AQA GCSE Physics | 8463

SPECIFICATION POINT 4.2.4.3

The National Grid

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**38**
Available paper years	**2004–2023**

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.

4.2.4.3 The National Grid

Answer 01 · Mark scheme

June 2004 | 3451H | Original Q11 | Legacy

The full source mark scheme begins on page 58. Follow original question 11 in that document.

Answer 02 · Mark scheme

June 2004 | 3462H3 | Original Q9 | Legacy

The full source mark scheme begins on page 79. Follow original question 9 in that document.

Answer 03 · Mark scheme

November 2006 | PHY1A | Original Q5 | Legacy

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

4.2.4.3 The National Grid

Answer 04 · 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

4.2.4.3 The National Grid

Answer 04 · 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

4.2.4.3 The National Grid

Answer 05 · Mark scheme

November 2007 | PHY1A | Original Q8 | Legacy

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

4.2.4.3 The National Grid

Answer 06 · 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

4.2.4.3 The National Grid

Answer 06 · Mark scheme

January 2008 | PHY1H | Original Q1 | Legacy

PHY1H

4.2.4.3 The National Grid

Answer 07 · Mark scheme

Question 6

question	answers	extra information	mark
(a)(i)	step-down (transformer) because fewer turns on the output/secondary (coil)	no credit for just 'step-down transformer' accept '…less turns…' do **not** credit '…fewer coils…' **or** 'the p.d. across the input / primary will be greater than the p.d. across the output / secondary'	1
(ii)	to prevent a short (circuit)(through the turns of wire or through the core	do **not** credit references to safety **or** heat (insulation)	1
(iii)	(easily) magnetised (and demagnetised)	accept '(it's) magnetic' do **not** accept 'because it's a conductor'	1
(b)	2250	correct substitution eg $\frac{150}{\text{p.d. across secondary}} = \frac{500}{7500}$ gains **1** mark **or** appropriate transformation eg (p.d. across secondary =) $\frac{\text{number of turns on secondary}}{\text{number of turns on primary}} \times$ p.d. across primary gains **1** mark	2

continued

PHY3H

Question 6 continued

question	answers	extra information	mark
(c)	any **two** from:		2
	• <u>to reduce the voltage</u> / p.d. (of the domestic supply)	**or** to reduce to 230 V allow 'to reduce to 240 V' do **not** credit 'reduce <u>current</u> to 230V'	
	• higher voltage difficult to insulate		
	• higher voltage (would) result in (fatal) electric shock	**not** just 'less dangerous'	
	• domestic appliances are not designed for (very) high voltage (input) / (are designed) for 230V		
		do **not** credit 'to increase efficiency' / 'to save energy' do **not** credit just 'it's safer'	
(d)	any **two** (1) each		1
	• if the (local) power station breaks down / fails / demand / load exceeds supply	**or** words to that effect	1
	• electricity / power can be switched from elsewhere in the system / from other power station(s)	**or** words to that effect	
	• electricity can be generated in places remote from customers	**or** words to that effect	
	• (in total) fewer power stations are needed		
	• power available in rural / remote areas		
	• National Grid allows for (better) control of supply and demand		
		do **not** credit just cheaper / more efficient / safer	
total			9

4.2.4.3 The National Grid

Answer 07 · Mark scheme January 2008 | PHY3H | Original Q6 | Legacy

PHY3H

Answer 08 · Mark scheme March 2008 | PHY1AP | Original Q1 | Legacy

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

Answer 09 · Mark scheme June 2008 | PHY1AP | Original Q8 | Legacy

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

4.2.4.3 The National Grid

Answer 10 · Mark scheme

Question 4

question	answers	extra information	mark
(a)(i)	replaced faster than it is used	accept replaced as quick as it is used accept will never run out do **not** accept can be used again	1
(a)(ii)	any **two** from: • wind • waves • tides • fall of water • biomass • geothermal	**two** sources required for the mark do **not** accept water / oceans accept OTEC accept hydroelectric accept a named biomass / biofuel eg wood	1
(b)(i)	any **two** from: • increases from 20 ^{o} to 30 ^{o} • reaches maximum value at 30 ^{o} • then decreases from 30 ^{o} • same pattern for each month	accept peaks at 30 ^{o} for **both** marks accept goes up then down for **1** mark ignore it's always the lowest at 50^{o}	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

