marks, while just over 10% scored 2 marks and just fewer than 10 % scored 1 mark.

10.3

Only about 25 % of the students scored 2 marks for identifying the correct measurements needed to determine the speed of the car at the end of the track. Nearly 75% of the students scored 1 mark. The most common incorrect choice was the length of the track.

4.1.1.1 Energy stores and systems

Answer 124 · Examiner comments

June 2025 | 8463/1H | Original Q10

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

GCSE
PHYSICS

8463/1H: Paper 1 (Higher tier)
Report on the Examination

8463
June 2022

Version: 1.0

4.1.1.1 Energy stores and systems

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General

Grade 4-5 calculation questions ask for students to recall an equation, before using it in a subsequent calculation. In the 2022 series, students were given an Equations Sheet which had all the equations printed on it. Subsequently, the performance on the more straightforward calculations has improved on previous years.

The multistep calculations targeted at candidates working at grades 8-9, questions **09.1** and **10.1**, were well attempted with many students answering correctly. Of these two questions, students were slightly more successful on question **09.1** with about 55% of students scoring full marks, whereas for question **10.1** approximately 45% of students scored full marks.

Question **02.1** was generally well attempted and students who had carried out the density required practical had an advantage over those who hadn't. For this question, about 35% of students scored 6 marks and approximately 25% of students scored 5 marks.

Handwriting continues to be a problem for a number of students, making it very difficult for examiners to read what has been written. Students who have handwriting that is difficult to read may benefit from a scribe or from word processing their answers in exams.

Question 11

Due to incorrect Advance Information guidance being issued for this question, and to avoid students being disadvantaged, Question 11 was discounted and all students were awarded full (9) marks.

Levels of demand

Questions are set at three levels of demand for this paper:

- **Standard demand** questions are designed to broadly target grades 4–5.
- **Standard/high demand** questions are designed to broadly target grades 6–7.
- **High demand** questions are designed to broadly target grades 8–9.

A student's final grade, however, is based on their attainment across the qualification as a whole, not just on questions that may have been targeted at the level at which they are working.

Question 1 (Standard demand)

01.1 About 55% of students scored 2 marks. The unit conversion caused a problem for many students and powers of 10 errors were frequently seen. A correct calculation using an incorrectly or not converted value for power would score 1 mark.

01.2 Students were generally successful at answering this question with approximately 40% scoring 2 marks and about 50% scoring 1 mark. Most students wrote variations of the first and third bullet points in the markscheme. A number of students wrote that the turbines may be broken, which was enough to score a mark for the idea of maintenance.

01.3 'Turbine will rotate faster' was insufficient to score a mark. 'Rotate more smoothly' was not enough to score the 'less friction' mark. Students who stated that 'no energy was wasted' did not score the second marking point. Approximately 35% of students scored 3 marks, 35% of students scored 2 marks and 20% of students scored 1 mark.

01.4 About 30% of students scored 2 marks, while approximately 50% of students scored 1 mark. Many students answered in terms of 'saving energy' which was insufficient. Other students answered in terms of absolute statements which did not score, 'energy efficient appliances waste no energy' for example.

Question 2 (Standard demand)

02.1 Generally very well answered with about 35% of students gaining 6 marks and 25% scoring 5 marks. Students were told that this required practical would appear in the 2022 series via the Advance Information. A number of students quoted the density equation incorrectly, although this was given on the Equations Sheet for the 2022 series. There were extremely few students who didn't attempt the question and less than 1% of students who attempted the question scored zero.

02.2 Approximately 85% of students answered this question correctly. Of the incorrect answers seen, a significant proportion gave the maximum and minimum values the wrong way round. Another common mistake was to write maximum: 2.55 and minimum 0.10, which showed a clear misunderstanding of expressing an uncertainty.

02.3 About 95% of students answered this question correctly.

02.4 Approximately 45% of students scored 2 marks and 40% scored 1 mark. 'In case an error / mistake was made the first time' was insufficient. 'To check the repeatability of the data' was ignored, as this wouldn't improve the accuracy of the data. 'Get rid of anomalies' was assumed to mean 'remove anomalies', but 'stops anomalies from occurring' did not score. Likewise 'stops random errors' did not score.

