AQA GCSE Physics | 8463

SPECIFICATION POINT 4.3.2.2

Temperature changes in a system and specific heat capacity

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**19**
Available paper years	**2012–2025**

Using this booklet

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

Name: _____ **Date:** _____

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

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 01 · Mark scheme

June 2012 | PH1HP | Original Q1 | Legacy

Question 1

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

Question 1 continues on the next page

PH1HP

Question 1 continued

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

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 01 · Mark scheme

June 2012 | PH1HP | Original Q1 | Legacy

PH1HP

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 02 · Mark scheme

January 2013 | PH1HP | Original Q2 | Legacy

Question 2

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

Question 2 continues on the next page . . .

PH1HP

Question 2 continued . . .

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

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 02 · Mark scheme

January 2013 | PH1HP | Original Q2 | Legacy

PH1HP

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 03 · Mark scheme

June 2013 | PH1HP | Original Q5 | Legacy

Question 5

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

Question 5 continues on the next page . . .

PH1HP

Question 5 continued . . .

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

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 03 · Mark scheme

June 2013 | PH1HP | Original Q5 | Legacy

PH1HP

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 04 · Mark scheme

June 2014 | PH1HP | Original Q7 | Legacy

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

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 05 · Mark scheme June 2015 | PH1HP | Original Q5 | Legacy

The full source mark scheme begins on page 31. Follow original question 5 in that document.

Answer 06 · Mark scheme June 2015 | PH1HP | Original Q7 | Legacy

The full source mark scheme begins on page 31. Follow original question 7 in that document.

Answer 07 · Mark scheme June 2016 | PH1HP | Original Q5 | Legacy

The full source mark scheme begins on page 47. Follow original question 5 in that document.

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 08 · Mark scheme

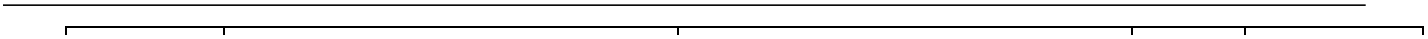
June 2017 | PH1HP | Original Q5 | Legacy

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

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 08 · Mark scheme

June 2017 | PH1HP | Original Q5 | Legacy



4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 09 · Mark scheme

June 2018 | 8463/1H | Original Q9

Question	Answers	Extra information	Mark	AO/ Spec. Ref
09.1	risk of electric shock (if someone touched the case)	allow risk of electrocution (if someone touched the case)	1	AO1 4.2.3.2
09.2		an answer of 11 (A) scores **3** marks		AO2 4.2.4.1
	2530 = I × 230	this mark may be awarded if P is incorrectly / not converted	1	
	$I = \frac{2530}{230}$	this mark may be awarded if P is incorrectly / not converted	1	
	I = 11 (A)	this answer only	1	
		an answer of 0.011 (A) scores **2** marks		
09.3		an answer of 0.12 (kg) **or** an answer that rounds to 0.12 (kg) scores **5** marks		AO2 4.2.4.2 4.1.1.3
	E = 2530 × 14	this mark may be awarded if P is incorrectly / not converted	1	
	E = 35 420 (J)	this answer only	1	
	35 420 = m × 4200 × 70	allow their calculated E = m × 4200 × 70	1	
	$m = \frac{35\,420}{4200 \times 70}$	allow $m = \frac{\text{their calculated E}}{4200 \times 70}$	1	
	m = 0.12 (kg)	allow an answer that is consistent with their calculated value of E	1	
Total			**9**	

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 10 · Mark scheme

June 2019 | 8463/1H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8.1	Initial temperature was a control variable		1	WS3.7 4.3.2.2 AO3
8.2	copper greater change in mass (than the other metals)	 this mark is dependent on scoring the first mark allow more ice melted (than the other metals) allow the ice melted faster (than the other metals)	1 1	4.1.2.1 AO3
8.3	variation in initial mass of ice cube **or** surface area of the ice cube touching the metal	allow variation in initial volume of ice cube allow melting of ice while handling allow variation in room temperature allow initial temperature of metal block	1	WS3.7 4.1.2.1 AO3

Answer 10 · Mark scheme

June 2019 | 8463/1H | Original Q8

8.4	$E = m \times 2100 \times 15$ $E = m \times 334\,000$ $5848 = 31\,500\ m + 334\,000\ m$ **or** $5848 = 365\,500\ m$ $m = \frac{5848}{(31\,500 + 334\,000)}$ **or** $m = \frac{5848}{(365\,500)}$ $m = 0.016$ (kg)	an answer of 0.016 (kg) scores **5** marks allow **2** marks for an answer that rounds to 0.186 or 0.0175 if no other mark scored allow **1** mark for either $5848 = m \times 2100 \times 15$ **or** $5848 = m \times 334\,000$	1 1 1 1 1	4.3.2.2 4.3.2.3 AO2
Total			**9**	