4.2.4.3 The National Grid

Answer 10 · Mark scheme June 2008 | PHY1H | Original Q4 | Legacy

PHY1H

Answer 11 · Mark scheme March 2009 | PHY1AP | Original Q2 | Legacy

Two	**A**	falling water (hydroelectric)	**2**
	B	fossil fuel	**1**
	C	tides	**4**
	D	wind	**3**

Answer 12 · Mark scheme June 2009 | PHY1AP | Original Q5 | Legacy

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

4.2.4.3 The National Grid

Answer 13 · Mark scheme June 2009 | PHY3H | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)(i)	secondary(coil) / output (coil)	do **not** accept just coil	1
1(a)(ii)	core (laminated soft) iron	do **not** accept for either mark it is made out of iron ore allow **1** mark for 'it is made out of iron core'	1 1
1(a)(iii)	magnetic field (which is) changing / alternating	accept magnetism / magnetic force direction (of field) changes / strength (of field) varies scoring second mark is dependent on first mark	1 1
1(b)	...step-up .... step-down ...	both in the correct order	1
1(c)	Do not build new houses .... Build new power lines away	 deduct **1** mark for any other(s) to a minimum total of (0)	1 1
Total			**8**

4.2.4.3 The National Grid

Answer 13 · Mark scheme

June 2009 | PHY3H | Original Q1 | Legacy

PHY3H

Answer 14 · Mark scheme

November 2009 | PHY1AP | Original Q5 | Legacy

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

4.2.4.3 The National Grid

Answer 15 · Mark scheme

January 2010 | PHY3H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	(laminated soft) iron	do **not** accept steel	1
5(a)(ii)	produces a magnetic field which is alternating / changing / varying and which induces / produces an alternating / changing potential difference across the secondary coil	accept magnetic flux accept current / voltage	3
5(b)	3067 (V)	allow all **3** marks for 3060 to 3070 (V) $V = \frac{230 \times 4000}{300}$ gains **2** marks $\frac{230}{V} = \frac{300}{4000}$ gains **1** mark	3
Total			**7**

4.2.4.3 The National Grid

Answer 15 · Mark scheme

January 2010 | PHY3H | Original Q5 | Legacy

PHY3H

Answer 16 · Mark scheme

March 2010 | PHY1AP | Original Q9 | Legacy

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

4.2.4.3 The National Grid

Answer 16 · 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**

4.2.4.3 The National Grid

Answer 17 · 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 18 · Mark scheme

June 2010 | PHY1AP | Original Q9 | Legacy

Nine	2	3	3	2

4.2.4.3 The National Grid

Answer 19 · Mark scheme

June 2019 | 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 . . .

4.2.4.3 The National Grid

Answer 19 · Mark scheme

June 2019 | PHY1H | Original Q5 | Legacy

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**

4.2.4.3 The National Grid

Answer 19 · Mark scheme June 2010 | PHY1H | Original Q5 | Legacy

PHY1H

Answer 20 · Mark scheme November 2010 | PHY1AP | Original Q7 | Legacy

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

4.2.4.3 The National Grid

Answer 21 · 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**

4.2.4.3 The National Grid

Answer 21 · Mark scheme January 2011 | PHY1H | Original Q4 | Legacy

PHY1H

Answer 22 · Mark scheme March 2011 | PHY1AP | Original Q8 | Legacy

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

Answer 23 · Mark scheme June 2011 | PHY1AP | Original Q7 | Legacy

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

4.2.4.3 The National Grid

Answer 24 · Mark scheme

Question 7

question	answers	extra information	mark
7(a)	400 000	allow **1** mark for correct substitution ie $\frac{25000}{?} = \frac{800}{12800}$ **or** $\frac{25}{?} = \frac{800}{12800}$	2
	volt(s) / V	an answer 400 gains **2** marks an answer 400 kilovolts / kV gains **3** marks although the unit mark is independent to gain **3** marks it must be consistent with the numerical value	1
7(b)	any **one** from: • (so that there is) no short circuit • (so that the) current goes round the coil • (so that the) current does not enter the core	do **not** accept any response in terms of heat insulation, safety or electric shock do **not** accept electricity for current	1

Question 7 continues on the next page

4.2.4.3 The National Grid

PHY3H

Question 7 continues

question	answers	extra information	mark
7(c)	(the alternating p.d. in the primary causes) an (alternating) current in the primary (causes an) <u>alternating / changing</u> (magnetic) field in the (iron) core <u>induces</u> (alternating) p.d. across the <u>secondary</u> (coil)	reference to the current in the core negates this mark accept in / through or similar for across accept current for p.d. accept output (coil) for secondary (coil) to gain **3** marks the sequence must be correct	1 1 1
Total			**7**