Question 3 (Standard demand)

03.1 Over 99% of students answered this question correctly as they had all the Physics equations on the Equations Sheet for the 2022 series.

03.2 Nearly 95% of students answered this question correctly. In this series all students were given all the equations on the Equations Sheet. The first mark is for the substitution into the equation as it appears on the equations sheet. Some students failed to score any marks by incorrectly rearranging the equation, then substituting into the incorrectly rearranged equation.

03.3 Over 99% of students answered this question correctly as they had all the Physics equations on the Equations Sheet for the 2022 series.

03.4 95% of students answered this question correctly. In this series all students were given all the equations on the Equations Sheet. The first mark is for the substitution into the equation as it appears on the Equations Sheet. Some students failed to score any marks by incorrectly rearranging the equation, then substituting into the incorrectly rearranged equation.

Question 4 (Standard/High demand)

04.1 A large number of students found it difficult to identify the independent and dependent variables in the investigation that was described. Control variables appeared often in students' answers. 'Temperature change' seemed to be the most common incorrect answer for the dependent variable. About 50% of students scored 2 marks and approximately 35% of students scored 1 mark.

04.2 65% of students answered correctly. The most common incorrect answer was 87.4 °C.

04.3 About 35% of students answered this question correctly. Common incorrect answers referred to the resolution, or just repeated the question and said 'difficult to read' which was insufficient.

04.4 Approximately 75% of students scored 3 marks and about 10% of students scored 2 marks. Power of 10 errors were common and usually resulted in 2 marks being scored for an incorrectly or not converted value of energy.

04.5 Many students found relating the time for the temperature to decrease to thermal conductivity difficult. About 15% of students scored 2 marks, while 40% scored 1 mark. Answers in terms of good / bad insulators were insufficient to score a mark.

Question 5 (Standard/High demand)

05.1 Approximately 45% of students scored 1 mark, with about 5% of students scored 3 marks. Around 30% of students scored no marks. The first marking point of this explanation was most likely to score, the third marking point was least likely to score.

05.2 About 30% of students scored all 3 marks for this explanation. 10% of students scored 2 marks and 10% scored 1 mark. A lot of student answers were not creditworthy, with mixed up descriptions of ion transfer, electron transfer, proton transfer, protons weighing more than electrons and transfer of electrons increasing the mass of the rod on the balance. As a result about 50% of students scored zero.

05.3 Approximately 60% of students scored the mark. Some students evidently did not know what a zero error was. Answers like 'it means there is no error' being a good example of this. Some answers were insufficient, 'the actual mass of the rod is not required' being not enough to score the mark. 'Weight' was allowed for 'mass' when used correctly as the reading on the balance does depend on the weight of the object. An answer of 'only the change in weight was needed' would have scored the mark.

05.4 Some very good explanations were seen and about 10% of students scored all 3 marks. The first marking point was least likely to score. The third marking point needed to be linked to the second marking point before it could be scored.

Question 6 (Standard/High demand)

06.1 This question discriminated well between students. About 15% scored 4 marks with 20% gaining 3 marks. The first two marking points were most commonly scored. Students who said that 'no energy was lost' as a consequence of the step-up transformer's effect did not score the third marking point.

06.2 Approximately 55% of students scored 2 marks, while 15% of students scored 1 mark. Students who scored no marks usually confused the quantity that was decreased (pd) with the quantity that increased (current). Some student answers lacked technical accuracy referring to energy, power or charge incorrectly.

06.3 Two thirds of students scored 4 marks for this calculation, whereas about 20% of students scored 3 marks. A common mistake was to try to multiply the answer by the number of seconds in a day, which would probably only score the significant figure mark if correct, as the Physics equations were applied incorrectly.
Common mistakes were to round the answer to 1 400 000 000 C, which would score 3 marks if the full s.f. answer was seen, or round the answer to 141, which would score 3 marks for the supporting calculations if seen. A common error was to miscount the number of zeroes, so would only score 3 marks.

Question 7 (Standard/High demand)

07.1 54% of students could state what an alpha particle consists of. The list principle was applied when students wrote '2 protons and 2 neutrons – a helium atom', which did not score.

