AQA GCSE Physics | 8463

SPECIFICATION POINT 4.1.3

National and global energy resources

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**107**
Available paper years	**2004–2025**

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.

4.1.3 National and global energy resources

Answer 01 · Mark scheme June 2004 | 3451H | Original Q10 | Legacy

The full source mark scheme begins on page 122. Follow original question 10 in that document.

Answer 02 · Mark scheme June 2004 | 3462H3 | Original Q8 | Legacy

The full source mark scheme begins on page 143. Follow original question 8 in that document.

Answer 03 · Mark scheme June 2006 | 3451 | Original Q13 | Legacy

The full source mark scheme begins on page 160. Follow original question 13 in that document.

Answer 04 · Mark scheme June 2006 | 3462 | Original Q11 | Legacy

The full source mark scheme begins on page 180. Follow original question 11 in that document.

Answer 05 · Mark scheme November 2006 | PHY1A | Original Q2 | Legacy

Two	**A**	falling water	**4**
	B	sunlight	**1**
	C	waves	**2**
	D	wind	**3**

4.1.3 National and global energy resources

Answer 06 · Mark scheme November 2006 | PHY1A | Original Q5 | Legacy

Five	**A**	conduction	**1**
	B	convection	**4**
	C	insulation	**2**
	D	radiation	**3**

Answer 07 · Mark scheme November 2006 | PHY1A | Original Q8 | Legacy

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

Answer 08 · 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.

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.

4.1.3 National and global energy resources

Answer 09 · Mark scheme

January 2007 | PHY1H | Original Q6 | Legacy

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

Answer 10 · Mark scheme

March 2007 | PHY1A | Original Q1 | Legacy

Question	Key		
One	**A**	heat	**4**
	B	light	**1**
	C	movement	**2**
	D	sound	**3**

Answer 11 · Mark scheme

March 2007 | PHY1A | Original Q4 | Legacy

Four	**A**	0.9	**4**
	B	10	**1**
	C	30	**2**
	D	360	**3**

Answer 12 · Mark scheme

March 2007 | PHY1A | Original Q5 | Legacy

Five	**A**	The turbine turns the generator.	**4**
	B	Radiation is reflected onto the pipe.	**1**
	C	Steam drives the turbine.	**3**
	D	Water in the pipe absorbs energy.	**2**

Answer 13 · Mark scheme

March 2007 | PHY1A | Original Q6 | Legacy

Six	**A**	conclusion	**3**
	B	control	**1**
	C	environment	**4**
	D	evidence	**2**

	A	B	C	D

4.1.3 National and global energy resources

Answer 14 · Mark scheme

March 2007 | PHY1A | Original Q9 | Legacy

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

PHY1A (Energy and Electricity) Higher Tier

Question	Key		
One	**A**	conclusion	**3**
	B	control	**1**
	C	environment	**4**
	D	evidence	**2**
Two	**A**	free electrons	**4**
	B	ions	**3**
	C	particles	**1**
	D	waves	**2**

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

4.1.3 National and global energy resources

Answer 15 · Mark scheme June 2007 | PHY1A | Original Q4 | Legacy

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

Answer 16 · Mark scheme June 2007 | PHY1A | Original Q7 | Legacy

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

Answer 17 · Mark scheme June 2007 | PHY1A | Original Q9 | Legacy

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

Answer 18 · Mark scheme June 2007 | PHY1B | Original Q4 | Legacy

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

4.1.3 National and global energy resources

Answer 19 · Mark scheme

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 noise pollution • cause visual 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

4.1.3 National and global energy resources

Answer 19 · Mark scheme

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

4.1.3 National and global energy resources

Answer 20 · Mark scheme

November 2007 | PHY1A | Original Q5 | Legacy

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

Answer 21 · Mark scheme

November 2007 | PHY1A | Original Q7 | Legacy

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

4.1.3 National and global energy resources

Answer 22 · 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

4.1.3 National and global energy resources

Answer 22 · Mark scheme January 2008 | PHY1H | Original Q1 | Legacy

PHY1H

Answer 23 · Mark scheme March 2008 | PHY1AP | Original Q2 | Legacy

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

Answer 24 · Mark scheme March 2008 | PHY1AP | Original Q4 | Legacy

Four	**A**	coal	**2**
	B	natural gas	**4**
	C	oil	**1**
	D	renewable sources	**3**

Answer 25 · Mark scheme March 2008 | PHY1AP | Original Q6 | Legacy

Six	**A**	house	**4**
	B	power station	**1**
	C	step-down transformer	**3**
	D	step-up transformer	**2**

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

Answer 26 · Mark scheme March 2008 | PHY1AP | Original Q7 | Legacy

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

Answer 27 · Mark scheme March 2008 | PHY1AP | Original Q8 | Legacy

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

Answer 28 · Mark scheme June 2008 | PHY1AP | Original Q4 | Legacy

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

4.1.3 National and global energy resources

Answer 29 · Mark scheme

June 2008 | PHY1AP | Original Q8 | Legacy

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

Answer 30 · Mark scheme

June 2008 | PHY1AP | Original Q9 | Legacy

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

4.1.3 National and global energy resources

Answer 31 · 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° to 30° • reaches maximum value at 30° • then decreases from 30 ° • same pattern for each month	accept peaks at 30 ° 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

4.1.3 National and global energy resources

Answer 31 · Mark scheme June 2008 | PHY1H | Original Q4 | Legacy

PHY1H

4.1.3 National and global energy resources

Answer 32 · Mark scheme

Question 6

question	answers	extra information	mark
(a)(i)	3 fewer neutrons	accept fewer neutrons accept different number of neutrons do **not** accept different number of electrons	1
(a)(ii)	electron from the nucleus	both points needed	1
(a)(iii)	32 (days)	allow **1** mark for clearly obtaining 4 half-lives	2
(a)(iv)	has a **much** longer half-life little decay happened / still in the atmosphere	accept converse answers in terms of iodine-131 accept it has not reached one half-life yet accept it is still decaying	1 1
(b)	any **two** from: • some children developed TC before 1986 • some children (after 1986) that developed TC did not live in highly contaminated areas • the (large) increase can (only) be explained by (a large increase in) radiation as caused by Chernobyl • all areas would be contaminated (and raise the risk of TC) • no evidence (of effect) of other variables	marks are for reasons	2
(c)	People not exposed (to the radiation but who were otherwise similar)	accept people not affected (by the radiation)	1

Question 6 continues on the next page

PHY1H

Question 6 continued

question	answers	extra information	mark
(d)	any **two** from: • produce no pollutant / harmful gases • produces a lot of energy for a small mass (of fuel) **or** is a concentrated energy source • it is reliable **or** it can generate all of the time • produces only a small volume of (solid) waste	answers should be in terms of nuclear power and **not** why we should not use other fuels accept named gas or greenhouse gases do **not** accept no pollution accept amount for mass accept high energy density accept amount for volume	2
total			11

4.1.3 National and global energy resources

Answer 33 · Mark scheme November 2008 | PHY1AP | Original Q6 | Legacy

Six	**3**	**2**	**1**	**2**

Answer 34 · Mark scheme November 2008 | PHY1AP | Original Q7 | Legacy

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

Answer 35 · Mark scheme November 2008 | PHY1AP | Original Q8 | Legacy

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

4.1.3 National and global energy resources

Answer 36 · Mark scheme January 2009 | PHY1H | Original Q3 | Legacy

Question 3

question	answers	extra information	Mark
3(a)	1/25 **or** 1:25 **or** 0.04	accept 4 % **or** $\frac{15}{375}$ **or** $\frac{3}{75}$ **or** 1 in *25* for both marks allow **1** mark for total of 375 allow **1** mark for a clearly correct method using a clearly incorrect total do **not** accept 1:26	2
3(b)(i)	**B** (only) burning fossil fuels produces carbon dioxide / carbon (emissions) **or** nuclear fuels don't produce carbon dioxide	do **not** credit reason if **B** is not chosen insufficient – smallest amount of fossil fuels accept less carbon dioxide	1 1
3(b)(ii)	accept anything reasonable eg increased level of insulation use energy efficient light bulbs do not leave appliances on standby switch thermostats down (1 ^{o}C) generate own electricity install solar panels	accept insulate accept specific examples eg loft	1

Question 3 continues on the next page

PHY1H

Question 3 continued

question	answers	extra information	Mark
3(c)(i)	any **three** from: • no power output until wind speed exceeds 4 m/s • output rises rapidly after 4 m/s • output begins to level out / rises less rapidly at / after 13 m/s • output peaks at 21 / 22 m/s • output constant between 21 / 22 and 25 / 26 m/s • output falls (rapidly) after 25 / 26 m/s	accept for **1** mark goes up then comes down	3
3(c)(ii)	any **one** from: • unreliable energy source • dilute energy source • take up too much land	accept wind does not always blow accept need thousands / lots of turbines ignore reference to visual / noise pollution ignore reference to kill birds	1
Total			**9**

4.1.3 National and global energy resources

Answer 36 · Mark scheme January 2009 | PHY1H | Original Q3 | Legacy

PHY1H

Answer 37 · Mark scheme March 2009 | PHY1AP | Original Q3 | Legacy

Three	**A**	fossil fuels	**4**
	B	nuclear	**2**
	C	tides	**3**
	D	wind	**1**

Answer 38 · Mark scheme March 2009 | PHY1AP | Original Q6 | Legacy

Six	**1**	**3**	**1**	**2**

Answer 39 · Mark scheme March 2009 | PHY1AP | Original Q7 | Legacy

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

Answer 40 · Mark scheme June 2009 | PHY1AP | Original Q2 | Legacy

Two	**A**	coal	**3**
	B	nuclear	**2**
	C	tides	**4**
	D	wind	**1**

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

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

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

4.1.3 National and global energy resources

Answer 42 · Mark scheme June 2009 | PHY1H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	decrease in oil PLUS any **one** from: • increase in (proportion of) coal • increase in (proportion of) nuclear • increase in (proportion of) gas	must have decrease in (proportion of) oil and increase in (proportion of) coal / nuclear / gas	1
4(b)(i)	(nuclear) fission	accept fision do **not** accept any answer that looks like fusion	1
4(b)(ii)	water heated to produce (high pressure) steam steam turns turbine which drives generator		1 1

Question 4 continues on the next page . . .

