2024

Name_____

Triple Science

Higher

Physics: Paper 1

Physics Equations Sheet

GCSE Combined Science: Trilogy (8464) and GCSE Combined Science: Synergy (8465)

FOR USE IN JUNE 2024 ONLY

HT = Higher Tier only equations

kinetic energy = 0.5 × mass × (speed)^2	$E_k = \frac{1}{2} m v^2$
elastic potential energy = 0.5 × spring constant × (extension)^2	$E_e = \frac{1}{2} k e^2$
gravitational potential energy = mass × gravitational field strength × height	$E_p = m g h$
change in thermal energy = mass × specific heat capacity × temperature change	$\Delta E = m c \Delta\theta$
power = $\frac{\text{energy transferred}}{\text{time}}$	$P = \frac{E}{t}$
power = $\frac{\text{work done}}{\text{time}}$	$P = \frac{W}{t}$
efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$	
efficiency = $\frac{\text{useful power output}}{\text{total power input}}$	
charge flow = current × time	$Q = I t$
potential difference = current × resistance	$V = I R$
power = potential difference × current	$P = V I$
power = (current)^2 × resistance	$P = I^2 R$
energy transferred = power × time	$E = P t$

	energy transferred = charge flow × potential difference	$E = Q\ V$
HT	**potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil**	$\boldsymbol{V_p\ I_p = V_s\ I_s}$
	density = $\frac{\text{mass}}{\text{volume}}$	$\rho = \frac{m}{V}$
	thermal energy for a change of state = mass × specific latent heat	$E = m\ L$
	weight = mass × gravitational field strength	$W = m\ g$
	work done = force × distance (along the line of action of the force)	$W = F\ s$
	force = spring constant × extension	$F = k\ e$
	distance travelled = speed × time	$s = v\ t$
	acceleration = $\frac{\text{change in velocity}}{\text{time taken}}$	$a = \frac{\Delta v}{t}$
	(final velocity)^2 – (initial velocity)^2 = 2 × acceleration × distance	$v^2 - u^2 = 2\ a\ s$
	resultant force = mass × acceleration	$F = m\ a$
HT	**momentum = mass × velocity**	$\boldsymbol{p = m\ v}$
	period = $\frac{1}{\text{frequency}}$	$T = \frac{1}{f}$
	wave speed = frequency × wavelength	$v = f\ \lambda$
HT	**force on a conductor (at right angles to a magnetic field) carrying a current = magnetic flux density × current × length**	$\boldsymbol{F = B\ I\ l}$

Copyright © AQA and its licensors. All rights reserved.

AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

GCSE PHYSICS

H

Higher Tier Paper 1

Wednesday 22 May 2019 Afternoon Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:
- a ruler
- a scientific calculator
- a protractor
- the Physics Equations Sheet (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Fill in the box at the top of this page.
- Answer **all** questions in the spaces provided.
- Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
TOTAL	

Do not write outside the box

Answer **all** questions in the spaces provided.

0 1 Light bulbs are labelled with a power input.

0 1 . 1 What does power input mean?

[1 mark]

Tick (✓) **one** box.

The charge transferred each second by the bulb. ☐

The current through the bulb. ☐

The energy transferred each second to the bulb. ☐

The potential difference across the bulb. ☐

0 1 . 2 Write down the equation which links current, potential difference and power.

[1 mark]

_____

0 1 . 3 A light bulb has a power input of 40 W

The mains potential difference is 230 V

Calculate the current in the light bulb.

[3 marks]

_____

_____

_____

Current = _____ A

Do not write outside the box

Table 1 shows information about three different light bulbs.

Table 1

Light bulb	Total power input in watts	Useful power output in watts	Efficiency
P	6.0	5.4	0.90
Q	40	2.0	0.05
R	9.0	**X**	0.30

0 1 . 4 Write down the equation which links efficiency, total power input and useful power output.

[1 mark]

0 1 . 5 Calculate the value of **X** in **Table 1**.

[3 marks]

X = _____ W

0 1 . 6 In addition to power input, light bulbs should also be labelled with the rate at which they emit visible light.

Suggest why.

[2 marks]

11

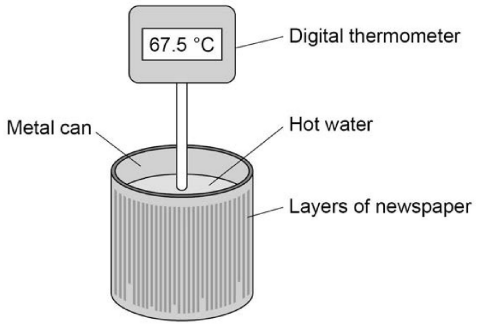
Turn over ►

Do not write outside the box

0 2 A student investigated the insulating properties of newspaper.

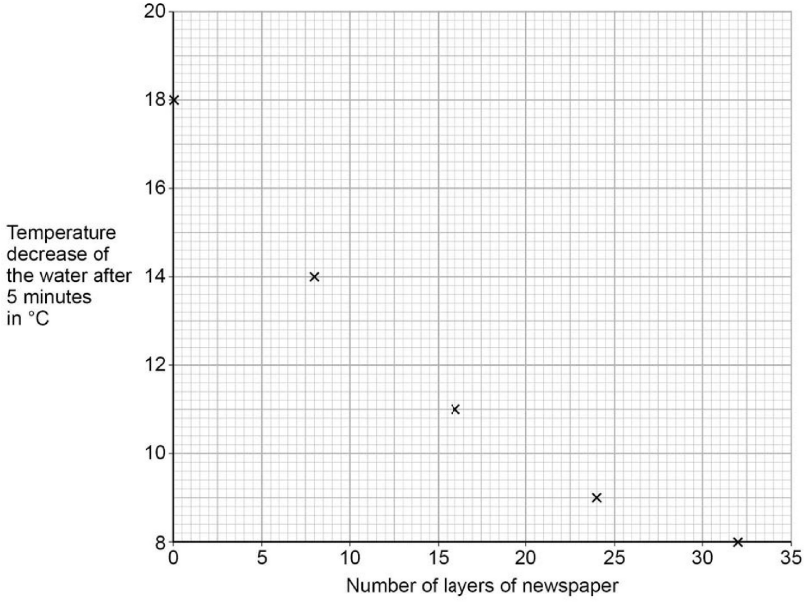
Figure 1 shows the apparatus the student used.

Figure 1



The student's results are shown in **Figure 2**.

Figure 2



Do not write outside the box

0 2 . 1 Describe a method the student could have used to obtain the results shown in **Figure 2**.

[6 marks]

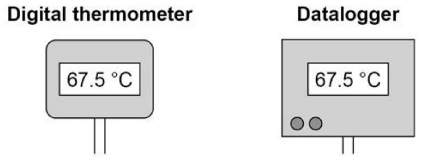
Question 2 continues on the next page

Do not write outside the box

0 2 . 2 The student could have used a datalogger with a temperature probe instead of the digital thermometer.

Figure 3 shows the readings on the digital thermometer and the datalogger.

Figure 3



The datalogger records 10 readings every second.