07.2 65% of students completed the nuclear equation correctly, scoring 2 marks, whereas 24% scored just 1 mark.

07.3 Students generally made good attempts to answer this question and marking points 1, 2 and 4 were seen most often. To score the 5th marking point students need to make a comparative statement, internal versus external damage. The third marking point was least likely to score, as students rarely referred to dose or the living cells / tissues / organs inside the body. Some students incorrectly thought that ionisation was a process that happened to cells, rather than atoms, so often didn't score the fifth marking point for this reason. Very few students scored 5 marks and the question discriminated well between students of differing ability.

Question 8 (Standard/High demand)

08.1 About 90% of students gave the correct measuring instrument. While it wasn't seen often, an answer of a 'volumetric pipette' was also creditworthy. 'Pipette' was insufficient.

08.2 Around 90% of students correctly identified the hazard in the investigation.

08.3 For this calculation, about 45% of students scored 5 marks and 20% of students scored 4 marks. A common mistake was to calculate *L* using one of the masses given in the question, rather than the change in mass. The resulting numerical answer would score zero as the equation was not being used correctly.

08.4 About 15% of students scored 2 marks for this explanation and 10% of students scored 1 mark. Many students reached incorrect conclusions and many students simply reworded the information given in the question.

08.5 7% of students scored 2 marks and 3% of students scored 1 mark. Many students reached incorrect conclusions and many students reworded the information given in the question without adding to it.

Question 9 (High demand)

09.1 Approximately 55% of students scored 5 marks, but in the 2022 series students were provided with an Equations Sheet with all the equations. A commonly seen answer was 73 500, which scored 4 marks for not converting the height into metres.

09.2 5% scored 2 marks and about 30% scored 1 mark. Many students failed to score a mark by pointing to the 'inaccuracy of the measured mass / height / gravitational field strength', or referring to the measurements as being 'low resolution'. 'Mass may have been greater than 60 kg' or 'time may have been longer / shorter than 1.40 seconds' were other common incorrect answers.

09.3 About 75% of students identified the correct conclusion.

Question 10 (High demand)

10.1 About 45% of students scored 6 marks for this extended calculation, but in the 2022 series students were provided with an Equations Sheet with all the equations. Therefore, students were supported when it came to attempting this question. With an alternative approach using equations from paper 2, students' answers were marked on whichever approach brought them closest to the correct final answer. An answer of 6 m/s with no supporting working did not score full marks as students could achieve this answer by multiplying the spring constant and the extension together, which would give them the maximum force acting on the toy aeroplane.

10.2 About 65% of students scored the mark. The most common incorrect answers seen were gravitational potential or elastic potential.

10.3 Approximately 20% of students scored a mark. Many students failed to score a mark because they gave a factor without a specific change e.g. 'extension of spring', rather than 'increase the extension of the spring'.

Question 11 (High demand)

Due to incorrect Advance Information guidance being issued for this question, and to avoid students being disadvantaged, Question 11 was discounted and all students were awarded full (9) marks.

4.1.1.1 Energy stores and systems

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account of how students have performed for each question.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

AQA
Questions matter

GCSE

Physics

8463/1H Paper 1 Higher Tier

Report on the Examination

8463
June 2024

Version: 1.0

4.1.1.1 Energy stores and systems

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4.1.1.1 Energy stores and systems

General

Grade 4-5 calculation questions ask for students to recall an equation first before using it in a subsequent calculation, however in the 2024 series, students were given a Physics Equations Sheet which had all the equations printed on it. Subsequently, the performance on straightforward calculations has improved compared with years when equations have needed to be recalled from memory.

The grade 8-9 multistep calculations, question **05.5** and **06.2**, were well attempted. Question **05.5** had 18% of students scoring 5 marks, while question **06.2** had 14% of students scoring 6 marks.

Question **03.1** was well attempted and students who had carried out the resistance of a wire required practical would have had a material advantage over those who hadn't. For this question, 44% of students scored 5 or 6 marks and 37% of students scored 3 or 4 marks.

Handwriting continues to be a problem for a number of students, making it very difficult for examiners to read what has been written. An increasing number of students are using computers to word process their answers for extended response questions, which is helpful for examiners in awarding credit for student responses. However, students must use the question number as printed in the question paper eg 4.3 rather than 4(c) to ensure that their work is marked with the corresponding question part.