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 11 · Mark scheme

November 2020 | 8463/1H | Original Q7

Question 7

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

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 12 · Mark scheme

November 2021 | 8463/1H | Original Q2

Question 2

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

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 12 · Mark scheme

November 2021 | 8463/1H | Original Q2

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

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 13 · Mark scheme

November 2021 | 8463/1H | Original Q11

Question 11

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

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 13 · Mark scheme

November 2021 | 8463/1H | Original Q11

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

Total			**11**

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 14 · Mark scheme

June 2022 | 8463/1H | Original Q4

Question 4

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

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

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

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 14 · Mark scheme June 2022 | 8463/1H | Original Q4

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

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

Total Question 4		**9**

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 15 · Mark scheme

June 2023 | 8463/1H | Original Q2

Question 2

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

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

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

Total Question 2	7

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 16 · Mark scheme

June 2024 | 8463/1H | Original Q8

Question 8

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

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

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

Total Question 8	8

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 17 · Mark scheme

June 2025 | 8463/1H | Original Q2

Question 2

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

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

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 17 · Mark scheme

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

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

Total Question 2	10

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	(atoms of an element with) the same number of protons but a different number of neutrons	ignore number of electrons allow same atomic number allow different mass number	1 1	AO1 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	light(er) nuclei fuse to form heavier nuclei / elements some of the mass (of the nuclei) is converted into energy (of radiation)	allow hydrogen nuclei fuse ignore bonding / colliding allow to form helium nuclei	1 1 1	AO1 4.4.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	(a large amount of energy transferred) causes a small temperature increase of the walls / material (therefore) the walls of the reactor should not reach melting point	 allow (therefore) the walls of the reactor should not melt	1 1	AO3 4.1.1.3 4.3.2.2 4.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	any **one** from: • a nuclear explosion • a (nuclear) meltdown • a nuclear bomb	allow atomic for nuclear allow Chernobyl / Fukushima (disaster)	1	AO1 4.4.4.1

Total Question 5	8

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 19 · Mark scheme

June 2025 | 8463/1H | Original Q6

Question 6

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

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

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

Total Question 6	10

4.3.2.2 Temperature changes in a system and specific heat capacity

AQA

GCSE

Science A / Physics

PH1HP

Mark scheme

4405/4403
June 2015

Version/Stage: 1.0 Final

4.3.2.2 Temperature changes in a system and specific heat capacity

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

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

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

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4.3.2.2 Temperature changes in a system and specific heat capacity

Mark Scheme

Information to Examiners

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

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

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

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

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

3. Marking points

3.1 Marking of lists

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

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

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

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

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

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

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

3.1 Use of chemical symbols / formulae

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

3.2 Marking procedure for calculations

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

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

3.3 Interpretation of 'it'

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

3.4 Errors carried forward

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

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

3.5 Phonetic spelling

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

3.6 Brackets

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

3.2 Ignore / Insufficient / Do not allow

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

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

4. Quality of Communication and levels marking

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

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

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

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

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

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

4.3.2.2 Temperature changes in a system and specific heat capacity

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

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

4.3.2.2 Temperature changes in a system and specific heat capacity

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

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

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

4.3.2.2 Temperature changes in a system and specific heat capacity

Question 2 continued . . .

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

4.3.2.2 Temperature changes in a system and specific heat capacity

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

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

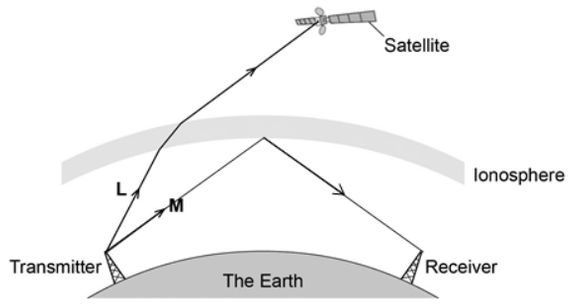
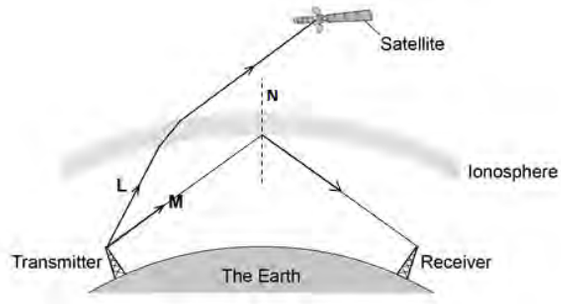
Question 3 continues on the next page . . .

4.3.2.2 Temperature changes in a system and specific heat capacity

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

4.3.2.2 Temperature changes in a system and specific heat capacity

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

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

Question 4 continues on the next page. . .