The student considered using a temperature probe and datalogger.

Explain why it was **not** necessary to use a temperature probe and datalogger for this investigation.

[2 marks]

8

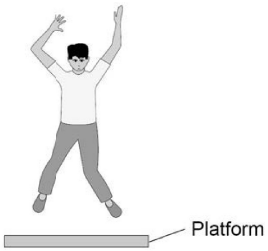
Do not write outside the box

0 3 A scientist investigated how the maximum muscle power of humans varies with age and gender.

The scientist asked volunteers to stand on a platform and to jump as high as they could.

Figure 4 shows a volunteer taking part in the experiment.

Figure 4



An electronic timer measured the time that the volunteer was in the air.

0 3 . 1 The muscle power in watts per kg is calculated using the following equation:

$$\text{muscle power} = \frac{9.8 \times \text{jump height}}{\text{time}}$$

One volunteer has a muscle power of 41 W/kg

He was in the air for 0.12 s

Calculate his jump height.

[3 marks]

Jump height = _____ m

Turn over ►

Do not write outside the box

0 3 . 2 Write down the equation which links kinetic energy, mass and speed.

[1 mark]

0 3 . 3 One volunteer had a kinetic energy of 270 J and a speed of 3.0 m/s at the moment he left the ground.

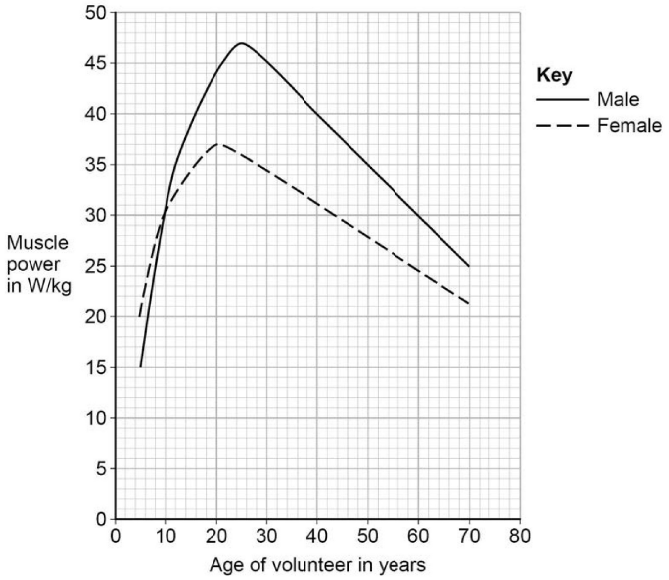
Calculate his mass.

[3 marks]

Mass = _____ kg

Figure 5 shows the scientist's results.

Figure 5



Do not write outside the box

0 3 . 4 Compare the muscle power of males with the muscle power of females.

Use data from **Figure 5** in your answer.

[4 marks]

0 3 . 5 The muscle power of each volunteer was measured five times.

The highest muscle power reading was recorded instead of calculating an average.

Suggest **one** reason why.

[1 mark]

12

Turn over for the next question

Do not write outside the box

0 4 Electric cars have motors that are powered by a battery.

Diesel cars have engines that are powered by diesel fuel.

Table 2 compares one type of electric car with one type of diesel car.

Table 2

Power source	Energy density in MJ / kg	Mass of power source in kg	Total mass of car in kg	Time to recharge battery or refill fuel tank in minutes
Battery	0.95	280	1600	40
Diesel fuel	45	51	1500	3

0 4 . 1 The electric car has a range of 400 km with a fully charged battery.

The diesel car has a range of 1120 km with a full tank of diesel.

Explain the difference in the time needed to complete a 500 km journey using the electric car compared with the diesel car.

Assume both cars travel at the same speed.

[2 marks]

Do not write outside the box

0 4 . 2 Energy density is the amount of energy stored per kilogram of the energy source.

Show why the diesel car has a greater range than the electric car.

Use data from **Table 2**.

Assume the efficiency of the two cars is the same.

Include calculations in your answer.

[3 marks]

Question 4 continues on the next page

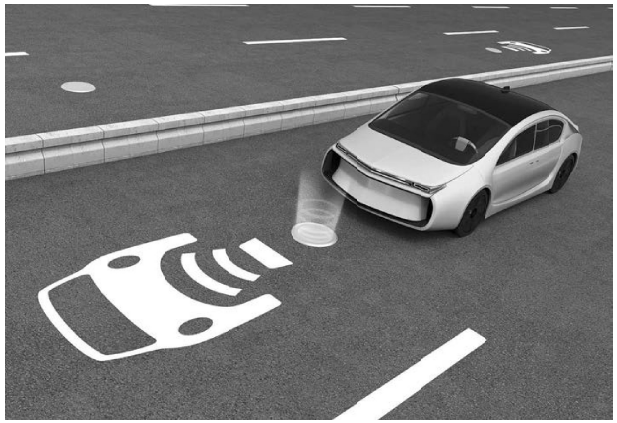
Do not write outside the box

Engineers have developed a way of charging electric cars while they are driving along the road.

Coils of wire buried under the road transfer energy to the car's battery as the car is passing over the coils.

Figure 6 shows a charging lane on a motorway.

Figure 6



0 4 . 3 Suggest **two** advantages of using this method to charge electric cars compared with plugging them into the mains electricity supply.

[2 marks]

1

2

Do not write outside the box

0 4 . 4 When electric cars are not being driven, energy stored in their batteries could be used to meet sudden peaks in electricity demand.

Suggest how.

[2 marks]

9

Turn over for the next question

Do not write outside the box

0 5 Polonium-210 ($^{210}_{84}\mathrm{Po}$) is a radioactive isotope that decays by emitting alpha radiation.

0 5 . 1 Complete the decay equation for polonium-210

[2 marks]

$$^{210}_{84}\mathrm{Po} \longrightarrow \square\!\square\mathrm{Pb} + {}^{4}_{2}\mathrm{He}$$

0 5 . 2 Explain why contamination of the inside of the human body by a radioactive material that emits alpha radiation is highly dangerous.

[3 marks]

Do not write outside the box

0 5 . 3 A sample of polonium-210 was left for 414 days.

After this time it had a mass of 1.45×10^{-4} g

The half-life of polonium-210 is 138 days.

Calculate the initial mass of the sample.

[3 marks]

Initial mass = _____ g

8

Turn over for the next question

Do not write outside the box

0 6 **Figure 7** shows a person using an electric lawn mower.

Figure 7



0 6 . 1 The lawn mower is connected to the mains electricity supply.

What is the frequency of the mains electricity supply in the UK?

[2 marks]

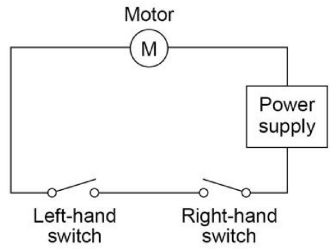
Frequency = _____ Unit _____

Do not write outside the box

The lawn mower has a switch on each side of the handle.

Figure 8 shows the circuit diagram for the lawn mower.