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- **Standard/high demand** questions are designed to broadly target grades 6–7.
- **High demand** questions are designed to broadly target grades 8–9.

A student's final grade, however, is based on their attainment across the qualification as a whole, not just on questions that may have been targeted at the level at which they are working.

Question 1 (Standard Demand)

01.1 98% of students scored this mark, identifying the energy store which increases when water is heated.

01.2 93% of students scored this mark. Some incorrect answers seen were 'method A' or 'method B' students thinking they were linking a method to the energy transfer. Another common answer was 'hydroelectric energy' which didn't score. The word 'potential' was needed for an answer of 'gravitational potential.' As the question was worded it seemed reasonable to credit 'kinetic' since the water moving uphill would have kinetic energy before it reached its destination and stored only gravitational potential energy.

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01.3 55% of students scored 4 marks. Some students failed to realise that the calculations needed were to show the amount of stored energy wasted or the amount of stored energy usefully transferred. Simple subtractions were insufficient to score the calculation marks. To score 4 marks, two comparisons were needed in addition to a comparative calculation. Although the comparative calculation performed by a minority of students involved dividing 33 600 kJ by 490 kJ and getting an answer of 68.6, which is the number of times more energy stored by method A compared to B. This single calculation was enough to score 4 marks with the two simple comparisons. The installation comparison only scored if value was added to the information eg Method A is easier to install or is likely to cost less money.

01.4 To score marks for this question, students needed to say what activity should be stopped (or reduced) and what should be done instead for both transport and electricity generation. At its simplest this could be use electric cars instead of petrol cars and use renewable methods instead of fossil fuels to generate electricity. As well as the examples on the mark scheme other valid methods were also creditworthy: car sharing, for example, or limiting the distance that goods could be shipped across country. 39% of students scored 4 marks, while 35% of students scored 3 marks.

Question 2 (Standard Demand)

02.1 A sentence completion question about nuclear fission which discriminated well between students. 72 % of students scored 3 marks, 21% scored 2 marks and 5% scored 1 mark.

02.2 99.5% of students scored the mark for writing down the correct equation. However, in this exam series all equations were provided for the students on the Physics Equations Sheet.

02.3 A standard demand calculation of energy question. 48% of students scored 3 marks, while 41% of students scored 2 marks. Not converting or incorrectly converting the unit will have allowed many students to only score 2 marks.

02.4 44% of students scored a mark. ‘Wear protective clothing’ or ‘hazmat suits’ were common incorrect answers. Any idea of ‘burying it’ was credited, so ‘bury it in a field’ was ok, as was ‘bury it in landfill,’ which from a student’s perspective is equivalent to burying it underground. ‘Keeping it away from people’ was insufficient.

02.5 96% of students scored 2 marks. The answer of 29.2 days was worth 1 mark as this could only have been calculated by doing the correct calculation and then subtracting the result from 365.

Question 3 (Standard/High Demand)

03.1 Students who had completed the investigation found this question straightforward, especially as the circuit was shown in a photo. It was not necessary for the circuit connections to be described. The mean mark for the question was 4 marks. 44% of students scored 5 or 6 marks, while 37% of students scored 3 or 4 marks.

03.2 83% of students identified the graph showing the relationship between length of wire and resistance.

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03.3 28% of students scored 2 marks, while 50% scored 1 mark. The converse of 'low p.d.' was the bare minimum to score the first mark, so 'not a high p.d.' was taken to mean the p.d. was low. Similarly, 'not enough to give you a shock' and 'not enough to electrocute you' were creditworthy for the second mark.

Question 4 (Standard/High Demand)

04.1 Students answers were generally very confused with this question and statements about transfer of positive electrons or protons or even neutrons were commonly seen. Students struggled to understand that when you are in contact with a charged object you have the same charge as that object. It was common to see statements about the dome being negative so the student (and her hair) are positively charged. If a student said that the student was positively charged they could not score mark points 1 and 2, but they could still score mark point 3 if they said that like / same charges repel. 10% of students scored 3 marks, while 15% scored 2 marks and 32% scored 1 mark.