4.2.4.3 The National Grid

Answer 25 · Mark scheme

November 2011 | PHY1AP | Original Q6 | Legacy

Six	**1**	**2**	**3**	**4**

4.2.4.3 The National Grid

Answer 26 · 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**

4.2.4.3 The National Grid

Answer 26 · Mark scheme

June 2012 | PH1HP | Original Q3 | Legacy

PH1HP

4.2.4.3 The National Grid

Answer 27 · 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**

4.2.4.3 The National Grid

Answer 27 · Mark scheme

January 2013 | PH1HP | Original Q6 | Legacy

PH1HP

4.2.4.3 The National Grid

Answer 28 · Mark scheme

June 2013 | PH1HP | Original Q1 | Legacy

Question 1

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

4.2.4.3 The National Grid

Answer 28 · Mark scheme

June 2013 | PH1HP | Original Q1 | Legacy

PH1HP

4.2.4.3 The National Grid

Answer 29 · Mark scheme June 2014 | PH1HP | Original Q1 | Legacy

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 . . .

Answer 29 · Mark scheme

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**	

4.2.4.3 The National Grid

Answer 30 · Mark scheme

3(a)	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)**	AO1 3.3.2
No relevant / correct content.	**Either** there is an attempt at a description of the construction of a transformer **or** a correct statement of the effect of one type of transformer on the input p.d.	There is a description of the construction of a transformer **and** a correct statement of the effect of one type of transformer on the input p.d.	There is a clear description of the construction of a transformer **and** there is a correct description of how transformers affect the input p.d.	

details of construction:	extra information
a (laminated) core	
core is made from a magnetic material / iron	
2 coils	
the coils are made from an electrical conductor / copper	
the coils are covered in plastic / insulation	
the coils are (usually) on opposite sides	
step-up transformer has more turns on secondary coil than (its) primary (or vice versa)	
step-down transformer has less turns on secondary coil than (its) primary (or vice versa)	
effect on input p.d. :	
step-up transformer, the output p.d. is greater (than the input p.d.)	accept voltage for p.d.
step-down transformer, the output p.d. is lower (than the input p.d.)	

Question 3 continues on the next page . . .

4.2.4.3 The National Grid

Question 3 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
3(b)	switch mode (transformer)		1	AO1 3.3.2j
Total			**7**	

4.2.4.3 The National Grid

Answer 31 · Mark scheme

June 2016 | PH1HP | Original Q2 | Legacy

The full source mark scheme begins on page 96. Follow original question 2 in that document.

4.2.4.3 The National Grid

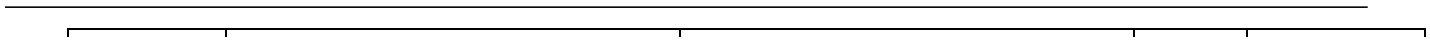
Answer 32 · Mark scheme June 2017 | PH1HP | Original Q7 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	transformer **J** increases the voltage and decreases the current	allow steps up for increases	1	AO1 1.4.2a,b,c
	(so lower current means) less energy wasted **or** less heating of the surroundings	allow heat for energy	1	
	(which) increases efficiency		1	
	(but) transformer **K** decreases the voltage to a safer / appropriate value (for consumers)	allow steps down for decreases if no other mark scored then allow **1** mark for transformer **J** is a step-up transformer <u>and</u> transformer **K** is a step-down transformer	1	
7(b)(i)	at times of low demand (for electricity)		1	AO1 1.4
	when there is a surplus (of electricity)		1	
	water is pumped from low level to high level	accept the turbine acts as a pump **or** the generator acts as a motor	1	
	energy is stored as gravitational potential energy	allow gpe for gravitational potential energy	1	
7(b)(ii)	can store / produce large amount of energy		1	AO1 1.4
	(means) power output increases rapidly	accept short start-up time	1	
Total			**10**	

4.2.4.3 The National Grid

Answer 32 · Mark scheme

June 2017 | PH1HP | Original Q7 | Legacy



4.2.4.3 The National Grid

Answer 33 · Mark scheme June 2018 | 8463/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	any **one** from: • too few turns / coils on the secondary • p.d. across the primary was reduced	allow number of turns / coils on the primary was increased ignore human error	1	AO3 4.7.3.4
07.2	the p.d. (across the secondary) goes above 2V	allow p.d. across secondary is higher than p.d. across primary after 20 turns	1	AO3 4.7.3.4
07.3	it increases (until the nails reach a constant temperature)		1	AO1 4.6.3.1