PHY1H

Question 4 continued . . .

question	answers	extra information	mark
4(b)(iii)	any **two** from: • produces no pollutant gases • it is reliable **or** can generate all of the time • concentrated energy source **or** produces a lot of energy from a small mass • produces only small volume of (solid) waste • fossil fuels will last longer • will need to buy less fuel from other countries	 accept named gas or greenhouse gases accept no atmospheric pollution accept harmful for pollutant accept does not contribute to global warming do **not** accept no pollution on its own do **not** accept better for the environment unless qualified accept a named fossil fuel accept fossil fuels are running out do **not** accept fossil fuels are non-renewable unless qualified accept no new fossil fuel power stations needed do **not** accept it is cheap do **not** accept import less electricity	2
4(b)(iv)	it is / can be radioactive **or** emits radiation (from the nuclei)	do **not** accept answers in terms of kills cells / cancer accept emits gamma (rays)	1

Question 4 continued on the next page . . .

4.1.3 National and global energy resources

Answer 42 · Mark scheme

PHY1H

Question 4 continued . . .

question	answers	extra information	mark
4(c)	coal (burning) power stations / burning coal produces carbon dioxide	they refers to coal-burning power stations accept sulfur dioxide / nitrogen oxides for CO_2	1
	(increased) CO_2 increases / contributes to / causes global warming / greenhouse effect	mention of ozone layer negates this mark do **not** accept CO_2 warms atmosphere	1
Total			**9**

4.1.3 National and global energy resources

Answer 42 · Mark scheme

June 2009 | PHY1H | Original Q4 | Legacy

PHY1H

Answer 43 · Mark scheme

November 2009 | PHY1AP | Original Q5 | Legacy

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

Answer 44 · Mark scheme

November 2009 | PHY1AP | Original Q6 | Legacy

Six	**1**	**4**	**4**	**2**

Answer 45 · Mark scheme

November 2009 | PHY1AP | Original Q7 | Legacy

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

4.1.3 National and global energy resources

Answer 46 · Mark scheme

January 2010 | PHY1H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	(dismantle and) remove radioactive waste / materials / fuels	accept nuclear for radioactive do **not** accept knock down / shut down	1
5(a)(ii)	increases it	do **not** accept it has a negative effect	1
5(b)(i)	**K** most efficient **or** **M** least efficient (efficiency) of **K** and **L** increases, (efficiency) of **M** (almost) constant / slightly reduced	if efficiency is not mentioned it must be implied answers in terms of energy generated only gains no credit accept **K** and / or **L** are more efficient than **M** all 3 power stations must be mentioned to get this mark	1 1
5(b)(ii)	any **two** from: • do not know how many (nuclear) power stations there will be • power stations may continue to increase in efficiency • do not know what type of power station new ones will be • do not know future energy / electricity demands • may be new uses for uranium	accept new methods may be found to generate electricity / energy accept other ways of generating energy may be expanded accept we may become more energy efficient	2
Total			**6**

4.1.3 National and global energy resources

Answer 46 · Mark scheme

January 2010 | PHY1H | Original Q5 | Legacy

PHY1H

4.1.3 National and global energy resources

Answer 47 · Mark scheme

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**

4.1.3 National and global energy resources

Answer 48 · Mark scheme January 2010 | PHY2H | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)(i)	(two) nuclei (of light elements) join forming a larger / heavier nucleus / one	accept hydrogen atoms for nuclei accept comparative term equivalent to larger accept forms a helium (nucleus / atom) this mark only scores if fusion is in terms of hydrogen atoms	1 1
2(a)(ii)	stars	accept a named star e.g. the Sun accept nebula mention of planets negates answer	1
2(b)(i)	any **one** from: • (currently) only experimental • reaction does not last long enough • use more energy than they produce	allow difficult to control do **not** allow inefficient on its own	1
2(b)(ii)	any **one** from: • will give another source of energy • unlimited fuel supplies / energy • would not produce any radioactive waste • want to show that it can be done	do **not** accept answers only in terms of fossil fuels or carbon dioxide accept unlimited hydrogen accept less radioactive waste accept nuclear for radioactive do **not** accept toxic waste accept any sensible suggestion	1

Question 2 continues on the next page . . .

PHY2H

Question 2 continued . . .

question	answers	extra information	mark
2(c)(i)	any **one** from: • repeating did not produce the same results / data • experiments were not / may not be reproducible • data / experiments were not valid	accept could not be repeated accept has not been repeated do **not** accept answers in terms of scientists being biased	1
2(c)(ii)	any **one** from: • cannot trust journalists • newspaper journalist may not have a science background • newspaper may publish what people want to read • newspaper may simplify ideas • people believe / trust the scientists writing the journal • people have heard of the scientists writing in the journal • scientists writing in the journal are famous • journal only publishes the work of respected / famous scientists • data is checked by other scientists before published in the journal	bias is insufficient on its own accept any sensible suggestion, these are examples they do not constitute a full list	1
Total			**7**

4.1.3 National and global energy resources

Answer 48 · Mark scheme January 2010 | PHY2H | Original Q2 | Legacy

PHY2H

Answer 49 · Mark scheme March 2010 | PHY1AP | Original Q2 | Legacy

Two	**A**	heat (thermal energy)	**1**
	B	light	**3**
	C	movement (kinetic energy)	**4**
	D	sound	**2**

Answer 50 · Mark scheme March 2010 | PHY1AP | Original Q8 | Legacy

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

Answer 51 · Mark scheme March 2010 | PHY1AP | Original Q9 | Legacy

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

4.1.3 National and global energy resources

Answer 51 · Mark scheme

SCIENCE A (4461)/PHYSICS (4451)

Objective Test Answer Key

PHY1AP (Energy and Electricity)

March 2010

Higher Tier

Question	Key		
One	**A**	0.25	**4**
	B	60	**3**
	C	100	**1**
	D	240	**2**
Two	**A**	computer monitor	**1**
	B	loudspeaker	**3**
	C	microphone	**2**
	D	solar cell	**4**

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

4.1.3 National and global energy resources

Answer 52 · Mark scheme March 2010 | PHY1BP | Original Q5 | Legacy

Five	**4**	**2**	**1**	**1**

Answer 53 · Mark scheme June 2010 | PHY1AP | Original Q1 | Legacy

Question	Key		
One	**A**	Coal	**4**
	B	Gas	**1**
	C	Hydroelectric (falling water)	**2**
	D	Nuclear	**3**

Answer 54 · Mark scheme June 2010 | PHY1AP | Original Q2 | Legacy

Two	**A**	electricity is produced	**4**		
	B	moving water drives turbines	**2**		
	C	turbines drive generators	**3**		
	D	water collects in a reservoir	**1**		
	A		**B**	**C**	**D**

Answer 55 · Mark scheme June 2010 | PHY1AP | Original Q7 | Legacy

Seven	4	3	4	4

Answer 56 · Mark scheme June 2010 | PHY1AP | Original Q8 | Legacy

Eight	3	2	2	2

4.1.3 National and global energy resources

Answer 57 · Mark scheme

June 2010 | PHY1AP | Original Q9 | Legacy

Nine	2	3	3	2

4.1.3 National and global energy resources

Answer 58 · Mark scheme

June 2010 | PHY1H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	tidal / tides	do **not** accept water / waves	1
5(a)(ii)	any **three** from: • shorter journey time • less pollution from traffic • energy source is free • energy source / tides are predictable • produces less / no pollutant gases (than fuel burning power stations) • conserves supplies of fossil fuels • uses renewable energy (to generate electricity) • provides employment • no visual / noise pollution	 accept easier to go from town to town accept less petrol / fuel used accept CO_2 / carbon emissions reduced accept no CO_2 / greenhouse gases produced accept air pollution for pollutant gases less harm to the environment is insufficient the electricity is cheaper is insufficient do **not** accept produces no radioactive waste the pollution mark scores twice only if it is clear one reference is to traffic and the other is to electricity generation	3

Question 5 continues on the next page . . .

PHY1H

Question 5 continued . . .

question	answers	extra information	mark
5(b)(i)	(sometimes) electricity demand may be greater than supply (of electricity from the system) **or** can sell (excess) electricity (to the National Grid)	accept in case turbines / generators fail	1
5(b)(ii)	decreases the current reducing energy loss (along cables)	accept increases the voltage accept less heat / thermal energy lost / produced	1 1
Total			**7**

4.1.3 National and global energy resources

Answer 58 · Mark scheme June 2010 | PHY1H | Original Q5 | Legacy

PHY1H

Answer 59 · Mark scheme November 2010 | PHY1AP | Original Q4 | Legacy

Four	**2**	**3**	**3**	**4**

Answer 60 · Mark scheme November 2010 | PHY1AP | Original Q5 | Legacy

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

Answer 61 · Mark scheme November 2010 | PHY1AP | Original Q8 | Legacy

Eight	**2**	**4**	**2**	**3**

Answer 62 · Mark scheme

Question 3

question	answers	extra information	mark
3(a)	any **two** from: **YES** answers may include: • wind produces no pollutant gases • nuclear produces no pollutant gases • (burning) gas does not produce SO_2 **NO** answers may include: • nuclear produces <u>radioactive</u> waste • (burning) gas produces CO_2 / pollutant gases / air pollution	marks are awarded only for the reason but must match the ringed answer for both marks a **MAYBE** answer should include a **YES** and **NO** response answers in terms of the sources being renewable or non-renewable are insufficient accept wind burns no fuel accept CO_2 / SO_2 / oxides of nitrogen / greenhouse gas for pollutant gases accept nuclear burns no fuel accept gas does not cause acid rain do **not** accept they don't / none produce pollutant gases accept contributes to global warming / greenhouse effect	2

Question 3 continues on the next page . . .