Figure 8



0 6 . 2 The motor in the lawn mower can only be turned on when the person using it holds the handle of the lawn mower with both hands.

Explain why.

[2 marks]

0 6 . 3 The power input to the motor is 1.8 kW

The resistance of the motor is 32 Ω

Calculate the current in the motor.

[3 marks]

Current = _____ A

Turn over ►

Do not write outside the box

0 6 . 4 The useful power output from the motor is 1.5 kW

Calculate the time it takes for the motor to transfer 450 000 J of useful energy.

[3 marks]

Time = _____ seconds

10

Do not write outside the box

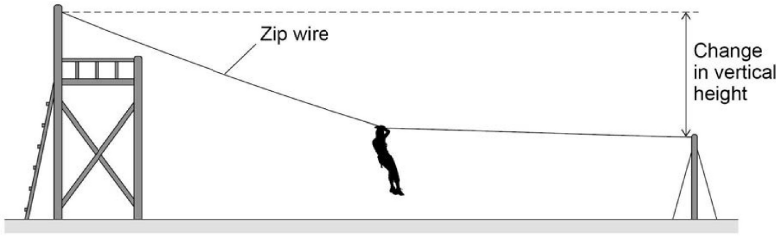
Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 7 **Figure 9** shows a person sliding down a zip wire.

Figure 9



0 7 . 1 As the person slides down the zip wire, the change in the gravitational potential energy of the person is 1.47 kJ

The mass of the person is 60 kg

gravitational field strength = 9.8 N/kg

Calculate the change in vertical height of the person.

[3 marks]

Change in vertical height = _____ m

Do not write outside the box

0 7 . 2 As the person moves down the zip wire her increase in kinetic energy is less than her decrease in gravitational potential energy.

Explain why.

[2 marks]

0 7 . 3 Different people have different speeds at the end of the zip wire.

Explain why.

[2 marks]

7

Turn over for the next question

Do not write outside the box

0 8 A student investigated the thermal conductivity of different metals.

This is the method used:

1. Measure the mass of an ice cube.
2. Put the ice cube on a metal block which is at room temperature.
3. Measure the mass of the ice cube after one minute.
4. Repeat with other blocks of the same mass made from different metals.

Figure 10



Table 3 shows the student's results.

Table 3

Metal	Initial mass of ice cube in grams	Final mass of ice cube in grams	Change in mass of ice cube in grams
Aluminium	25.85	21.14	4.71
Copper	26.20	20.27	5.93
Lead	25.53	21.97	3.56
Steel	24.95	19.45	5.50

Do not write outside the box

0 8 . 1 The initial temperature of each ice cube was –15 °C

Why was it important that the initial temperature of each ice cube was the same?

[1 mark]

Tick (✓) **one** box.

- Initial temperature was a continuous variable. ☐
- Initial temperature was a control variable. ☐
- Initial temperature was the dependent variable. ☐
- Initial temperature was the independent variable. ☐

0 8 . 2 Which metal had the highest thermal conductivity?

Give a reason for your answer.

[2 marks]

Metal: _____

Reason: _____

_____

_____

0 8 . 3 Suggest **one** source of random error in the student's investigation.

[1 mark]

_____

_____

_____

_____

Turn over ►

Do not write outside the box

0 8 . 4 An ice cube has a temperature of –15.0 °C

The total thermal energy needed to raise the temperature of this ice cube to 0.0 °C and completely melt the ice cube is 5848 J

specific heat capacity of ice = 2100 J/kg °C
specific latent heat of fusion of ice = 334 000 J/kg

Calculate the mass of the ice cube.

[5 marks]

_____

_____

_____

_____

_____

_____

_____

_____

Mass of ice cube = _____ kg

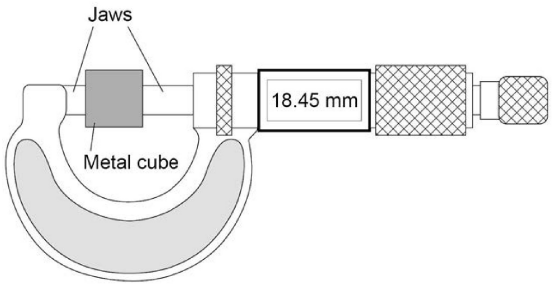
9

Do not write outside the box

0 9 A student measured the width of a solid metal cube using a digital micrometer.

Figure 11 shows the micrometer.

Figure 11



0 9 . 1 The resolution of the micrometer is 0.01 mm

The student could have used a metre rule to measure the width of the cube.

Explain how using a metre rule would have affected the accuracy of the student's measurement of width.

[2 marks]

Question 9 continues on the next page

Turn over ►

Do not write outside the box

0 9 . 2 The mass of the metal cube was measured using a top pan balance.

The balance had a zero error.

Explain how the zero error may be corrected after readings had been taken from the balance.

[2 marks]

0 9 . 3 The width of the cube was 18.45 mm. The density of the cube was 8.0×10^3 kg/m^3

Calculate the mass of the cube.

[5 marks]

Mass = _____ kg

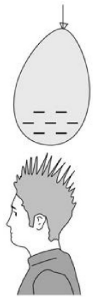
9

Do not write outside the box

1 0 **Figure 12** shows a student after rubbing a balloon on his hair.

The balloon and hair have become charged.

Figure 12



1 0 . 1 Describe the force that acts on the student's hair in **Figure 12**.

[2 marks]

1 0 . 2 An earthed conductor was brought near the charged student.
A spark jumped between the conductor and the student.

The potential difference between the conductor and the student was 2.5 kV
The energy transferred by the spark was 0.0050 J

Calculate the charge transferred by the spark.

[3 marks]

Charge = _____ C

Turn over ►

Do not write outside the box

1 0 . 3 A defibrillator can transfer a charge to regulate a person's heartbeat.

Figure 13 shows a defibrillator.

Figure 13



When the defibrillator is in use, a potential difference of 4800 V is applied across the person's chest.

A charge of 0.16 coulombs passes through the person's chest in 4.0 ms

Calculate the resistance of the person's chest.

[5 marks]

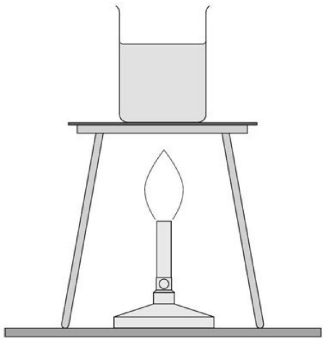
Resistance = _____ Ω

10

Do not write outside the box

1 1 **Figure 14** shows a Bunsen burner heating some water in a beaker.
Eventually the water changes into steam.

Figure 14



1 1 . 1 Explain how the internal energy of the water changes as it is heated from 20 °C to 25 °C

[2 marks]

1 1 . 2 How is the particle model used to explain the difference in density between a liquid and a gas?

[1 mark]

Tick (✓) **one** box.