4.2.4.3 The National Grid

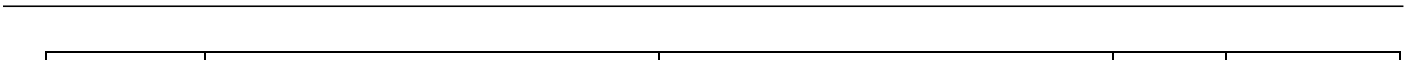
Answer 33 · Mark scheme June 2018 | 8463/2H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4		an answer of 1.2 (A) scores **5** marks		AO2 4.7.3.4
	$\frac{640}{4} = \frac{V_p}{1.75}$		1	
	$V_p = \frac{640 \times 1.75}{4}$		1	
	$V_p = 280$ (V)		1	
	$280 \times I_p = 336$	allow their calculated $V_p \times I_p = 336$	1	
	$I_p = 1.2$ (A)	allow an answer that is consistent with their calculated value of V_p	1	
	or			
	$336 = I_s \times 1.75$ (1)			
	$I_s = \frac{336}{1.75}$ (1)			
	$I_s = 192$ (A) (1)			
	$I_p = 192 \times \frac{4}{640}$ (1)	allow I_p = their calculated $I_s \times \frac{4}{640}$		
	$I_p = 1.2$ (A) (1)	allow an answer that is consistent with their calculated value of I_s		
Total			**8**	

4.2.4.3 The National Grid

Answer 33 · Mark scheme

June 2018 | 8463/2H | Original Q7



4.2.4.3 The National Grid

Answer 34 · 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	

4.2.4.3 The National Grid

Answer 34 · 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**

4.2.4.3 The National Grid

Answer 35 · Mark scheme

November 2021 | 8463/1H | Original Q10

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	(very high p.d. means) very low currents		1	AO1 4.2.4.3
	which means less (thermal) energy is transferred to surroundings	allow less power loss in cables	1	
	which increases the efficiency of power transmission		1	
10.2	electric field strength is very high		1	AO1 4.2.5.2
	causing the air to become ionised	allow the air breaks down allow the air becomes a conductor allow the air conducts charge	1	
	(the kite / string) conducts charge to the person / earth	ignore answers referring to the kite touching the power cables	1	
10.3	straight line passing through the origin		1	AO3 4.2.5.2
	line drawn below existing line for all values		1	
10.4	the potential difference across the wires/cable is the same		1	AO1 4.2.2 4.2.1.4
	(but) the resistance of the steel wire is greater (and so less current in the steel)		1	
Total			**10**	

4.2.4.3 The National Grid

Answer 36 · Mark scheme

June 2022 | 8463/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	transformer **X** increases potential difference		1	AO1 4.2.4.3
	and decreases current	do not accept if student states that potential difference decreases	1	
	reducing (thermal) energy transfer to surroundings **or** reducing (thermal) energy transfer from transmission cables	do not accept no energy transfer to surroundings	1	
	increasing the efficiency (of power transmission)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	transformer **Y** decreases the potential difference		1	AO1 4.2.4.3
	to a safe / safer value	dependent on scoring 1st marking point	1	

4.2.4.3 The National Grid

Answer 36 · Mark scheme

June 2022 | 8463/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	$3.24 \times 10^{11} = Q \times 230$		1	AO2 4.2.4.2
	$Q = \frac{3.24 \times 10^{11}}{230}$		1	
	Q = 1 408 695 652 (C)		1	
	$Q = 1.41 \times 10^{9}$ (C) **or** *Q* = 1 410 000 000 (C)	allow correct rounding of an incorrect answer using data from the question	1	

Total Question 6		**10**

Answer 37 · Mark scheme

June 2022 | 8463/2HR | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	**A** primary coil **and** **B** secondary coil		1	AO1 4.7.3.4
	C iron core		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	$\frac{230}{V_s} = \frac{200}{1200}$		1	AO2 4.7.3.4
	$V_s = \frac{1200 \times 230}{200}$		1	
	$V_s = 1380$ (V)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	(the alternating current causes) a changing magnetic field around the primary (coil)		1	AO2 4.7.3.4
	creates magnetic field that changes direction in the core	allow creates a changing magnetic field in the core	1	
	this induces an alternating potential difference across the secondary (coil causing an alternating current)		1	