PHY1H

Question 3 continued . . .

question	answers	extra information	mark
3(b)	nuclear power stations use a non-renewable fuel	accept uranium / plutonium is non-renewable do **not** accept some are unrenewable	1
Total			**3**

4.1.3 National and global energy resources

Answer 62 · Mark scheme January 2011 | PHY1H | Original Q3 | Legacy

PHY1H

Answer 63 · 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 <u>and</u> 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**

4.1.3 National and global energy resources

Answer 63 · Mark scheme January 2011 | PHY1H | Original Q4 | Legacy

PHY1H

4.1.3 National and global energy resources

Answer 64 · 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**

4.1.3 National and global energy resources

Answer 64 · Mark scheme January 2011 | PHY2H | Original Q4 | Legacy

PHY2H

Answer 65 · Mark scheme March 2011 | PHY1AP | Original Q3 | Legacy

Three	**A**	electrical	**3**
	B	kinetic	**4**
	C	light	**1**
	D	sound	**2**

Answer 66 · Mark scheme March 2011 | PHY1AP | Original Q9 | Legacy

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

4.1.3 National and global energy resources

Answer 66 · 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**

4.1.3 National and global energy resources

Answer 67 · Mark scheme June 2011 | PHY1AP | Original Q1 | Legacy

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

Answer 68 · Mark scheme June 2011 | PHY1AP | Original Q3 | Legacy

Three	**2**	**1**	**1**	**3**

Answer 69 · Mark scheme June 2011 | PHY1AP | Original Q8 | Legacy

Eight	**4**	**2**	**3**	**3**

Answer 70 · 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

4.1.3 National and global energy resources

Answer 71 · Mark scheme

June 2011 | PHY1H | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)(i)	decommissioning		1
2(a)(ii)	level of radiation **or** radiation dose (to workers) decreased	accept the isotope / cobalt(-60) has decayed (a lot) accept the isotope / cobalt(-60) has decayed in 2 half lives accept exposed to less radiation do **not** accept no radiation left	1
	less hazardous / dangerous (to workers health)	accept safer do **not** accept there is no hazard accept allows reactor to cool (down) an answer of radiation levels decrease by 75 % or drops to 25 % gains **2** marks	1
2(b)(i)	more in favour **or** fewer against	quoting figures alone is insufficient do **not** accept it increases ignore any reasons given	1

Question 2 continues on the next page

PHY1H

Question 2 continued

question	answers	extra information	mark
2(b)(ii)	any **one** from: • sample too small • do not know how many (people) were asked • different people asked (in different years) • sample not representative (of population) • people did not understand the questions • do not know who carried out the surveys • do not know if surveys asked same questions	do **not** accept they are biased unless acceptable reason for bias given	1

Question 2 continues on the next page

PHY1H

Question 2 continued

question	answers	extra information	mark
2(b)(iii)	any **one** from: • no / less pollutant gases produced • reliable source (of energy / electricity) • running out of fossil fuels • conserve fossil fuels • meet increasing demand • less reliance on imported fossil fuels / electricity • concentrated energy source(s) • lower transportation costs for fuel • to replace old <u>nuclear</u> power stations	accept a named gas accept does not contribute to global warming accept a named fossil fuel accept fossil fuels won't have to be used accept named fossil fuel ignore references to efficiency / job creation / local economy / selling electricity	1
2(c)	economic issues		1
Total			**7**

4.1.3 National and global energy resources

Answer 71 · Mark scheme June 2011 | PHY1H | Original Q2 | Legacy

PHY1H

Answer 72 · 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**

4.1.3 National and global energy resources

Answer 72 · Mark scheme June 2011 | PHY1H | Original Q4 | Legacy

PHY1H

Answer 73 · Mark scheme November 2011 | PHY1AP | Original Q1 | Legacy

Question	Key		
One	**A**	coal	**1**
	B	natural gas	**3**
	C	nuclear fuel	**2**
	D	wind	**4**

Answer 74 · Mark scheme November 2011 | PHY1AP | Original Q8 | Legacy

Eight	**3**	**4**	**4**	**2**

Answer 75 · Mark scheme November 2011 | PHY1BP | Original Q4 | Legacy

Four	**3**	**4**	**4**	**3**

4.1.3 National and global energy resources

Answer 76 · 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**

4.1.3 National and global energy resources

Answer 76 · Mark scheme

June 2012 | PH1HP | Original Q1 | Legacy

PH1HP

Answer 77 · Mark scheme

June 2012 | PH1HP | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	energy from hot rocks in the Earth	accept heat that occurs naturally in the Earth accept steam / hot water rising to the Earth's surface accept an answer in terms of the energy released by radioactive decay in the Earth heat energy is insufficient	1
3(a)(ii)	water is pumped / moved up (to a higher reservoir)	 this mark point only scores if first mark point is awarded	1 1
3(b)			6

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.

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant content	There is a brief description of at least one advantage or disadvantage for either the planned wind turbines or the suggested electricity power link.	There is a description of advantages and disadvantages for either the planned wind turbines or the suggested electricity power link. **or** A description of the advantages or disadvantages for both the planned wind turbines and the suggested electricity power link.	There is a clear and detailed description of at least one advantage and one disadvantage for both the planned wind turbines and suggested electricity power link.

Question 3 continues on the next page

PH1HP

Question 3 continued

examples of the points made in the response	extra information
Offshore wind turbines	
advantages	
• renewable (energy resource)	
• low running costs	
• energy is free	
• no gas emissions (when in use)	accept a named gas eg CO_2 accept no fuel is burned accept less dependent on fossil fuels
• land is not used (up)	
disadvantages	
• unreliable – accept wind does not always blow	ignore references to destroying or harming habitats
• hazard to birds / bats	
• visual pollution – do not accept noise pollution	do **not** allow if clearly referring to onshore wind turbines
• difficulty of linking turbines to the National Grid	do **not** accept spoils landscape
• large initial cost	
• difficult to erect / maintain	accept a lot of maintenance needed
• CO_2 emissions in manufacture (of large number of turbines)	

Question 3 continues on the next page

PH1HP

Question 3 continued

examples of the points made in the response	extra information
Suggested Link	
advantages	
• income for Iceland	
• using Iceland's (available) energy (resources)	accept using (Iceland's) renewable energy (resources) do **not** accept reduce the amount of Iceland's wasted energy
• provide electricity when wind does not blow / reliable	
• provide electricity at times of peak demand	
• even out fluctuations in supply	
• excess electricity from Britain (windy days) to Iceland and used to pump water up to store energy	
• Britain less dependent on fossil fuels	accept Britain needs fewer (new) power stations accept conserves fossil fuels
disadvantages	
• large initial cost	accept expensive (to lay cables)
• power loss along a long cable	
• (engineering) difficulties in laying / maintaining the cable	accept difficult to repair (if damaged)

Total			**9**

4.1.3 National and global energy resources

Answer 77 · Mark scheme

June 2012 | PH1HP | Original Q3 | Legacy

PH1HP

Answer 78 · Mark scheme

January 2013 | PH1HP | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	any **three** from: • gas can be switched on (and off) quickly but nuclear cannot • gas can be used to meet surges in demand • gas can contribute to / meet the base load • nuclear provides base load **or** nuclear is used to generate all of the time	gas has a short start-up time alone is insufficient accept specific times from graph, anything from 1700 to 2200	3

3(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
0 marks	**Level 1 (1-2 marks)**	**Level 2 (3-4 marks)**	**Level 3 (5-6 marks)**	
No relevant content.	There is a brief description of one advantage **or** disadvantage of using either biogas or wind **or** makes a conclusion with a reason.	There is a description of some advantages **and / or** disadvantages for biogas **and / or** wind **or** there is a direct comparison between the two systems **and** at least one advantage / disadvantage **or** a detailed evaluation of one system only with a conclusion.	There is a clear and detailed comparison of the two systems. There must be a clear conclusion of which system would be best with at least one comparative reason given for the choice made.	

Question 3 continues on the next page . . .

PH1HP

Question 3 continued . . .

examples of the points made in the response	extra information
Biogas	
• renewable	
• energy resource is free	
• reliable energy source	accept works all of the time
• does not depend on the weather	
• uses up (animal) waste products	
• concentrated energy source	
• cheaper (to buy and install)	accept once only
• shorter payback-time (than wind)	
• adds carbon dioxide to the atmosphere	when waste burns it produces carbon dioxide is insufficient
• contributes to the greenhouse effect **or** contributes to global warming	
• no transport cost for fuels	
Wind turbine	
• renewable	
• energy resource is free	
• not reliable	
• depends on the weather / wind	
• will be times when not enough electricity generated for the farm's needs	
• dilute energy source	
• longer payback-time (than biogas)	
• more expensive (to buy and install)	accept once only
• does not produce any carbon dioxide	accept pollutant gases for carbon dioxide accept does not pollute air
	produces visual or noise pollution is insufficient harmful gases is insufficient

Total			**9**

4.1.3 National and global energy resources

Answer 78 · Mark scheme

January 2013 | PH1HP | Original Q3 | Legacy

PH1HP

Answer 79 · Mark scheme

January 2013 | PH1HP | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	refracted into the block, angle r < i		1
	refracted correctly out of block, two rays in air parallel	judge by eye if first mark not scored allow **1** mark for correct refraction shown as ray leaves the block	1
4(b)(i)	the angle of refraction is (always) less than the angle of incidence		1
	the angle of refraction increases as the angle of incidence increases	accept angle i and angle r are **not** directly proportional accept there is positive correlation	1
4(b)(ii)	(for the same angle of incidence) the angle of refraction in plastic is less than the angle of refraction in water	accept (for the same angle of incidence) plastic refracts light more than water accept it is less	1
4(c)(i)	accept any sensible suggestion to do with being able to see inside (during daylight hours) eg able to (see to) work / cook inside	accept to see what they are doing lights up the room is insufficient ignore no need to pay for electricity	1
4(c)(ii)	accept any <u>ethical</u> suggestion, eg • fair access to energy for all • unequal use of energy resources • consequences for the future of decisions made now • damage to global environment affects all	damage to the environment is insufficient	1
Total			**7**