- Particles in a gas have less kinetic energy than particles in a liquid. ☐
- Particles in a gas have more potential energy than particles in a liquid. ☐
- Particles in a liquid are further apart than particles in a gas. ☐
- Particles in a liquid are larger than particles in a gas. ☐

Turn over ►

Do not write outside the box

1 1 . 3 A student measured the mass of boiling water that was turned into steam in five minutes.

Explain how the student could use this information to estimate the power output of the Bunsen burner in watts.

[4 marks]

7

END OF QUESTIONS

There are no questions printed on this page

Do not write outside the box

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

There are no questions printed on this page

Do not write outside the box

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Copyright information

For confidentiality purposes, from the November 2015 examination series, acknowledgements of third party copyright material will be published in a separate booklet rather than including them on the examination paper or support materials. This booklet is published after each examination series and is available for free download from www.aqa.org.uk after the live examination series.

Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright-holders may have been unsuccessful and AQA will be happy to rectify any omissions of acknowledgements. If you have any queries please contact the Copyright Team, AQA, Stag Hill House, Guildford, GU2 7XJ.

Copyright © 2019 AQA and its licensors. All rights reserved.

AQA

GCSE
PHYSICS
8463/1H

Paper 1 Higher Tier

Mark scheme

June 2019

Version: 1.0 Final

196G8463/1H/MS

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1.1	The energy transferred each second to the bulb.		1	4.1.1.4 AO1
1.2	power = potential difference × current **or** $P = VI$		1	4.2.4.1 AO1
1.3	$40 = I \times 230$ $I = \frac{40}{230}$ I = 0.17 (A)	an answer of 0.17 (A) scores **3** marks a correct answer that rounds to 0.17 (A) scores **3** marks	1 1 1	4.2.4.1 AO2
1.4	efficiency = $\frac{\text{useful power output}}{\text{total power input}}$		1	4.1.2.2 AO1
1.5	$0.30 = \frac{\text{useful power output}}{9.0}$ useful power output = 0.30 × 9.0 useful power output = 2.7 (W)	an answer of 2.7 (W) scores **3** marks	1 1 1	4.1.2.2 AO2
1.6	bulbs also transfer thermal energy the efficiency of the light bulb also needs to be considered	allow light bulbs emit infrared radiation as well as visible light ignore so people know how bright the bulb is allow the cost to power the light bulb depends on the efficiency allow to see how much energy is wasted	1 1	4.1.2.2 4.1.1.4 AO1 AO3
Total			**11**	

Question 2

Question	Answers		Mark	AO/ Spec. Ref.
2.1	**Level 3**: The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.		5–6	RP2 WS2.2 4.1.2.1 AO1
	Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.		3–4	
	Level 1: The design/plan 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 • Wrap N layers of newspaper around the metal can • Heated water in a kettle **or** Using a Bunsen burner • Put hot water in the metal can • Use a measuring cylinder to measure the volume of water • Measure initial and final temperature with the digital thermometer • Use a stopclock / stopwatch to measure a time of 5 minutes • Calculate temperature decrease • Repeat with different number of layers of newspaper • Repeat with no layers of newspaper • Use same initial temperature of hot water • Use same volume of water each time Level 3: Workable method which includes changing the number of layers and includes at least one control variable (same volume of water or same starting temperature)			
2.2	the digital thermometer and the datalogger have the same resolution	allow both measure to 1 d.p. ignore accuracy ignore precision they give the same result is insufficient	1	RP2 WS2.3 4.1.2.1 AO3
	only need to measure the start and end temperature **or** only need 2 readings **or** only need to calculate the temperature change		1	
Total			**8**	

Question 3

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

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

Question 4

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

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

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5.1	$^{206}_{82}Pb$		1 1	4.4.2.2 AO1
5.2	alpha radiation is highly ionising causing an increased risk of cancer **or** organ failure **or** radiation sickness / poisoning **or** mutation of genes / DNA **or** damage to cells / tissues / organs until the radioactive material is removed / excreted **or** activity of radioactive material reaches / approaches background radiation levels	 allow kill cells allow all the alpha radiation is absorbed by the body ignore references to half-life	1 1 1	4.4.2.4 AO1
5.3	$\frac{414}{138} = 3$ (half-lives) $1.45 \times 10^{-4} \times 2 \times 2 \times 2$ $= 1.16 \times 10^{-3}$ (g) **or** = 0.00116 (g)	an answer of 1.16×10^{-3} (g) scores **3** marks	1 1 1	4.4.2.3 AO2
Total			**8**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6.1	50 Hz / hertz	 allow Hertz	1 1	4.2.3.1 AO1
6.2	(both) switches need to be closed / on to complete the series circuit **or** to allow charge to flow **or** so there is a current in the circuit		1 1	4.2.2 AO1
6.3	 $1800 = I^2 \times 32$ $I^2 = \frac{1800}{32}$ **or** $I^2 = 56.25$ **I** = 7.5 (A)	an answer of 7.5 (A) scores **3** marks an answer of 0.237(A) scores **2** marks this mark may be awarded if P is incorrectly or not converted this mark may be awarded if P is incorrectly or not converted this answer only	 1 1 1	4.2.4.1 AO2
6.4	 $1500 = \frac{450\ 000}{t}$ $t = \frac{450\ 000}{1500}$ t = 300 (s)	an answer of 300 (s) scores **3** marks an answer of 300 000 (s) scores **2** marks this mark may be awarded if P is incorrectly or not converted this mark may be awarded if P is incorrectly or not converted this answer only	 1 1 1	4.1.1.4 AO2
Total			**10**	

Question 7

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

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

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**	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9.1	metre rule has a lower resolution	allow metre rule has a resolution of 1mm / 1cm fewer decimal places is insufficient	1	WS2.3 RP5 4.3.1.1 AO1
	so is less accurate (than the micrometer screw gauge)		1	
9.2	record the value of the zero error when there is no object on the balance		1	RP5 4.3.1.1 AO3
	subtract / add the value of the zero error		1	
9.3		an answer of 0.0502 (kg) scores **5** marks		RP5 4.3.1.1 AO2
	$V = (18.45 \times 10^{-3})^3$ **or** $V = 0.01845^3$	this mark may be awarded if width is incorrectly / not converted	1	
	$V = 6.28 \times 10^{-6}$ (m^3)	this answer only	1	
	$8.0 \times 10^3 = \frac{m}{6.28 \times 10^{-6}}$	allow $8.0 \times 10^3 = \frac{m}{\text{their calculated V}}$	1	
	$m = 8.0 \times 10^3 \times 6.28 \times 10^{-6}$	allow $m = 8.0 \times 10^3 \times$ their calculated V	1	
	m = 0.0502 (kg)	allow an answer consistent with their calculated V	1	
Total			**9**	

Question 10

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

Question 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.1	the (mean) kinetic energy of the particles increases	allow the (mean) speed of the particles increases 'kinetic energy increases' is insufficient by itself do not accept particles vibrating	1	4.3.2.1 AO1
	which increases the (internal) energy of the water	ignore description of evaporation	1	
11.2	Particles in a gas have more potential energy than particles in a liquid.		1	4.3.1.1 AO1
11.3	Energy given to water E = mL with quantities defined		1	4.3.3.1 AO1
	power output (of Bunsen burner) $= \frac{\text{energy transferred (to water)}}{\text{time}}$	allow $P = \frac{E}{t}$ with quantities defined	1	
	power output $= \frac{\text{change in mass} \times \text{specific latent heat}}{\text{time}}$	allow E = Pt equated with E = mL or stated in words **or** $P = \frac{mL}{t}$ with quantities defined	1	
	time should be converted to seconds **or** use a time of 300 seconds		1	
Total			**7**	

AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
PHYSICS

H

Higher Tier Paper 1

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:
- a ruler
- a scientific calculator
- the Physics Equations Sheet (enclosed).