4.2.4.3 The National Grid

Answer 37 · Mark scheme

June 2022 | 8463/2HR | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	down		1	AO2 4.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	$B = 60 \times 10^{-6}$ (T)		1	AO2 4.7.2.2
	$0.045 = 60 \times 10^{-6} \times 50 \times l$	allow correct substitution of incorrectly / not converted value of B	1	
	$l = \dfrac{0.045}{60 \times 10^{-6} \times 50}$	allow correct rearrangement using an incorrectly / not converted value of B	1	
	$l = 15$ (m)	allow a correct calculation using an incorrectly / not converted value of B	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	the wire / force is at right angles to the magnetic field	allow the current is constant allow the cable is straight allow the field is uniform allow the force is constant	1	AO3 4.7.2.2

Total Question 7		**14**

4.2.4.3 The National Grid

Answer 38 · Mark scheme

June 2023 | 8463/1H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	increase decrease	must be in this order	1 1	AO1 4.2.4.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	$P = I^2R$		1	AO1 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	$1.60 \times 10^9 = 2000^2 \times R$ $R = \frac{1.60 \times 10^9}{2000^2}$ $R = 400\ (\Omega)$		1 1 1	AO2 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	efficiency = $\frac{\text{useful energy output}}{\text{total energy input}}$ **or** efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$		1	AO1 4.1.2.2

4.2.4.3 The National Grid

Answer 38 · Mark scheme

June 2023 | 8463/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	$0.992 = \frac{\text{useful energy output}}{34.2}$ useful energy output = 0.992 × 34.2 useful energy output = 33.9 (GJ)	 allow a correct answer given to more than 3 s.f.	1 1 1	AO2 4.1.2.2

Total Question 1	10

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.

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

Further copies of this Mark Scheme are available from:

Publications Department, Aldon House, 39, Heald Grove, Rusholme, Manchester, M14 4NA
Tel: 0161 953 1170

or

download from the AQA website: www.aqa.org.uk

Copyright © 2004 AQA and its licensors

COPYRIGHT
AQA retains the copyright on all its publications. However, registered centres for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to centres to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales 3644723 and a registered charity number 1073334. Registered address AQA, Devas Street, Manchester. M15 6EX. *Dr Michael Cresswell Director General*

4.2.4.3 The National Grid

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'.

Copyright © 2004 AQA and its licensors

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.

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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.

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

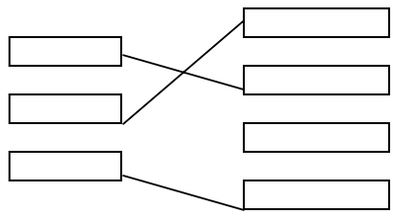
3451F Q2

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

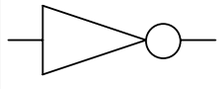
3451F Q6

	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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

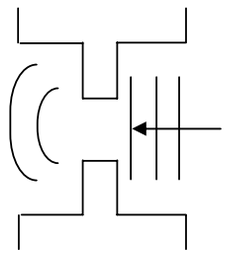
3451F Q8

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

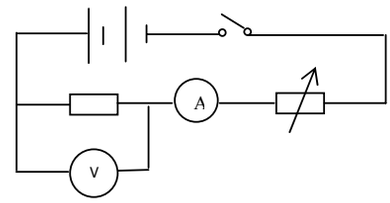
3451F Q9

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

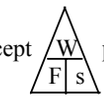
3451F Q12

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

3451F Q15

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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 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

Copyright © 2004 AQA and its licensors

GCSE 2004
June Series

ASSESSMENT and QUALIFICATIONS ALLIANCE

Mark Scheme

Science: Double Award

Specification B (Co-ordinated)

3462/3F

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

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

Further copies of this Mark Scheme are available from:

Publications Department, Aldon House, 39, Heald Grove, Rusholme, Manchester, M14 4NA
Tel: 0161 953 1170

or

download from the AQA website: www.aqa.org.uk

Copyright © 2004 AQA and its licensors

COPYRIGHT
AQA retains the copyright on all its publications. However, registered centres for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to centres to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales 3644723 and a registered charity number 1073334. Registered address AQA, Devas Street, Manchester. M15 6EX. *Dr Michael Cresswell Director General*

4.2.4.3 The National Grid

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'.

Copyright © 2004 AQA and its licensors

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.

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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.