4.1.3 National and global energy resources

Answer 79 · Mark scheme

January 2013 | PH1HP | Original Q4 | Legacy

PH1HP

Answer 80 · Mark scheme

January 2013 | PH1HP | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	any **one** from: • energy / source is constant • energy / source does not rely on uncontrollable factors • can generate all of the time	accept a specific example, eg the weather will not run out is insufficient	1
6(b)	(dismantle and) remove radioactive waste / materials / fuel	accept nuclear for radioactive knock down / shut down is insufficient	1
6(c)	any **two** from: • reduce use of fossil fuelled power stations • use more nuclear power • use (more) renewable energy sources • make power stations more efficient • (use) carbon capture (technology)	accept specific fossil fuel accept use less fossil fuel accept build new nuclear power stations accept a named renewable energy source do **not** accept natural for renewable do **not** accept use less non-renewable (energy) sources	2
6(d)	(by increasing the voltage) the current is reduced this reduces the energy / power loss (from the cable) and this increases the efficiency (of transmission)	accept reduces amount of waste energy accept heat for energy do **not** accept stops energy loss	1 1 1
Total			**7**

4.1.3 National and global energy resources

Answer 80 · Mark scheme

January 2013 | PH1HP | Original Q6 | Legacy

PH1HP

4.1.3 National and global energy resources

Answer 81 · 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 ignore references to energy transfers	1
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 accept image marked where two reflected rays traced back cross behind the mirror	1
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**

4.1.3 National and global energy resources

Answer 81 · Mark scheme

June 2013 | PH1HP | Original Q3 | Legacy

PH1HP

4.1.3 National and global energy resources

Answer 82 · Mark scheme

June 2013 | PH1HP | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)(i)	produces carbon dioxide / nitrogen oxides that (may) contribute to global warming	accept greenhouse gases ignore pollutant gases accept causes global warming damages ozone layer negates this mark accept alternative answers in terms of: sulfur dioxide / nitrogen oxides causing acid rain	1 1
6(a)(ii)	carbon capture / storage **or** plant more trees **or** remove sulfur (before burning fuel)	answer must relate to part (a)(i) collecting carbon dioxide is insufficient	1
6(b)(i)	(power station can be used) to meet surges in demand	accept starts generating in a short time can be switched on quickly is insufficient	1
6(b)(ii)	can store energy for later use	accept renewable (energy resource) accept does not produce CO_2 / SO_2 / pollutant gases	1

Question 6 continues on the next page . . .

PH1HP

Question 6 continued . . .

question	answers	extra information	mark
6(c)(i)	turbines do not generate at a constant rate	accept wind (speed) fluctuates accept wind is (an) unreliable (energy source)	1
6(c)(ii)	any **one** from: • energy efficient lighting (developed / used) • increased energy cost (so people more likely to turn off) • more people becoming environmentally aware	use less lighting is insufficient accept electricity for energy	1
Total			**7**

4.1.3 National and global energy resources

Answer 82 · Mark scheme

June 2013 | PH1HP | Original Q6 | Legacy

PH1HP

4.1.3 National and global energy resources

Answer 83 · Mark scheme

June 2013 | PH2HP | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	plutonium (239)	accept Pu / Thorium / MOX (mixed oxide) do **not** accept uranium-238 **or** hydrogen	1
3(a)(ii)	(energy) used to heat water and produce (high pressure) steam the steam drives a turbine (which turns a generator)		1 1 1
3(b)	Neutron(s) shown 'hitting' other U-235 nuclei U-235 nuclei (splitting) producing 2 or more neutrons	one uranium nucleus is sufficient	1 1
3(c)	any **two** from: • neutrons are absorbed (by boron / control rods) • there are fewer neutrons • chain reaction slows down / stops	accept fewer reactions occur	2
Total			**8**

4.1.3 National and global energy resources

Answer 83 · Mark scheme

June 2013 | PH2HP | Original Q3 | Legacy

PH2HP

4.1.3 National and global energy resources

Answer 84 · Mark scheme June 2013 | PH2HP | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	78		1
5(b)	atomic		1
5(c)(i)	131 54	correct order only	1 1
5(c)(ii)	32 (days)	allow **1** mark for showing 4 half-lives provided no subsequent step	2
5(c)(iii)	limits amount of iodine-131 / radioactive iodine that can be absorbed so reducing risk of cancer (of the thyroid)	accept increases level of non-radioactive iodine in thyroid do **not** accept cancels out iodine-131 accept stops risk of cancer (of the thyroid)	1 1
Total			**8**

4.1.3 National and global energy resources

Answer 84 · Mark scheme

June 2013 | PH2HP | Original Q5 | Legacy

PH2HP

4.1.3 National and global energy resources

Answer 85 · Mark scheme

Question	Answers	Extra information	Mark	AO spec ref
1(a)	advantage any **one** from: • produce no / little greenhouse gases / carbon dioxide	allow produces no / little polluting gases allow doesn't contribute to global warming / climate change allow produce no acid rain / sulphur dioxide reference to atmospheric pollution is insufficient produce no harmful gases is insufficient	1	AO1 1.4.1a
	• high(er) energy density in fuel	accept one nuclear power station produces as much power as several gas power stations nuclear power stations can supply a lot of or more energy is insufficient		
	• long(er) operating life	allow saves using reserves of fossil fuels or gas		
	disadvantage any **one** from: • produce (long term) radioactive waste • accidents at nuclear power stations may have far reaching or long term consequences • high(er) decommissioning costs • long(er) start up time	accept waste is toxic accept nuclear for radioactive accept high(er) building costs	1	

Question 1 continues on the next page . . .

Question 1 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
1(b)(i)	12 000 (kWh)	allow **1** mark for correct substitution eg 2000 × 6 **or** 2 000 000 × 6 **or** $\frac{12\,000\,000}{1000}$ an answer of 12 000 000 scores **1** mark	2	AO2 1.3.1c
1(b)(ii)	any idea of unreliability, eg • wind is unreliable • shut down if wind too strong/weak • wind is variable	reference to weather alone is insufficient	1	AO1 1.4
1(c)	any **one** from: • cannot be seen • no hazard to (low flying) aircraft / helicopters • unlikely to be or not damaged / affected by (severe) weather • (normally) no / reduced shock hazard	unlikely to be damaged is insufficient safer is insufficient less maintenance is insufficient installed in urban areas is insufficient	1	AO1 1.4
Total			**6**	

4.1.3 National and global energy resources

Answer 86 · 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**	

4.1.3 National and global energy resources

Answer 87 · Mark scheme June 2014 | PH2HP | Original Q6 | Legacy

6(a)	(same) number of protons	same atomic number is insufficient	1	AO1 2.5.1e
6(b)(i)	nuclei split	do **not** accept atom for nuclei / nucleus	1	AO1 2.6.1b
6(b)(ii)	(nuclear) <u>reactor</u>		1	AO1 2.6.1a
6(c)	beta any **one** from: • atomic / proton number increases (by 1) • number of neutrons decreases / changes by 1 • mass number does not change • a neutron becomes a proton	 accept atomic / proton number changes by 1 (total) number of protons and neutrons does not change	1 1	AO2 2.5.2d
6(d)	(average) time taken for number of nuclei to halve **or** (average) time taken for count-rate / activity to halve		1	AO1 2.5.2h

Question 6 continues on the next page . . .

Question 6 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
6(e)(i)	6.2 (days)	Accept 6.2 to 6.3 inclusive allow **1** mark for correctly calculating number remaining as 20 000 **or** allow **1** mark for number of 80 000 plus correct use of the graph (gives an answer of 0.8 days)	2	AO2 2.5.2h
6(e)(ii)	radiation causes ionisation that may then harm / kill healthy cells	allow radiation can be ionising accept specific examples of harm, eg alter DNA / cause cancer	1 1	AO3 2.5.2g
6(e)(iii)	benefit (of diagnosis / treatment) greater than risk (of radiation)	accept may be the only procedure available	1	AO3 2.5.2g
Total			**11**	

4.1.3 National and global energy resources

Answer 87 · Mark scheme

June 2014 | PH2HP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO spec ref

Answer 88 · Mark scheme

June 2015 | PH1HP | Original Q5 | Legacy

The full source mark scheme begins on page 194. Follow original question 5 in that document.

4.1.3 National and global energy resources

Answer 89 · Mark scheme June 2015 | PH2HP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
3(a)(i)	splitting of a(n atomic) nucleus	do not accept splitting an atom	1	AO1 2.6.1b	**E**
3(a)(ii)	Neutron		1	AO1 2.6.1c	**E**
3(b)(i)	nuclei have the same charge **or** nuclei are positive	accept protons have the same charge	1	AO1 2.3.1d	**E**
3(b)(ii)	(main sequence) star	accept Sun or any correctly named star accept red (super) giant	1	AO1 2.6.2b	**E**
3(c)(i)	any **two** from: • easy to obtain / extract • available in (very) large amounts • releases more energy (per kg) • produces little/no radioactive waste	do **not** accept figures *only* naturally occurring is insufficient seawater is renewable is insufficient less cost is insufficient	2	AO2/3 2.6	**E**
3(c)(ii)	any **one** from: • makes another source of energy available • increases supply of electricity • able to meet global demand • less environmental damage • reduces amount of other fuels used	accept any sensible suggestion accept a specific example accept a specific example	1	AO3 2.6	**E**
3(d)	12	allow **1** mark for obtaining 3 half-lives	2	AO2 2.5.2h	**E**

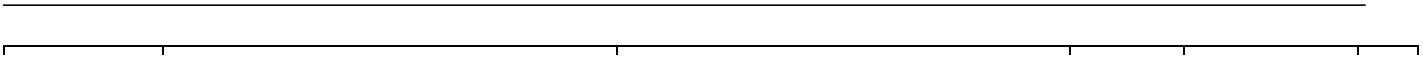
4.1.3 National and global energy resources

Answer 89 · Mark scheme

Total			**9**

4.1.3 National and global energy resources

Answer 89 · Mark scheme June 2015 | PH2HP | Original Q3 | Legacy



Answer 90 · Mark scheme June 2016 | PH1HP | Original Q2 | Legacy

The full source mark scheme begins on page 210. Follow original question 2 in that document.

Answer 91 · Mark scheme June 2016 | PH1HP | Original Q6 | Legacy

The full source mark scheme begins on page 210. Follow original question 6 in that document.