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
TOTAL	

There are no questions printed on this page

Do not write outside the box

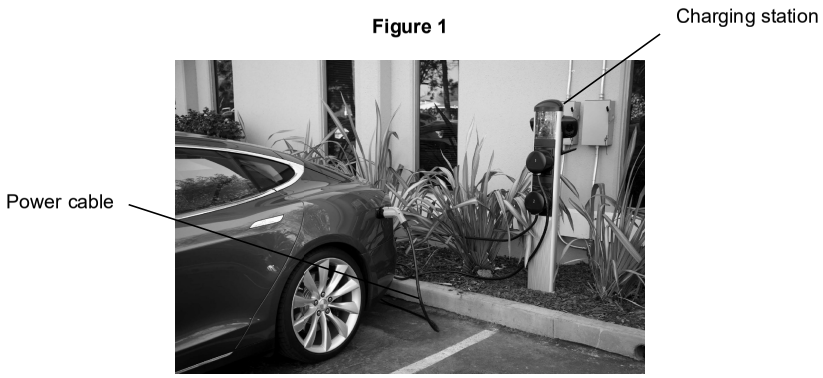
DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Answer **all** questions in the spaces provided.

Do not write outside the box

0 1 **Figure 1** shows an electric car being recharged.

Figure 1



0 1 . 1 The charging station applies a direct potential difference across the battery of the car.

What does 'direct potential difference' mean?

[1 mark]

Question 1 continues on the next page

Do not write outside the box

0 1 . 2 Which equation links energy transferred (E), power (P) and time (t)?

[1 mark]

Tick (✓) **one** box.

energy transferred = $\frac{\text{power}}{\text{time}}$ ☐

energy transferred = $\frac{\text{time}}{\text{power}}$ ☐

energy transferred = power × time ☐

energy transferred = power^2 × time ☐

0 1 . 3 The battery in the electric car can store 162 000 000 J of energy.

The charging station has a power output of 7200 W.

Calculate the time taken to fully recharge the battery from zero.

[3 marks]

Time taken = _____ s

Do not write outside the box

0 1 . 4 Which equation links current (I), potential difference (V) and resistance (R)?

[1 mark]

Tick (✓) **one** box.

$I = V \times R$ ☐

$I = V^2 \times R$ ☐

$R = I \times V$ ☐

$V = I \times R$ ☐

0 1 . 5 The potential difference across the battery is 480 V.

There is a current of 15 A in the circuit connecting the battery to the motor of the electric car.

Calculate the resistance of the motor.

[3 marks]

Resistance = _____ Ω

Question 1 continues on the next page

Do not write outside the box

0 1 . 6 Different charging systems use different electrical currents.

- Charging system **A** has a current of 13 A.
- Charging system **B** has a current of 26 A.
- The potential difference of both charging systems is 230 V.

How does the time taken to recharge a battery using charging system **A** compare with the time taken using charging system **B**?

[1 mark]

Tick (✓) **one** box.

Time taken using system **A** is half the time of system **B** ☐

Time taken using system **A** is the same as system **B** ☐

Time taken using system **A** is double the time of system **B** ☐

10

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 2 Energy from the Sun is released by nuclear fusion.

0 2 . 1 Complete the sentences.

[2 marks]

Nuclear fusion is the joining together of _____.

During nuclear fusion the total mass of the particles _____.

0 2 . 2 Nuclear fusion of deuterium is difficult to achieve on Earth because of the high temperature needed.

Electricity is used to increase the temperature of 4.0 g of deuterium by 50 000 000 °C.

specific heat capacity of deuterium = 5200 J/kg °C

Calculate the energy needed to increase the temperature of the deuterium by 50 000 000 °C.

Use the Physics Equation Sheet.

[3 marks]

Energy = _____ J

Do not write outside the box

0 2 . 3 The idea of obtaining power from nuclear fusion was investigated using models.

The models were tested before starting to build the first commercial nuclear fusion power station.

Suggest **two** reasons why models were tested.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

0 2 . 4 Generating electricity using nuclear fusion will have fewer environmental effects than generating electricity using fossil fuels.

Explain **one** environmental effect of generating electricity using fossil fuels.

[2 marks]

_____

_____

_____

_____

_____

9

Turn over for the next question

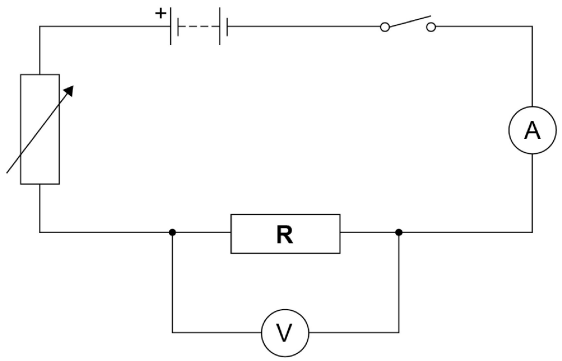
Do not write outside the box

0 3 Student **A** investigated how the current in resistor **R** at constant temperature varied with the potential difference across the resistor.

Student **A** recorded both positive and negative values of current.

Figure 2 shows the circuit Student **A** used.

Figure 2



0 3 . 1 Describe a method that Student **A** could use for this investigation.

[6 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Do not write outside the box

0 3 . 2 Student **B** repeated the investigation.

During Student **B**'s investigation the temperature of resistor **R** increased.

Explain how the increased temperature of resistor **R** would have affected Student **B**'s results.

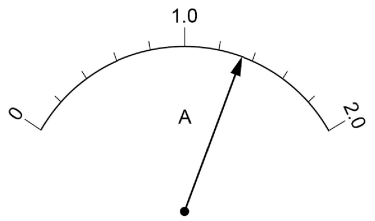
[2 marks]

Question 3 continues on the next page

Do not write outside the box

Figure 3 shows the scale on a moving coil ammeter at one time in the investigation.

Figure 3



0 3 . 3 What is the resolution of the moving coil ammeter?

[1 mark]

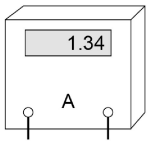
Resolution = _____ A

Do not write outside the box

0 3 . 4 Student **B** replaced the moving coil ammeter with a digital ammeter.

Figure 4 shows the reading on the digital ammeter.

Figure 4



The digital ammeter has a higher resolution than the moving coil ammeter.

Give **one** other reason why it would have been better to use the digital ammeter throughout this investigation.