Question 4 continued…

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

4.3.2.2 Temperature changes in a system and specific heat capacity

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

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

Question 5 continues on the next page . . .

4.3.2.2 Temperature changes in a system and specific heat capacity

Question 5 continued . . .

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

4.3.2.2 Temperature changes in a system and specific heat capacity

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

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

4.3.2.2 Temperature changes in a system and specific heat capacity

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

4.3.2.2 Temperature changes in a system and specific heat capacity

AQA

GCSE

Science A / Physics

PH1HP

Mark scheme

4405/4403
June 2016

Version 1.0: Final Mark Scheme

4.3.2.2 Temperature changes in a system and specific heat capacity

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

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

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

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Mark Scheme

Information to Examiners

1. General

The mark scheme for each question shows:

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

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

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

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

2. Emboldening

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

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

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

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

3. Marking points

3.1 Marking of lists

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

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

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

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

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

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

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

3.2 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.

4.3.2.2 Temperature changes in a system and specific heat capacity

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

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**	

4.3.2.2 Temperature changes in a system and specific heat capacity

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 . . .

4.3.2.2 Temperature changes in a system and specific heat capacity

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

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

4.3.2.2 Temperature changes in a system and specific heat capacity

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

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**	

4.3.2.2 Temperature changes in a system and specific heat capacity

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**	

4.3.2.2 Temperature changes in a system and specific heat capacity

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

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**	

4.3.2.2 Temperature changes in a system and specific heat capacity

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 . . .

4.3.2.2 Temperature changes in a system and specific heat capacity

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

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

4.3.2.2 Temperature changes in a system and specific heat capacity

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 . . .

4.3.2.2 Temperature changes in a system and specific heat capacity

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

4.3.2.2 Temperature changes in a system and specific heat capacity

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	

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 11 · Examiner comments November 2020 | 8463/1H | Original Q7

Question 7 (High demand)

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

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

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

Answer 12 · Examiner comments November 2021 | 8463/1H | Original Q2

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

Question 11

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

Concluding Remarks

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

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

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

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

Mark Ranges and Award of Grades

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

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 15 · Examiner comments — June 2023 | 8463/1H | Original Q2

Question 2 (Standard Demand)

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

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

Answer 15 · Examiner comments — June 2023 | 8463/1H | Original Q2

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

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

Answer 16 · Examiner comments — June 2024 | 8463/1H | Original Q8

Question 8 (High Demand)

08.1 Questions about the microscopic causes of pressure are difficult for GCSE students and this question was no exception. Many students repeated information given in the question which did not score any marks. A minority of students scored the first mark point, many students simply stating that the volume decreased which was insufficient. Students made a good attempt at explaining that there were more collisions between the particles and the container walls, but failed to score because they didn't refer to a specified time period e.g. per second, or rate or more frequent, etc. Some students stated that the kinetic energy of the particles had increased, which stopped them from scoring the second mark point. Very few students scored the third mark point which was the most demanding of the three. 9% of students scored 2 or 3 marks, while 43% of students scored 1 mark.

08.2 94% of students scored this mark, linking temperature increase to mean kinetic energy of particles.

08.3 A grade 6-7 calculation question which discriminated well between students. Many students failed to convert the specific heat capacity so scored 3 marks instead of 4. Some students tried to convert the energy into kJ but very few did this successfully, usually ending with a 'power of 10' error. 22% of students scored 3 marks while 62% of students scored 4 marks.

Answer 17 · Examiner comments

June 2025 | 8463/1H | Original Q2

Question **02.2** was well attempted and students who had carried out the specific heat capacity required practical would have had an advantage over those who had not. For this question, just fewer than 40% of the students scored 5 or 6 marks and a further 46% of the students scored 3 or 4 marks.

Handwriting continues to be a problem for a number of students, making it very difficult for examiners to read what has been written. An increasing number of students are using computers to word process their answers for extended response questions, which is helpful for examiners in awarding credit for student responses. However, students must use the question number as printed in the question paper e.g. 04.3 rather than 4(c) to ensure that their work is matched and marked with the corresponding question part.

Many students did not cross out the work they did not want to be marked. This results in the 'list principle' being applied which means if there are two sets of working or answers and they conflict, the student scores zero.

Levels of demand

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

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

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

01.1

Common answers which were insufficient included 'running out', 'not running out', 'sustainable', 'not sustainable'. The specification uses the word 'replenished' so words equivalent to this were needed, so 'replaced' or 'more of the energy resource is produced' were just able to score a mark. For non-renewable the idea that the resource is finite, or there is a limited amount was needed to score the mark. It was not enough to just state the exact

opposite of the renewable energy resources mark point. Just fewer than 20 % of the students scored 2 marks, while just over 50 % of the students scored 1 mark.