4.1.3 National and global energy resources

Answer 92 · Mark scheme

2	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	AO1 AO2 AO3 1.1.1cde

0 marks	**Level 1 (1-2 marks)**	**Level 2 (3-4 marks)**	**Level 3 (5-6 marks)**
No relevant information	A description of how at least **one** feature makes design A better than design B.	A basic explanation in terms of physical processes of how some features of design A make it better than design B.	A clear and correct explanation in terms of physical processes, including direct comparisons, of how most features of design A make it better than design B.

examples of physics points made in the response

colour of pipe:

- black (pipe) surface is a good absorber of IR radiation / energy

material of pipe:

- metal pipes are good conductors

or

- metal pipes are better conductors than plastic pipes
- higher rate of energy transfer through metal pipe

colour of surface:

- (inside of solar panel is) white / shiny surface which is a good reflector of IR radiation to the pipe
- (inside of solar panel is) white / shiny surface which is a poor absorber of IR radiation

Insulation:

- layer of insulation reduces conduction through base of solar panel

length of pipe / surface area of pipe:

- water is in solar panel for longer time
- water absorbs more energy
- pipe absorbs more IR

design A has a greater water temperature increase (could be linked to any feature)

extra information

accept converse answers in terms of why design B is worse than design A

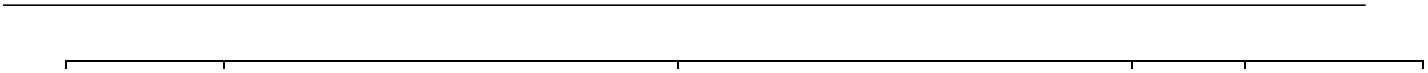
allow heat / radiation for IR throughout

Total			**6**

4.1.3 National and global energy resources

Answer 92 · Mark scheme

June 2017 | PH1HP | Original Q2 | Legacy



4.1.3 National and global energy resources

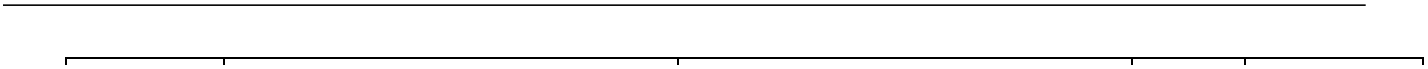
Answer 93 · Mark scheme June 2017 | PH1HP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)	any **two** from: • length / area / size / shape of turbine blades • wind speed • angle of blades / hairdryer	ignore mass / weight / number of turbine blades ignore material of turbine blades accept distance / position of hairdryer allow power setting on hairdryer ignore speed of the turbine spinning	2	AO3 1.4.1b
3(b)(i)	3 points plotted correctly	allow **1** mark for 1 or 2 points plotted correctly ignore any line of best fit drawn	2	AO2 1.4.1b
3(b)(ii)	random (error)	ignore reference to anomaly	1	AO3 1.4.1b
3(b)(iii)	zero output voltage with 1 blade (as number of blades increases) output voltage increases	accept turbine didn't rotate with 1 turbine blade accept (as number of blades increases) speed increases do not accept direct proportion	1 1	AO3 1.4.1b
3(c)	any **two** from: • output voltage / power (required) • mass / weight / material / area / size / shape / length of blades • height / position / location of turbine • cost to construct turbine • environmental impact of wind turbine	ignore reference to efficiency ignore number of blades unqualified allow payback time accept reference to noise / visual pollution	2	AO3 1.4.1b
Total			**9**	

4.1.3 National and global energy resources

Answer 93 · Mark scheme

June 2017 | PH1HP | Original Q3 | Legacy



4.1.3 National and global energy resources

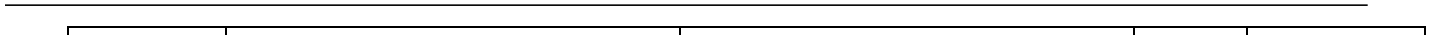
Answer 94 · Mark scheme June 2017 | PH1HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	wood / charcoal / peat	allow named solid dried plant material or animal product do not accept seashells	1	AO1 1.4.1a
5(b)	380 (°C)	allow **1** mark for correct substitution ie $8.36 \times 10^7 = 250 \times 880 \times \theta$	2	AO2 1.1.4d
5(c)	(white is a) poor emitter of IR radiation (curved surface) has a small surface area (to volume ratio) (high specific heat capacity means) large amount of energy needed to transfer to surroundings before temperature decreases (significantly) (low U-value means) concrete is a poor conductor **or** a (good) insulator	allow heat for IR ignore white is a good reflector only or poor absorber	1 1 1 1	AO1 AO2 1.1.4d 1.1.3c
Total			**7**	

4.1.3 National and global energy resources

Answer 94 · Mark scheme

June 2017 | PH1HP | Original Q5 | Legacy



4.1.3 National and global energy resources

Answer 95 · Mark scheme June 2017 | PH1HP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	6.3 (W)	accept an answer that rounds to 6.3 W allow **1** mark for correct substitution ie $0.40 = \left(\frac{2.5}{\text{total power}}\right)$ **or** $40 = \left(\frac{2.5}{\text{total power}}\right) \times 100$	2	AO2 1.2.1d
6(b)	4 (hours)	allow **2** marks for an answer of 14 400 (seconds) **or** allow **2** marks for an answer of 240 (minutes) allow **1** mark for correct substitution ie 36 000 = 2.5 x t allow **2** marks for an answer of 0.004 allow **1** mark for an answer of 14.4 for a student who uses 6.3 W or 6.25 W allow **2** marks for an answer of 1.6 hours allow **1** mark for an answer of 5714 or 5760 or 5.71 or 5.76	3	AO2 1.3.1c
6(c)	lower power input (because) solar cells not pointed directly at Sun **or** large amount of cloud **or** solar cells in shade **or** dust on solar cells	allow less light ignore efficiency or description of energy transfer to the surroundings weather is insufficient	1 1	AO1 1.4.1c

4.1.3 National and global energy resources

Answer 95 · Mark scheme

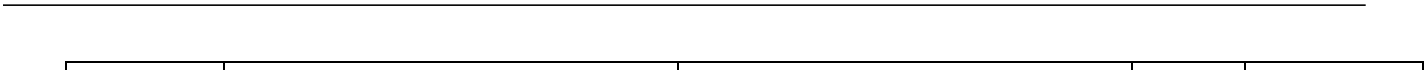
June 2017 | PH1HP | Original Q6 | Legacy

6(d)		accept converse answers which refer to the phone switched off		AO2 1.3.1a,b
	(when the phone is switched on) energy from the solar cell is transferred to the battery and the phone **or** only some of the energy from the solar cell charges the battery	accept power for energy in first marking point only	1	
	(so) the battery stores less energy per second	takes less time to charge when switched off is insufficient	1	
Total			**9**	

4.1.3 National and global energy resources

Answer 95 · Mark scheme

June 2017 | PH1HP | Original Q6 | Legacy



4.1.3 National and global energy resources

Answer 96 · Mark scheme

June 2018 | 8463/1H | Original Q8

Question	Answers	Extra information	Mark	AO/ Spec. Ref
08.1	any **three** from: • no carbon dioxide emitted (to produce electricity) • doesn't cause global warming • nuclear power doesn't cause earthquakes • more energy released per kg of fuel (compared to shale gas)	no greenhouse gases is insufficient allow climate change or greenhouse effect for global warming	3	AO1 AO2 4.1.3
08.2	uranium **or** plutonium	ignore any numbers given	1	AO1 4.4.4.1
08.3	a neutron is absorbed by a (large) nucleus the nucleus splits into two (smaller) nuclei releasing energy (and gamma rays) and (two / three) neutrons	a description in terms of only atoms negates first two marking points	1 1 1 1	AO1 4.4.4.1
Total			**8**	

4.1.3 National and global energy resources

Answer 97 · 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**	

Answer 98 · 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	

Answer 99 · Mark scheme

November 2020 | 8463/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	Any **one** from: • (medical) x-rays • radiotherapy • nuclear weapons (testing) • named nuclear disaster eg Chernobyl / Fukushima / Three Mile Island.	allow CT scans allow nuclear fallout ignore radioactive / nuclear waste	1	AO1 4.4.3.1
05.2	uranium / plutonium	ignore any number given allow thorium	1	AO1 4.4.4.1
05.3	neutron absorbed by a uranium nucleus nucleus splits into two parts and (2 / 3) neutrons (are released) and gamma rays (are emitted)	 allow an atom splits into two parts if 1st marking point doesn't score 	1 1 1 1	AO1 4.4.4.1
05.4	lighter nuclei join to form heavier nuclei some of the mass (of the nuclei) is converted to energy (of radiation)	allow specific examples	1 1	AO1 4.4.4.2
05.5	activity decreases quickly risk of harm decreases quickly	allow nuclei / waste will decay at a greater rate ignore waste is radioactive for less time allow burial site doesn't need to be monitored for as long **or** doesn't need to be buried underground for as long **or** may not need to be buried underground	1 1	AO3 4.4.2.3
Total			**10**	

Answer 100 · Mark scheme

November 2021 | 8463/1H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	nuclei decreases	do not accept atoms	1 1	AO1 4.4.4.2
02.2	m = 0.004 (kg) E = 0.004 × 5200 × 50 000 000 E = 1.04 × 10^9 (J) **or** E = 1 040 000 000 (J)	 allow a correct substitution of an incorrectly/not converted value of m allow a correct calculation using an incorrectly/not converted value of m	1 1 1	AO2 4.3.2.2 4.1.1.3
02.3	any **two** from: • to make sure the fusion process is possible • to develop an understanding of the process • to make adaptations to the process • to assess the efficiency of the process • to make predictions • assess safety risks • to assess environmental impact • set-up cost is lower (for small scale experiments)		2	AO3 4.1.3

02.4	releases carbon dioxide which causes global warming **OR** releases particulates which causes global dimming **or** which causes breathing problems **OR** releases sulfur dioxide which causes acid rain **OR** releases nitrogen oxides which causes breathing problems **or** which causes acid rain	allow releases greenhouse gases allow which causes climate change	1 1	AO1 4.1.3
Total			**9**	