[1 mark]

_____

_____

_____

10

Turn over for the next question

Do not write outside the box

0 4 A student investigated the density of different fruits.

Table 1 shows the results.

Table 1

Fruit	Density in g/cm^3
Apple	0.68
Kiwi	1.03
Lemon	0.95
Lime	1.05

0 4 . 1 The student determined the volume of each fruit using a displacement can and a measuring cylinder.

What other piece of equipment would the student need to determine the density of each fruit?

[1 mark]

_____

Do not write outside the box

0 4 . 2 Write down the equation which links density (ρ), mass (m) and volume (V).

[1 mark]

0 4 . 3 The mass of the apple was 85 g.

The density of the apple was 0.68 g/cm^3.

Calculate the volume of the apple.

Give your answer in cm^3.

[3 marks]

Volume = _____ cm^3

0 4 . 4 The student only measured the volume of each fruit once.

The volume measurements **cannot** be used to show that the method to measure volume gives precise readings.

Give the reason why.

[1 mark]

6

Do not write outside the box

0 5 . 1 During one year, 1.25 × 10^{18} J of energy was transferred from the National Grid.

number of seconds in 1 year = 3.16 × 10^7

Calculate the mean energy transferred from the National Grid each second.

Give your answer to 3 significant figures.

[2 marks]

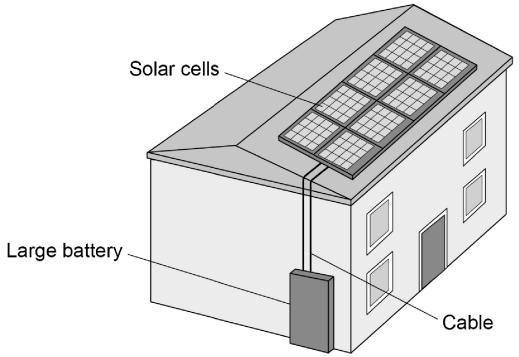
Energy each second (3 significant figures) = _____ J

Figure 5 shows a house with a solar power system.

The solar cells generate electricity.

When the electricity generated by the solar cells is not needed, the energy is stored in a large battery.

Figure 5



Do not write outside the box

0 5 . 2 The charge flow through the cable between the solar cells and the battery in 24 hours was 27 000 coulombs.

Calculate the mean current in the cable.

[4 marks]

Mean current = _____ A

0 5 . 3 At one time, the total power input to the solar cells was 7.8 kW.

The efficiency of the solar cells was 0.15

Calculate the useful power output of the solar cells.

[3 marks]

Useful power output = _____ W

Question 5 continues on the next page

Do not write outside the box

0 5 . 4 It is unlikely that **all** of the electricity that the UK needs can be generated by solar power systems.

Explain why.

[2 marks]

11

Do not write outside the box

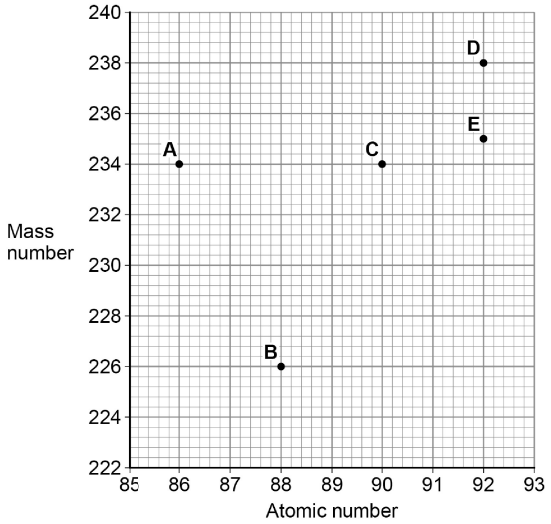
Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 6 **Figure 6** shows the mass number and the atomic number for the nuclei of five different atoms.

Figure 6



0 6 . 1 How many neutrons are there in a nucleus of atom **A**?

[1 mark]

Do not write outside the box

0 6 . 2 Which **two** atoms in **Figure 6** are the same element?

[1 mark]

Tick (✓) **one** box.

A and **B** ☐

A and **C** ☐

C and **D** ☐

D and **E** ☐

Question 6 continues on the next page

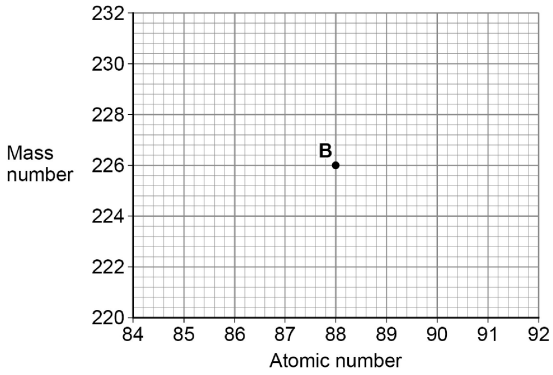
Do not write outside the box

0 6 . 3 Nucleus **B** decays by emitting an alpha particle.

Draw an arrow on **Figure 7** to represent the alpha decay.

[2 marks]

Figure 7



0 6 . 4 What is meant by the 'random nature of radioactive decay'?

[1 mark]

Do not write outside the box

0 6 . 5 A polonium (Po) nucleus decays by emitting an alpha particle and forming a lead (Pb) nucleus.

$$Po \rightarrow Pb + \alpha$$

The lead (Pb) nucleus then decays by emitting a beta particle and forms a bismuth (Bi) nucleus.

$$Pb \rightarrow Bi + \beta$$

The bismuth (Bi) nucleus then decays by emitting a beta particle and forms a polonium (Po) nucleus.

$$Bi \rightarrow Po + \beta$$

Explain how these three decays result in a nucleus of the original element, polonium.

[3 marks]

8

Turn over for the next question

Do not write outside the box

0 7 A student investigated how the current in a series circuit varied with the resistance of a variable resistor.

Figure 8 shows the circuit used.

Figure 8

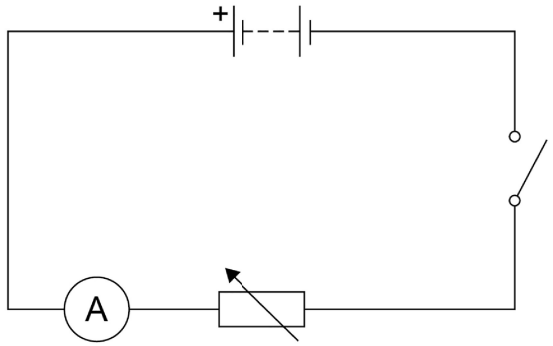
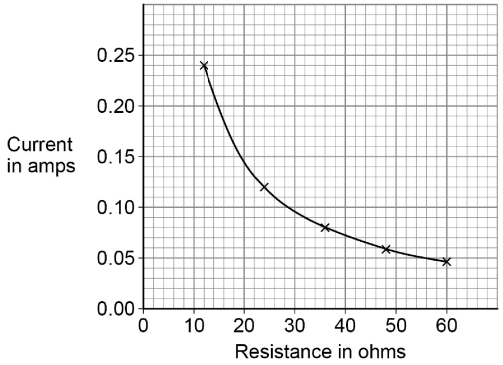


Figure 9 shows the results.