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

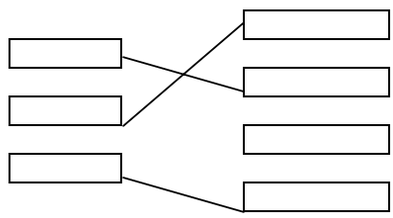
3462/3F Q2

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

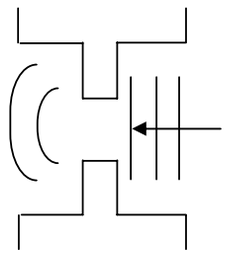
3462/3F Q6

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

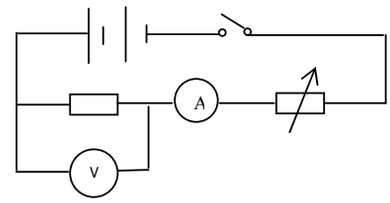
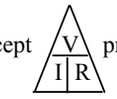
3462/3F Q7

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

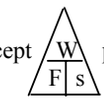
3462/3F Q10

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

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

Copyright © 2004 AQA and its licensors

4.2.4.3 The National Grid

AQA

GCSE

Science A / Physics

PH1HP

Mark scheme

4405/4403
June 2016

Version 1.0: Final Mark Scheme

4.2.4.3 The National Grid

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

Copyright © 2016 AQA and its licensors. All rights reserved.
AQA retains the copyright on all its publications. However, registered schools/colleges for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to schools/colleges to photocopy any material that is acknowledged to a third party even for internal use within the centre.

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.

PMT

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.

4.2.4.3 The National Grid

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**	

4.2.4.3 The National Grid

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

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**	

4.2.4.3 The National Grid

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

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**	

4.2.4.3 The National Grid

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**	

4.2.4.3 The National Grid

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 . . .

4.2.4.3 The National Grid

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**	

PMT

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

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 . . .

4.2.4.3 The National Grid

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**	

PMT

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**	

4.2.4.3 The National Grid

Answer 33 · Examiner comments June 2018 | 8463/2H | Original Q7

Question 7 (Standard/high and High demand)

07.1 Many students had the correct idea, but imprecise detail such as ‘wrong number of turns’ or ‘number of turns was miscounted’ were insufficient to score the mark.

07.2 Many students tried to answer the question from a general knowledge about transformers, rather than using information from the graph, and so did not gain credit.

07.3 Most of the answers were correct. A very small number of students wrote ‘hotter’ but made no reference to infrared or thought it was just a temperature increase.

07.4 This question involved a two stage calculation, a new feature of the examination. Nearly 33 % of students knew the equations to use and how to use them, scoring all five marks. A further 35% of students correctly used one equation to give a partially correct answer, scoring three marks.

Answer 34 · 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 35 · Examiner comments November 2021 | 8463/1H | Original Q10

Question 10

Question 10 was poorly answered across the question. Few students were able to explain the benefit of transmitting electricity at a high potential difference in **10.1**. Many students stated, incorrectly, that static electricity was responsible for the danger involved in flying a kite near power cables. Question **10.3** was poorly answered and many students chose to continue the existing graph line, rather than draw their own. Very few students appreciated in **10.4** that the wires would behave as if they are in parallel, despite the question stating this.

4.2.4.3 The National Grid

Answer 38 · Examiner comments June 2023 | 8463/1H | Original Q1

Question 1 (Standard Demand)

01.1 71% of students scored 2 marks on this question about transformers.

01.2 98% of students identified the correct equation. In this exam series, students were provided with all the equations on an Equations Sheet.

01.3 86% of students scored 3 marks. Many students failed to square the current so scored zero for the substitution and subsequent rearrangement.

01.4 84% of students answered correctly. In this exam series, students were provided with all the equations on an Equations Sheet. Students who quoted the version of the efficiency equation with power input and power output scored zero.

01.5 95% of students scored 3 marks. An answer of 33.9264 scored 3 marks as significant figures was not being tested in this question part. An answer given to 2 s.f. could score 3 marks with working. If the answer was rounded, the rounding needed to be correct.

4.2.4.3 The National Grid

AQA

GCSE
PHYSICS

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

8463
June 2022

Version: 1.0

4.2.4.3 The National Grid

Further copies of this Report are available from aqa.org.uk

Copyright © 2022 AQA and its licensors. All rights reserved.
AQA retains the copyright on all its publications. However, registered schools/colleges for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to schools/colleges to photocopy any material that is acknowledged to a third party even for internal use within the centre.

4.2.4.3 The National Grid

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.

4.2.4.3 The National Grid

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.

4.2.4.3 The National Grid

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.

4.2.4.3 The National Grid

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.

4.2.4.3 The National Grid

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.

4.2.4.3 The National Grid

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.