04.2 Only 8% of students scored a mark on this question. An answer of 'the area / space / region where an electron experiences a force' was creditworthy as were other examples of charged particles or ions. 'The area where other charged particles experience repulsion or attraction' was also creditworthy. Neither of these examples were seen often, however.

04.3 92% scored a mark for this question. A surprisingly large number of students made statements like 'as you get closer to the dome, the field strength increases' answering the question in the opposite way to the way it was set out. They scored a mark but would have saved a lot of time by writing 'it decreases.'

04.4 Some students did not convert, or incorrectly converted, the unit of charge and scored 3 marks.. Some students incorrectly converted the unit for charge and also spuriously converted the energy by multiplying or dividing by a power of ten. These students made two mistakes, so scored a maximum of 2 marks on this question. 36% of students scored all 4 marks, while 56% of students scored 3 marks for this calculation of potential difference.

04.5 80% of students identified the factor that would increase the distance a spark can jump between two objects.

Question 5 (Standard/High Demand)

05.1 72% of students scored 2 marks, while 15% of students scored 1 mark. A number of students thought mains p.d. was 240 V. It was officially changed to 230 V in 1987 and this is the value given in the specification. However, it was more common for students to get the p.d. correct and the frequency incorrect.

05.2 A grade 6-7 calculation of resistance, which discriminated well between students. The conversion of milliwatts to watts proved a problem for the vast majority of students. 53% scored all 4 marks, while 36% scored 3 marks.

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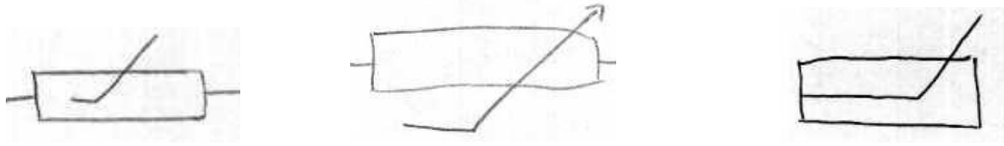
05.3 64% of students scored a mark for suggesting why dirty coins are not recognised by the machine. Answers which were insufficient, but ignored, included 'Can't measure resistance' and 'Dirt is an insulator'..

05.4 63% of students scored a mark for drawing the thermistor symbol. Answers that were not acceptable included the following examples.



05.5 This grade 8-9 calculation, worth 5 marks, question discriminated well between students of different abilities. If a student did not calculate the total resistance and then use that value to calculate the current in the circuit, then they didn't score the first 3 marks. If a student calculated the current in the circuit using just the 400 Ω resistor, then they could use that value to score the 4th and 5th marks for the calculation of the p.d. across the thermistor, using $V = IR$.
Answers with a p.d. greater 12 V usually scored zero marks, due to fundamental Physics errors. 18% of students scored 5 marks, while 31% of students scored 2 marks. 46% of students scored 0 marks. In this exam series all equations were provided for the students on the Physics Equations Sheet.

Question 6 (High Demand)

06.1 90% of students scored this mark, for identifying that the elastic potential energy store increases as the bungee cords are stretched.

06.2 A challenging grade 8-9 calculation question. A common incorrect answer was '10' which scored 5 marks because the only mistake the student made was not doubling the elastic potential energy calculated for one bungee cord. Due to the various ways students approached the question it discriminated well between different abilities. 14% of students scored 6 marks, while 34% scored 5 marks and 28% scored 4 marks. As long as a student had used the elastic potential energy equation calculating a value of E_e using a value of k and e^2 they could score the marks for using the E_p equation.

06.3 12% of students scored 2 marks, while 46% of students scored 1 mark, in this question for identifying the ways in which energy was dissipated.

Question 7 (Standard/High Demand)

07.1 52% of students scored this mark. The question states that the student's eye is not in line with the level of the water. The position of the eye is likely to remain in the same (incorrect) position as the water level changes when the ring is inserted. This will cause a random error as both volume measurements will be incorrect, but not by the same amount.

07.2 63% of students scored this mark. Additional mass or absorbing extra water were ignored. The answer needed to make a comparison, rather than just state that 'volume of string affects the measurement of volume.'