Figure 9



Do not write outside the box

0 7 . 1 The battery had a power output of 230 mW when the resistance of the variable resistor was 36 Ω.

Determine the potential difference across the battery.

[4 marks]

Potential difference = _____ V

0 7 . 2 The student concluded:

'the current in the circuit was inversely proportional to the resistance of the variable resistor.'

Explain how **Figure 9** shows that the student is correct.

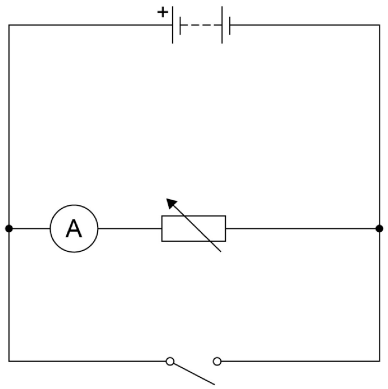
[2 marks]

Question 7 continues on the next page

Do not write outside the box

0 7 . 3 **Figure 10** shows a circuit with a switch connected incorrectly.

Figure 10



Explain how closing the switch would affect the current in the variable resistor.

[2 marks]

8

Do not write outside the box

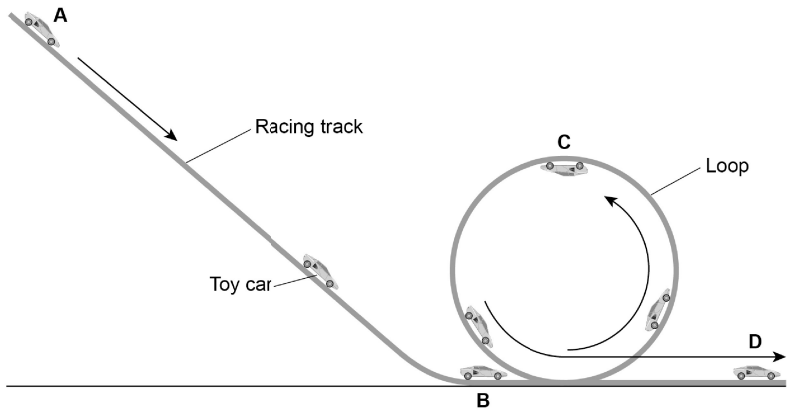
Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 8 **Figure 11** shows a toy car in different positions on a racing track.

Figure 11



0 8 . 1 The toy car and racing track can be modelled as a closed system.

Why can the toy car and racing track be considered 'a closed system'?

[1 mark]

Tick (✓) **one** box.

The racing track and the car both have gravitational potential energy. ☐

The racing track and the car are always in contact with each other. ☐

The total energy of the racing track and the car is constant. ☐

Do not write outside the box

0 8 . 2 The car is released from rest at position **A** and accelerates due to gravity down the track to position **B**.

mass of toy car = 0.040 kg

vertical height between position **A** and position **B** = 90 cm

gravitational field strength = 9.8 N/kg

Calculate the maximum possible speed of the toy car when it reaches position **B**.

[5 marks]

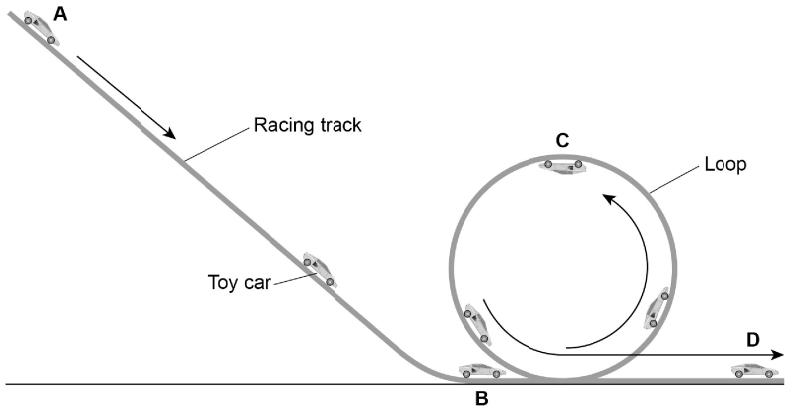
Speed = _____ m/s

Question 8 continues on the next page

Do not write outside the box

Figure 11 is repeated below.

Figure 11



0 8 . 3 At position **C** the car's gravitational potential energy is 0.20 J greater than at position **B**.

How much kinetic energy does the car need at position **B** to complete the loop of the track?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

Less than 0.20 J ☐

Exactly 0.20 J ☐

More than 0.20 J ☐

Reason _____

_____

_____

8

Do not write outside the box

Turn over for the next question

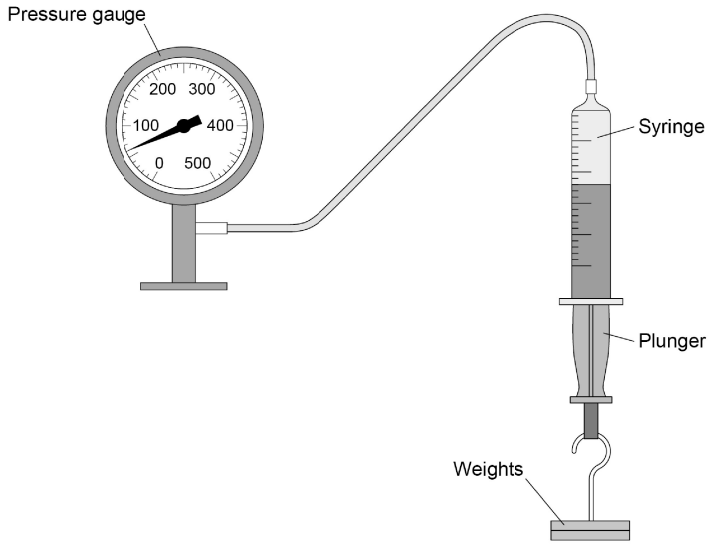
DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 9 A teacher demonstrated the relationship between the pressure in a gas and the volume of the gas.

Figure 12 shows the equipment used.

Figure 12



This is the method used.

1. Record the initial volume of gas in the syringe and the pressure reading before any weights are attached.
2. Attach a 2.0 N weight to the syringe.
3. Record the volume of the gas and the reading on the pressure gauge.
4. Repeat steps 2 and 3 until a weight of 12.0 N is attached to the syringe.

0 9 . 1 What was the range of force used?

[1 mark]

From _____ N to _____ N

0 9 . 2 Give **one** control variable in the investigation.

[1 mark]

_____

Do not write outside the box

0 9 . 3 When the volume of gas in the syringe was 45 cm^3, the pressure gauge showed a value of 60 kPa.

Calculate the pressure in the gas when the volume of gas in the syringe was 40 cm^3.

[4 marks]

Pressure = _____ kPa

0 9 . 4 When the volume of gas in the syringe increased, the pressure on the inside walls of the syringe decreased.