Answer 101 · 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	

4.1.3 National and global energy resources

Answer 101 · 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**	

4.1.3 National and global energy resources

Answer 102 · Mark scheme

June 2022 | 8463/1H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	*P* = 696 000 000 (W) *P* = 1200 (W)	 allow an answer consistent with their incorrectly / not converted value of *P*	1 1	AO2 4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	any **2** from: • wind is unreliable • wind turbines don't turn when the wind is too strong/weak • there are not enough wind turbines (in the UK)	 allow it was not windy (on that day) allow some wind turbines may be offline for maintenance allow energy from wind may not be enough (to generate 34 000 MW) ignore weather conditions unqualified	2	AO2 4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	the efficiency would increase because the percentage / proportion / amount of energy usefully transferred would increase **or** because the percentage / proportion / amount of energy wasted would decrease (because) less (work is done against) friction	 ignore more electricity generated allow less energy wasted	1 1 1	AO3 AO1 AO1 4.1.2.1 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	more efficient devices waste less energy **or** more efficient devices need a lower energy input (for the same energy output)	ignore use less electricity	1	AO3 4.1.2.2 4.1.3
	which would minimise the electricity / energy demand **or** which would minimise the environmental impact from (fossil fuel) electricity generation	allow less electricity needs to be generated allow lower energy / electricity bill allow examples of environmental impact e.g. lower CO_2 emissions ignore 'better for the environment' unless qualified ignore answers that discuss 'saving energy' unless qualified ignore answers that discuss alternative methods of generating electricity	1	

Total Question 1		**9**

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	

4.1.3 National and global energy resources

Answer 103 · 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**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	Similarities: • same number of protons **or** same atomic number • same number of electrons Difference: • different number of neutrons **or** different mass number	 allow both atoms / nuclei contain 6 protons allow carbon-12 has 6 neutrons **and** carbon-14 has 8 neutrons	 1 1 1	AO1 4.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	the time it takes for the number of nuclei (in a radioactive sample) to halve (is 5700 years) **or** the time it takes for the activity (of a radioactive sample) to halve (is 5700 years) **or** the time it takes for the radiation emitted (by a radioactive sample) to halve (is 5700 years) **or** the time it takes for the count rate (of a radioactive sample) to halve (is 5700 years) **or** the time it takes for the mass of carbon-14 (in a sample) to halve (is 5700 years)	allow atoms for nuclei ignore radioactivity	1	AO1 4.4.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	2 half-lives 128.74 (s)	 allow 129 (s)	1 1	AO2 4.4.2.3

4.1.3 National and global energy resources

Answer 104 · Mark scheme June 2023 | 8463/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	nitrogen-18		1	AO3 4.4.2.1
	greatest activity	MP2 and MP3 dependent on scoring MP1 allow emits most radiation per second allow emits most radiation in a given time period ignore shortest half-life	1	4.4.3.3
	(so) greatest dose of radiation absorbed (per second)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	irradiation is the exposure of an object / person to radiation	allow 'absorption of radiation' for 'exposure' allow specific examples of ionising radiation	1	AO1 4.4.2.4
	(while) contamination is the (unwanted) presence of radioactive material / atoms on an object / person	allow 'inside a person' for 'on an object / person'	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	any **one** from: • cancer / tumours • DNA / genetic mutation • damages / kills cells • radiation poisoning / sickness / burns	ignore mutates cells ignore death	1	AO3 4.4.3.3

Answer 104 · Mark scheme

June 2023 | 8463/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	some radioactive materials emit alpha radiation which has a (very) short range (in air)	 MP2 dependent on scoring MP1 allow weakly penetrating for short range (in air)	1 1	AO3 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.8	pilot's dose in 24 hours = 0.072 (mSv) number of days = $\frac{0.072}{0.00050}$ number of days = 144 OR nuclear power worker hourly dose = 0.0000208… (mSv) (1) number of days = $\frac{0.0030}{0.0000208}$ (1) number of days = 144 (1) OR $\frac{\text{hourly dose}}{\text{daily dose}} = \frac{0.0030}{0.00050} = 6$ (1) number of days = 6 × 24 (1) number of days = 144 (1)		1 1 1	AO2 4.4.3.1

Total Question 5	17

Answer 105 · Mark scheme

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.		

4.1.3 National and global energy resources

Answer 105 · 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)	allow don't use other transport methods e.g. (diesel) buses allow fossil fuels for petrol / diesel	1	AO3 4.1.3
	(instead) use electric cars **or** (instead) use hydrogen-fuelled cars **or** (instead) use a bicycle **or** (instead) use public transport **or** (instead) walk		1	
	Generating Electricity examples: don't use coal / oil / gas (to generate electricity)	allow fossil fuels for coal / oil / gas	1	
	(instead) use renewable methods **or** (instead) use nuclear power	allow specific examples of renewable energy resources	1	
	OR don't use (electrical) appliances when not needed	allow specific examples e.g. lights		
	to reduce the demand for electricity (generated) using coal / oil / gas	allow fossil fuels for coal / oil / gas accept other reasonable changes with valid alternative for 2 marks each		

Total Question 1	10

Answer 106 · Mark scheme

June 2024 | 8463/1H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	nuclei neutrons gamma (rays)	this order only	1 1 1	AO1 4.4.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	energy = power × time **or** $E = P \times t$		1	AO1 4.2.4.2 4.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	P = 500 000 000 (W)		1	AO2 4.2.4.2 4.1.1.4
	E = 500 000 000 × 3600	allow a correct substitution of an incorrectly / not converted value of P	1	
	E = 1 800 000 000 000 (J) **or** $E = 1.8 \times 10^{12}$ (J)	allow an answer consistent with an incorrectly / not converted value of P	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	any **one** from: • bury the radioactive waste • put the radioactive waste in cooling ponds • transport the radioactive waste in secure vessels • store the radioactive waste in metal containers • cover the radioactive waste in concrete	allow store it for (at least) one half-life ignore references to high / medium / low level waste ignore label the waste as hazardous	1	AO3 4.4.2.4

4.1.3 National and global energy resources

Answer 106 · Mark scheme

June 2024 | 8463/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	number of days = $\frac{92}{100} \times 365$		1	AO2 4.1.3
	number of days = 335.8	allow answers of 335 and 336 days allow an answer of 29.2 (days) for 1 mark	1	

Total Question 2	10

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	renewable: (an energy resource that is) replenished *(*as it is used*)*	allow replaced for replenished ignore has an infinite supply ignore not running out ignore sustainable	1	AO1 4.1.3
	non-renewable: (an energy resource that is) finite	allow limited supply ignore running out ignore won't last forever	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	density = $\frac{\text{mass}}{\text{volume}}$ **or** $\rho = \frac{m}{V}$		1	AO1 4.3.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	$1030 = \frac{824\,000}{V}$		1	AO2 4.3.1.1
	$V = \frac{824\,000}{1030}$		1	
	$V = 800\ (m^3)$		1	

4.1.3 National and global energy resources

Answer 107 · Mark scheme

June 2025 | 8463/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	any **two** from: • at very low flow speeds there is no power output • tidal power output is (always) greater than wind power output for the same flow speeds (above 0.25 m/s) • a change in flow speed makes a bigger difference to tidal power output than wind power output • there is a non-linear relationship between flow speed and power output	allow wind power needs a higher flow speed to get the same power output (as tidal power) ignore reference to exponential relationships do **not** accept flow speed of tidal is less than flow speed of wind ignore comments about reliability or efficiency	2	AO3 4.1.3

Answer 107 · Mark scheme

Question	Answers	Mark	AO / Spec. Ref.
01.5	**Level 2:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	3–4	AO3 4.1.3
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	
	Indicative content • wind turbine is much larger than the tidal turbine • wind turbine causes more visual pollution than the tidal turbine • tidal turbine is hidden from view (as it is under water) • tidal turbine is less likely to cause noise pollution (as it is under water) • wind turbine is likely to make more noise • wind turbine needs more raw materials (for construction) • more wind turbines needed for same power output (at the same flow speed) • wind turbine will harm birds, whereas tidal turbine will not • tidal turbine may harm fish, whereas wind turbine will not		

Total Question 1	12

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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4.1.3 National and global energy resources

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4.1.3 National and global energy resources

GCSE PHYSICS

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;
- 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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4.1.3 National and global energy resources

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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4.1.3 National and global energy resources

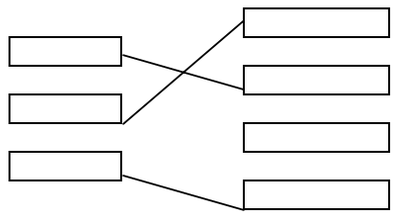
3451F Q2

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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4.1.3 National and global energy resources

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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4.1.3 National and global energy resources

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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4.1.3 National and global energy resources

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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4.1.3 National and global energy resources

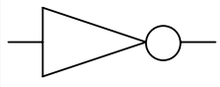
3451F Q6

	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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4.1.3 National and global energy resources

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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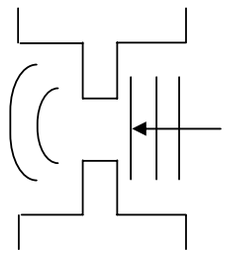
4.1.3 National and global energy resources

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	accept finish for E accept correct numbers from axes with units	1
	least steep part of the graph	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
total			6

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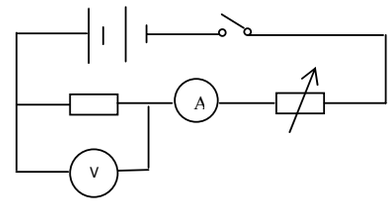
3451F Q9

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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4.1.3 National and global energy resources

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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4.1.3 National and global energy resources

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 $1.8 \times 30)$ i.e. adding the correct 2 power values	2
total			9

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4.1.3 National and global energy resources

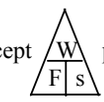
3451F Q12

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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4.1.3 National and global energy resources

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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4.1.3 National and global energy resources

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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4.1.3 National and global energy resources

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 do **not** accept numerical values unless expanded	1
	… (both) inputs are on / high / 1 **or** current flows in both inputs		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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4.1.3 National and global energy resources