01.2

Almost all of the students scored this mark for writing down the equation linking density, mass and volume using the equation sheet provided in this exam series.

01.3

The vast majority of the students scored 3 marks for this grade 4-5 calculation of mass using the density equation.

01.4

This question was poorly answered with fewer than 10 % of the students scoring 2 marks. About 30 % of the students scored 1 mark. Students who said that tidal power output was greater than wind power did not score a mark without reference to a particular flow speed. If wind flow speed was a consistent 2 m/s and tidal flow speed never reached 0.75 m/s the wind turbine's power output would be greater.

01.5

A good range of environmental impacts were described by many students. To score within level 2, students needed to make at least one comparative statement about a factor for both turbines. The simplest way of doing this was to compare relative size.
An answer; 'The wind turbine is larger, but harms birds. The tidal turbine harms fish but does not cause visual pollution' would score 4 marks.
Nearly all of the students scored some marks with nearly 50% scoring 3 or 4 marks.

02.1

Answers such as 'electrical devices near water' were insufficient, as was 'wires in the water'. A low p.d. power supply also is not a hazard, unless water was spilled on it, in which case it would score for the 'spilled water' which in a typical science laboratory is a hazard by itself. Risks by themselves like electrocution, electric shock or burns did not score but were ignored if given with an appropriate hazard. About 75 % of the students scored this mark usually for identifying 'hot water' or the 'heater' as the hazard. While in this experiment it is unlikely that water is at boiling point, 'boiling water' was creditworthy for 'hot water'.

02.2

To score 5 or 6 marks, students needed to be clear how the mass of the water should be determined. There were some very good, straightforward methods seen to calculate specific heat capacity, a graphical approach scored no additional credit. Some students who had more complex methods often became confused with the significance of what the gradient of their graph represented. It was possible for a student to score 6 marks for measuring the energy needed to increase the temperature of a suitable volume of water by just 1°C as the method would work, even if the temperature change is not as large as may be needed to obtain an accurate value.

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 17 · Examiner comments June 2025 | 8463/1H | Original Q2

02.3

Almost all of the students scored this mark for identifying that the beaker of water needed insulation and/or a lid. Any named insulation was allowed for this question. Aluminium / tin foil was also allowed as it would reduce energy transfer by infrared radiation. Place the beaker on a 'heatproof' mat was also creditworthy as it would decrease energy transfer through the base of the beaker by conduction.

02.4

Nearly three quarters of the students scored 2 marks for this percentage difference calculation. The most common mistake was to calculate the percentage difference between 4200 and 4410 which didn't score marks, unless they had set out the top of the equation correctly, (4410 – 4200) or (4200 – 4410) or calculated the difference of 210. Many students calculated 105 or 1.05, which scored no marks unless the working out was shown.

An answer of 4.76% or working showing a calculation of this figure, rounded to 5% scored no marks.

Answer 18 · Examiner comments June 2025 | 8463/1H | Original Q5

05.1

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

05.2

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

05.3

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

4.3.2.2 Temperature changes in a system and specific heat capacity

Answer 18 · Examiner comments June 2025 | 8463/1H | Original Q5

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

05.4

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

Answer 19 · Examiner comments June 2025 | 8463/1H | Original Q6

06.1

Just over 90 % of the students scored 3 marks on this grade 4-5 calculation of temperature increase using the specific heat capacity equation.

06.2

Just over 80 % of the students scored 4 marks for this calculation of charge flow using the equation $E = QV$. About 15 % of the students scored 3 marks as they had either not converted or converted incorrectly the energy into Joules.

06.3

Students found this question difficult with very few scoring marks because of incorrect assumptions about how potential difference, current and resistance are affected by series and parallel circuits. Marking point 2 was dependent on marking point 1 so that students who stated that the current was increased without a valid reason would not score. The third mark was demanding in requiring an understanding of how $P = IV$ related to the circuit being considered. Just over 80% of the students scored no marks.

4.3.2.2 Temperature changes in a system and specific heat capacity

AQA

GCSE
PHYSICS

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

8463
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4.3.2.2 Temperature changes in a system and specific heat capacity

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4.3.2.2 Temperature changes in a system and specific heat capacity

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.

4.3.2.2 Temperature changes in a system and specific heat capacity

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.

4.3.2.2 Temperature changes in a system and specific heat capacity

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.

4.3.2.2 Temperature changes in a system and specific heat capacity

Question 5 (Standard/High demand)

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

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

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

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

Question 6 (Standard/High demand)

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

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

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

Question 7 (Standard/High demand)

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

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

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

Question 8 (Standard/High demand)

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

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

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

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

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

4.3.2.2 Temperature changes in a system and specific heat capacity

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.

4.3.2.2 Temperature changes in a system and specific heat capacity

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.