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07.3 33% of students scored the mark for this question about resolution. Comments on low / high resolution were insufficient to score. Statements needed to refer to the resolution value itself or the number of decimal places the measurement could be read to. As measuring cylinders often have large gaps between markings, a statement that the resolution was 0.1 cm^3 was allowed.

07.4 71% of students scored a mark for this question about zero error. Common incorrect answers said, 'take repeat readings and calculate a mean.'

07.5 A grade 6-7 calculation question, but the unit conversion made this question more difficult than other similar calculations in the exam, with only 33% of students scoring all 4 marks. 57% of students scored 3 marks.

Question 8 (High Demand)

08.1 Questions about the microscopic causes of pressure are difficult for GCSE students and this question was no exception. Many students repeated information given in the question which did not score any marks. A minority of students scored the first mark point, many students simply stating that the volume decreased which was insufficient. Students made a good attempt at explaining that there were more collisions between the particles and the container walls, but failed to score because they didn't refer to a specified time period e.g. per second, or rate or more frequent, etc. Some students stated that the kinetic energy of the particles had increased, which stopped them from scoring the second mark point. Very few students scored the third mark point which was the most demanding of the three. 9% of students scored 2 or 3 marks, while 43% of students scored 1 mark.

08.2 94% of students scored this mark, linking temperature increase to mean kinetic energy of particles.

08.3 A grade 6-7 calculation question which discriminated well between students. Many students failed to convert the specific heat capacity so scored 3 marks instead of 4. Some students tried to convert the energy into kJ but very few did this successfully, usually ending with a 'power of 10' error. 22% of students scored 3 marks while 62% of students scored 4 marks.

Question 9 (High Demand)

09.1 Students needed to refer to the graph, and factual recall about alpha radiation, to score the 1st and 3rd mark points.,. The 2nd mark point was much more unlikely to score, as students often stated the graph went to zero, rather than being just above zero. A number of students confused the graph with a half-life graph, believing the *x*-axis showed time, not distance. 8% of students scored 3 marks, while 45% scored 2 marks and 35% scored 1 mark.

09.2 A lot of students thought it was enough to say 'an absorbing material' without specifying what the absorbing material should be made from. Any suitable absorbing material was creditworthy, a block of wood for example. However, reference to any metal foil was not creditworthy unless students referred to a certain thickness eg 5 mm thick aluminium foil. A 'foil' was taken to be the same thickness as kitchen foil, whereas a 'metal sheet' was taken to be thick enough to absorb

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beta radiation, provided students did not contradict their earlier statements. Paper and cardboard were not creditworthy as suitable absorbing materials. 51% of students scored 2 marks, while 7% of students scored 1 mark.

09.3 65% of students scored this mark by suggesting a suitable safety precaution. Hazmat suits and PPE were insufficient to score.

09.4 64% of students scored this mark by suggesting a suitable precaution to avoid contamination. Hazmat suits and PPE were insufficient to score.

09.5 Students at GCSE find the idea of rate of change to be a difficult one, hence linking the change in the number of atoms to activity was a difficult question in this exam series. 7% of students scored 4 marks, while 12% of students scored 3 marks. If students failed to draw a tangent, they were very unlikely to score any marks except the unit mark. A common incorrect choice of unit for activity for many students was sieverts, Sv. Examiners were looking for becquerel or Bq. Decays per second or decays/second were insufficient to score.

Question 10 (Standard/High Demand)

10.1 72% of students correctly identified the colour of the live wire insulation.

10.2 66% of students scored the mark on this question. Students who made the box for the answer into a fuse symbol did not score the mar nor did a fuse symbol added to any side of the box .

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10.3 A grade 6-7 calculation of current. 57% of students scored all 4 marks. 36% of students scored 3 marks, usually for incorrectly converting, or not converting, the unit.

10.4 A grade 6-7 calculation of mass. 61% of students scored 4 marks. 31% of students scored 3 marks for either incorrectly converting, or not converting, the unit.

10.5 40% of students scored 2 marks on this question recognising that the time would be longer because more energy in total would need to be transferred. An answer of ‘less energy is melting the wire’ was just enough to score the second mark. 15% of students scored zero on this question.

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4.1.1.1 Energy stores and systems

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

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