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>	describes 3 tracks correctly for **2** marks describes 2 or 1 track correctly for **1** mark	max 2
	C – alpha particle heading straight for the <u>nucleus</u> is <u>deflected</u> / <u>repelled</u> / <u>repulsed</u> backwards	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	
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

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4.1.3 National and global energy resources

Further copies of this Mark Scheme are available from:

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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;
- 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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4.1.3 National and global energy resources

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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4.1.3 National and global energy resources

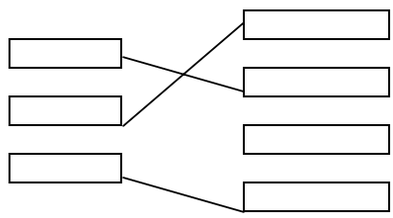
3462/3F Q2

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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4.1.3 National and global energy resources

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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4.1.3 National and global energy resources

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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4.1.3 National and global energy resources

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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4.1.3 National and global energy resources

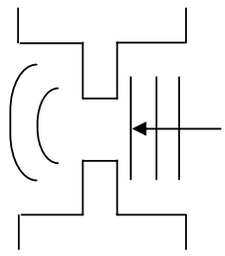
3462/3F Q6

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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4.1.3 National and global energy resources

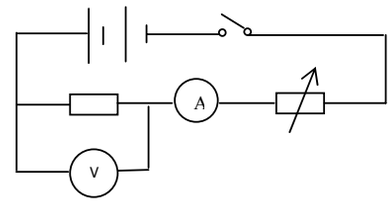
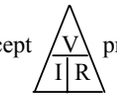
3462/3F Q7

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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4.1.3 National and global energy resources

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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4.1.3 National and global energy resources

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 1.8×30) i.e. adding the correct 2 power values	2
total			9

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4.1.3 National and global energy resources

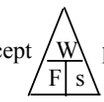
3462/3F Q10

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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4.1.3 National and global energy resources

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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4.1.3 National and global energy resources

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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Version 1.0: 0906

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Physics 3451/F
Specification B

Mark Scheme

2006 examination - June series

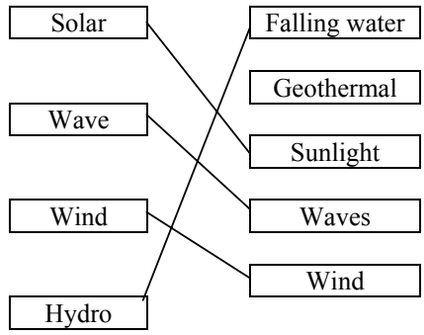
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Physics (Specification B)
Foundation Tier 3451/F

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

4.1.3 National and global energy resources

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

4.1.3 National and global energy resources

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

4.1.3 National and global energy resources

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

4.1.3 National and global energy resources

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 swap the brown and blue wires round	accept wires must be connected to screws	1 1
total			4

3451/F Q6

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

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

4.1.3 National and global energy resources

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>

Physics B – AQA GCSE Mark Scheme, 2006 June series

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

4.1.3 National and global energy resources

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

4.1.3 National and global energy resources

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

4.1.3 National and global energy resources

3451/F Q13

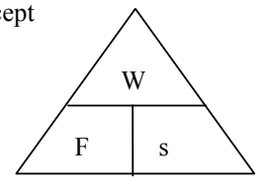
question	answers	extra information	mark
(a)	0.5 hertz	 accept Hz but **not** HZ / hz / hZ accept (waves) per second **or** / sec **or** / s **or** s^{-1} **or** sec^{-1}	1 1
(b)	any **one** from: • any named part of the electromagnetic spectrum • S – waves / secondary waves • wave on a rope	 do **not** 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 longitudinal – disturbance / vibration is parallel to the direction of energy transfer / wave travel	accept a correctly labelled diagram accept a correctly labelled diagram part explanation of the difference between transverse **and** longitudinal gains **1** mark	1 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

4.1.3 National and global energy resources

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 <u>increases</u> / is <u>longer</u> **or** thinking distance <u>increases</u>	do **not** accept reaction time slower **or** reactions are slower	1
	stopping distance / it <u>increases</u>	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

4.1.3 National and global energy resources

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

4.1.3 National and global energy resources

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

Physics B – AQA GCSE Mark Scheme, 2006 June series

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

4.1.3 National and global energy resources

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

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>

Version 1.0: 0906

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.

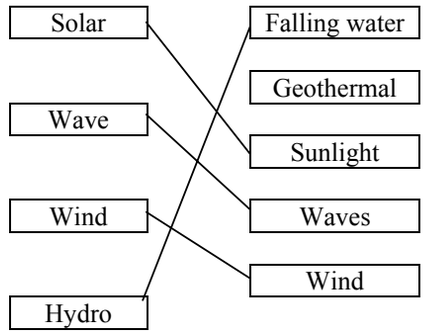
It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment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

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

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

4.1.3 National and global energy resources

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 <u>and</u> time in hours or seconds	2
total			5

4.1.3 National and global energy resources

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

4.1.3 National and global energy resources

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

4.1.3 National and global energy resources

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

4.1.3 National and global energy resources

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

4.1.3 National and global energy resources

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

4.1.3 National and global energy resources

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

4.1.3 National and global energy resources

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

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

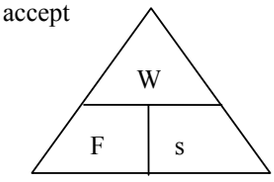
4.1.3 National and global energy resources

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

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

4.1.3 National and global energy resources

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

AQA

GCSE

Science A / Physics

PH1HP

Mark scheme

4405/4403
June 2015

Version/Stage: 1.0 Final

4.1.3 National and global energy resources

PMT

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

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PMT

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

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

4.1.3 National and global energy resources

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**	

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

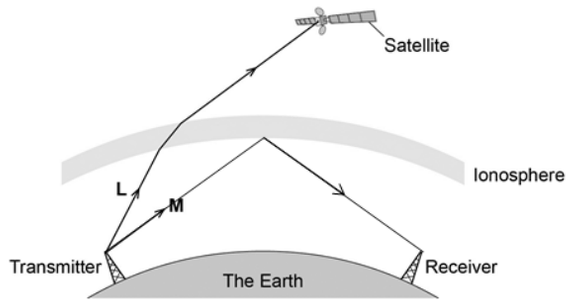
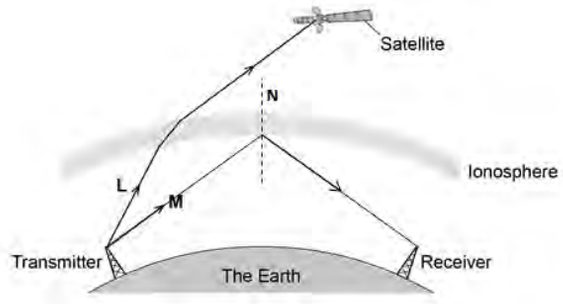
Question 2 continued . . .

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 . . .

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 . . .

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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**	

4.1.3 National and global energy resources

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	

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

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**	

AQA

GCSE

Science A / Physics

PH1HP

Mark scheme

4405/4403
June 2016

Version 1.0: Final Mark Scheme

4.1.3 National and global energy resources

PMT

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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PMT

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

3.2 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.

4.1.3 National and global energy resources

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**	

4.1.3 National and global energy resources

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) • both have very small (allow 'no') running costs • no carbon dioxide produced	 accept carbon neutral accept no greenhouse gases 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**	

4.1.3 National and global energy resources

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**	

4.1.3 National and global energy resources

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

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) 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 accept a specific numerical example	1 1	AO2 AO3 1.4.1c
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 . . .

4.1.3 National and global energy resources

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**	

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

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 98 · Examiner comments

November 2020 | 8463/1H | Original Q3

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.

Answer 99 · Examiner comments

November 2020 | 8463/1H | Original Q5

Question 5 (Standard/High demand)

05.1 40% of student scored a mark on this question. Electronics, microwaves, phones and food and drink were common incorrect responses. Man-made doesn't mean 'made by man' in this context it refers to the radiation source being artificial rather than naturally occurring. Incorrect answers commonly seen included things which are not man-made, eg sunlight, cosmic rays, other types of radiation which do not contribute to background radiation like microwaves or infrared.

05.2 74% of students could name a nuclear fuel. The most popular answer being 'uranium'. Commonly seen incorrect answers included coal, oil, gas and petrol.

05.3 Only 6% of students scored all 4 marks. To score the first marking point, students needed to indicate that the neutron becomes part of the U-235 nucleus, it was insufficient to only say that the neutron collides with the nucleus. Very few students scored the 4th marking point. Many students hadn't revised the process, evidenced by their meandering discussion of different radiation types and gold sheets. Whilst many students had some idea of the nuclear fission process, they often failed to gain marks because their answers lacked detail or were imprecise, eg neutrons being absorbed by 'atoms' rather than 'nuclei', a nucleus 'splitting' without the detail of two daughter nuclei being produced. A number of students went on to describe the chain reaction and / or the process of electricity generation which was unnecessary.

05.4 Only 8% of students scored both marks, with 29% of students scoring 1 mark. Elements fuse or atoms fuse was insufficient. Nuclei fuse was insufficient unless they said to form a larger / heavier nucleus. Very few knew that some of the mass of the nuclei was converted into energy. Some students fell back on their knowledge of chemical reactions and mentioned breaking bonds and exothermic reactions.

05.5 Only 8% of students scored 2 marks, 39% of students scored 1 mark. Very few students linked the short half-life to how the activity of the waste would change with time. Most students who scored the first marking point did so for saying the radioactive waste would decay quicker. Students tended to score the second marking point rather than the first, although vague statements like less harm/damage to the environment were insufficient.

4.1.3 National and global energy resources

Answer 100 · Examiner comments November 2021 | 8463/1H | Original Q2

Question 2 (Common Question)
Question **02.1** was not very well answered, around half the students scored the first marking point, but very few scored the second. The calculation was well answered, the most common mistake was not converting the mass from g to kg. Questions **02.3** and **02.4** were generally well answered due to the numerous options allowed in the mark scheme.

Answer 101 · 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 103 · 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

Answer 103 · 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.

4.1.3 National and global energy resources

Answer 104 · Examiner comments

June 2023 | 8463/1H | Original Q5

Question 5 (Standard/high Demand)

05.1 This question discriminated well with 43 % of students scoring 3 marks, 18 % of students scoring 2 marks and 17 % of students scoring 1 mark. There is evident confusion about the significance of the mass number and the atomic number and what they represent. Lots of students 'shot themselves in the foot' by making statements about incorrect numbers of particles. e.g. 'Number of neutrons in carbon-12 is different from carbon-14, it's 12 in carbon-12 and 14 in carbon-14', would score no marks. Any numbers given as examples had to be correct to score marks.

05.2 'Time for radioactivity to halve' was insufficient to score, which was a commonly seen answer. If a student specified 'the time to halve' they needed to be clear what was halving: mass, number of nuclei, activity, etc. 47% of students scored the mark for this question.

05.3 Students struggled to realise that if ¼ remained two half-lives had passed. Subsequently, any calculation they did scored no marks. 32% of students scored 2 marks. For only 1 mark to score the words '2 half-lives' needed to be seen, it was not sufficient to see the number '2'.

05.4 Most students incorrectly chose Fluorine-18 as causing the biggest risk, believing that its long half-life would cause the most harm. Students who chose nitrogen-18 were often imprecise in their explanation and used 'more radiation emitted' without indicating the time period over which the more radiation was emitted. 'Decays the fastest' was insufficient to score the 2nd marking point. Less than 1% of students scored 3 marks, 7% scored 2 marks and 15% scored 1 mark.

05.5 Students who had learned the definitions as stated in the specification scored well, with 18% of students scoring 2 marks. Many students were unclear of the difference between the two terms and gave vague answers about 'radiation being around you versus in you', which were insufficient to score. It was evident that many students don't appreciate that radioactive materials emit radiation and gave confused answers mixing the terms 'radiation' and 'radioactive'.

05.6 90% of students answered correctly, scoring a mark. The most common correct answer was 'cancer'. 'Death' was ignored as working with nuclear radiation would cause other specific harm before death occurred. 'Damage to tissues / organs' was also creditworthy, as they are made up of cells. As ionisation occurs at an atomic level, this was not sufficient to score a mark. A commonly seen incorrect answer was 'ionises cells'.

05.7 38% of students scored 2 marks on this question, while 3% of students scored 1 mark. Students who didn't mention alpha radiation / particles would not have scored marks. Some students thought that standing close to the radiation detector would help to rule out radiation due to background radiation, which was not creditworthy.

05.8 82% of students scored 3 marks usually for using the first method given in the mark scheme. Some students calculated 144 (days) but thought they had calculated hours so divided by 24 and wrote an answer of 6. They scored 2 marks, as their final answer was treated as a unit error.

4.1.3 National and global energy resources

AQA

GCSE
PHYSICS

8463/1H: Paper 1 (Higher tier)
Report on the Examination

8463
June 2022

Version: 1.0

4.1.3 National and global energy resources

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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.

4.1.3 National and global energy resources

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.

4.1.3 National and global energy resources

Questions matter

GCSE

Physics

8463/1H Paper 1 Higher Tier

Report on the Examination

8463
June 2024

Version: 1.0

4.1.3 National and global energy resources

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REPORT ON THE EXAMINATION – GCSE PHYSICS – 8463/1H– JUNE 2024

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.

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 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)

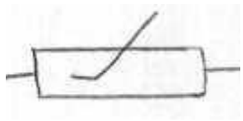
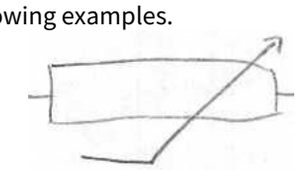
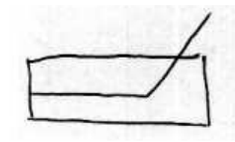
05.1 72% of students scored 2 marks, while 15% of students scored 1 mark. A number of students thought mains p.d. was 240 V. It was officially changed to 230 V in 1987 and this is the value given in the specification. However, it was more common for students to get the p.d. correct and the frequency 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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4.1.3 National and global energy resources

Mark Ranges and Award of Grades

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Questions matter

GCSE
Physics
8463/1H

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4.1.3 National and global energy resources

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General

Grade 4-5 calculation questions ask for students to recall an equation first before using it in a subsequent calculation, however in the 2025 series, students were provided with all of the equations on the Physics Equations Sheet. Subsequently, the performance on all calculations has improved compared with years when equations have needed to be recalled from memory.

The grade 8-9 multistep calculations, question **09.2** and **10.1**, were well attempted with many students scoring full marks. Question **09.2** had nearly three quarters of the students scoring 6 marks, while question **10.1** had almost 60 % of the students scoring 6 marks.

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

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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.

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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.

03.1

An answer of; 'Increase the resistance' without a method to do so was insufficient. 'Use the variable resistor' was just enough to score a mark, given there is a variable resistor in the circuit provided. Just over 60 % of the students scored the mark.

03.2

Almost all of the students chose the correct equation linking *I*, *V* and *R*.

03.3

Just fewer than 90 % of the students scored 4 marks, while a further 7 % of the students scored 3 marks. Reading the value of current from the graph proved difficult for a small minority of the students. A large tolerance was allowed for mark points 2, 3 and 4.

03.4

Most students identified that LEDs only allow charge to flow in one direction. Current in one direction was equivalent to this. Some students incorrectly thought that the ammeter was not capable of measuring a negative current, or thought that the order of the components mattered, or that the switch was open. Just over 20 % of the students scored 2 marks, while almost 30 % of the students scored 1 mark.

04.1

For marking point 1 a link was needed between the type of gas and the effect it has i.e. the greenhouse effect. Students who incorrectly linked carbon dioxide to ozone depletion could not score the first marking point. Most of the students scored at least 1 mark.

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04.2

Just fewer than 80 % of the students read the correct value of 8000 kg from the graph. Students who answered incorrectly usually chose the wrong car and wrote 5000 kg or read the maximum value when the electric car had driven 100 000 km.

04.3

Just over 90 % of the students scored the mark for correctly reading where the two lines crossed over on the graph. A large tolerance was allowed as the two lines had similar gradients at the cross-over point.

04.4

A surprising number of the students thought that carbon dioxide exhaled by the passengers of the car was the cause of the additional carbon dioxide being released. Other incorrect ideas involved the breakdown of the battery or the tyres or the catalytic converter. Few students stated that the car/battery needed (re) charging. Even fewer students linked the electricity generated to a type of energy resource and usually just repeated the information given in the question. Only 15 % of the students scored 2 marks, while a further 35% of the students scored 1 mark.

04.5

Just over 70 % of the students chose nuclear and solar as the correct energy resources. The most common incorrect choice was biofuel.

05.1

Just over 80 % of the students scored 2 marks for correctly describing what is meant by an isotope of an element. The number of electrons was ignored as this does not define an isotope.

05.2

Students needed to say light / lighter / small nuclei to demonstrate they understood that it is only lighter nuclei which fuse. The word fuse could have been substituted for other words like ‘join’, or ‘combine’ but ‘collide’ was insufficient. Some students demonstrated an excellent understanding of the fusion process and fusion in stars was accurately described. Fusion on earth where an extra neutron is released was ignored, as the process as stated in the specification was being tested. Just fewer than 20 % of the students scored 3 marks, while nearly 30 % of the students scored 2 marks and approximately 15 % of the students scored 1 mark.

05.3

Most students who scored a mark did so for stating that the reactor walls should not melt. Few students scored the first marking point. Most students were vague and used phrases like the walls need to ‘withstand the high temperatures’ which did not score a mark. Many students confused specific heat capacity with thermal conductivity and thermal insulation. Containing the fusion energy or products was another common insufficient response. Only

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about 4 % of the students scored 2 marks, while approximately 40 % of the students scored 1 mark.

05.4

Just over 30 % of the students scored the mark for the consequence of an uncontrolled chain reaction. 'Explosion' unqualified was insufficient to score the mark.

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.

07.1

Nearly all of the students chose the correct reason for why scientists change the model used to describe the structure of an atom.

07.2

Many students were confused about the distinction between irradiation and radioactive contamination. Many thought that it had to do with being exposed to radiation inside or outside the body, or one causing harm the other not causing harm. Exposure to a radioactive source was insufficient to score the irradiation mark. Without using the word 'exposed' students often did not express their ideas clearly enough. 'Absorbing radiation from a source' would have been another way of gaining credit for this idea. Students were more secure explaining what radioactive contamination meant and often gave examples like 'radioactive dust' or radioactive atoms' being present on or in people / objects. Almost a quarter of the students scored 2 marks, while just over 40 % of the students scored 1 mark.

07.3

About 90 % of the students scored 2 marks for this nuclear equation, while about 5 % of the students scored 1 mark.

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07.4

'4 half-lives' needed to be seen to score the first mark, the number '4' was not sufficient by itself for a mark. The most common mistake was to divide 256 000 by 16 000 to give an answer of 16, which scored no marks. Just over 70 % of the students scored 3 marks.

07.5

More / less active was insufficient as was a description of activity in terms of rate of decay.
Just over 20 % of the students scored 2 marks, while a further 12 % of the students scored 1 mark.

08.1

Just fewer than 90 % of the students scored 4 marks on this calculation of specific latent heat. Students who did not convert or incorrectly converted the mass could score a maximum of 3 marks.

08.2

Most students did not refer to the energy of the particles in terms of kinetic and potential energy, so scoring no marks. Many students thought the kinetic energy of the particles changed which limited them to scoring only the first marking point. Only about 3 % of the students scored 2 or 3 marks, while just over 10 % of the students scored 1 mark.

08.3

Students made good attempts at answering this challenging question about gas pressure. Technical accuracy was important for the second and third marking points, so it needed to be clear that particle collisions with the container walls were more frequent, more often or at a greater rate of collision. More frequent collisions between particles was insufficient for the second mark. The third marking point needed to reference the forces involved in collisions with the container walls, an implied greater force per collision was acceptable, but not a macroscopic force linked to force and area as that was not being tested. Almost half of the students scored 3 or 4 marks, while almost 40 % of the students scored 1 or 2 marks.

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.

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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.

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.

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4.1.3 National and global energy resources

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