Explain why.

[3 marks]

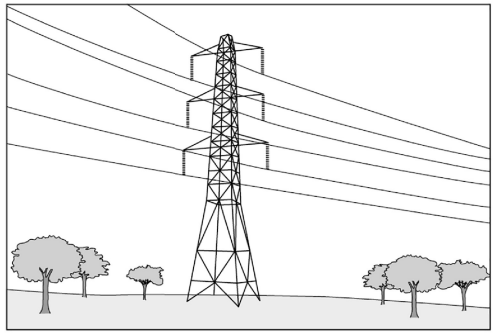
9

Turn over for the next question

Do not write outside the box

1 0 **Figure 13** shows some overhead power cables in the National Grid.

Figure 13



1 0 . 1 Explain the advantage of transmitting electricity at a very high potential difference.

[3 marks]

Do not write outside the box

1 0 . 2 It is dangerous for a person to fly a kite near an overhead power cable.

Figure 14 shows a person flying a kite.

Figure 14



The person could receive a fatal electric shock if the kite was very close to, but not touching the power cable.

Explain why.

[3 marks]

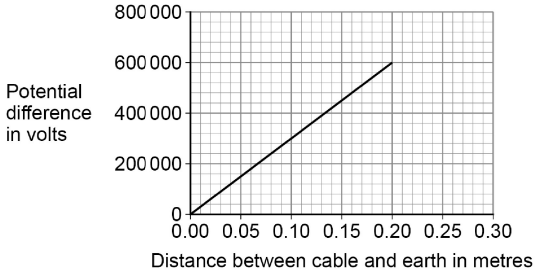
Question 10 continues on the next page

Do not write outside the box

A scientist investigated how the potential difference needed for air to conduct charge varies with the distance between a cable and earth.

Figure 15 shows the results.

Figure 15



1 0 . 3 The data in **Figure 15** gives the relationship between potential difference and distance when the air is dry.

When the humidity of air increases the air becomes a better conductor of electricity.

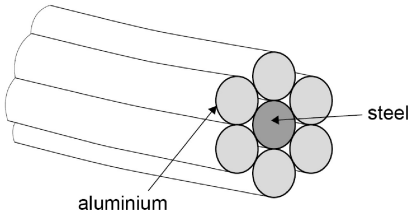
Draw a line on **Figure 15** to show how the potential difference changes with distance if the humidity of the air increases.

[2 marks]

Do not write outside the box

1 0 . 4 **Figure 16** shows a cross-section through a power cable.

Figure 16



A 1 metre length of a single aluminium wire is a better conductor than a 1 metre length of the steel wire.

The individual wires behave as if they are resistors connected in parallel.

Explain why the current in the steel wire is different to the current in a single aluminium wire.

[2 marks]

10

Turn over for the next question

Do not write outside the box

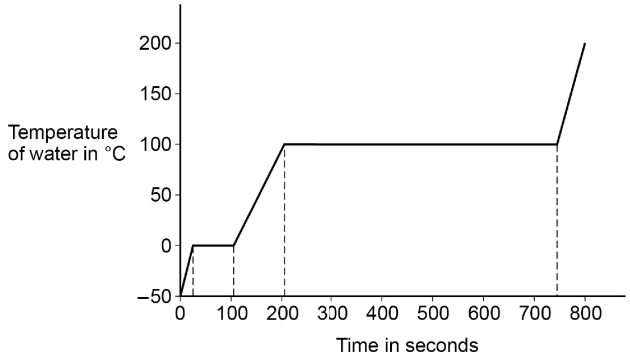
1 1 A student investigated how the temperature of a lump of ice varied as the ice was heated.

The student recorded the temperature until the ice melted and then the water produced boiled.

Figure 17 shows the student's results.

The power output of the heater was constant.

Figure 17



1 1 . 1 The specific heat capacity of ice is less than the specific heat capacity of water.

Explain how **Figure 17** shows this.

[2 marks]

Do not write outside the box

1 1 . 2 The specific latent heat of fusion of ice is less than the specific latent heat of vaporisation of water.

Explain how **Figure 17** shows this.

[2 marks]

1 1 . 3 A second student did the same investigation and recorded the temperature until the water produced boiled.

In the second student's investigation more thermal energy was transferred to the surroundings.

Describe **two** ways the results of the experiment in **Figure 17** would have been different.

[2 marks]

1

2

Question 11 continues on the next page

Do not write outside the box

1 1 . 4 When the water was boiling, 0.030 kg of water turned into steam.

The energy transferred to the water was 69 kJ.

Calculate the specific latent heat of vaporisation of water.

Give the unit.

[5 marks]

Specific latent heat of vaporisation =

Unit

11

END OF QUESTIONS

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

Question number	**Additional page, if required. Write the question numbers in the left-hand margin.**

Do not write outside the box

Question number	**Additional page, if required. Write the question numbers in the left-hand margin.**

Do not write outside the box

Question number	**Additional page, if required. Write the question numbers in the left-hand margin.**
	Copyright information For confidentiality purposes, all acknowledgements of third-party copyright material are published in a separate booklet. This booklet is published after each live examination series and is available for free download from www.aqa.org.uk. Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright-holders may have been unsuccessful and AQA will be happy to rectify any omissions of acknowledgements. If you have any queries please contact the Copyright Team. Copyright © 2021 AQA and its licensors. All rights reserved.

AQA

GCSE
PHYSICS
8463/1H

Paper 1 Higher Tier

Mark scheme

June 2021

Version: 1.1 Final Mark Scheme

216g8463/1H/MS

Question 1

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

Question 2

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

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

Question 3

Question	Answers	Mark	AO/ Spec. Ref
03.1	**Level 3**: The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 4.2.1.4 RPA4
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan 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 current in **R** using the ammeter • measure the p.d. across **R** using the voltmeter • vary the resistance of the variable resistor (or vary the number of cells or use a variable power supply) • record a range of values of current and p.d. • ensure current is low to avoid temperature increase • switch circuit off between readings • reverse connection of **R** to power supply • repeat measurements of I and V in negative direction • plot a graph of current against p.d.		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	current and p.d. would not be directly proportional **or** I-V graph would not be straight **or** I-V graph would be curved		1	AO3 4.2.1.4 RPA4
	(because) resistance of **R** would increase		1	
03.3	0.2 (A)		1	AO3 4.2.2 RPA4
03.4	any **one** from: • less chance of misreading • no parallax error	allow position of eye(s) does not affect reading	1	AO3 4.2.2 RPA4
	• it can give a reading closer to the true value	allow 'it is more accurate' ignore 'no human error' ignore 'easier to read'		
Total			**10**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	balance / scales		1	AO1 4.3.1.1 RPA5
04.2	density = $\frac{\text{mass}}{\text{volume}}$ **or** $\rho = \frac{m}{V}$		1	AO1 4.3.1.1 RPA5
04.3	$0.68 = \frac{85}{V}$ $V = \frac{85}{0.68}$ $V = 125\ (cm^3)$		1 1 1	AO2 4.3.1.1 RPA5
04.4	repeat readings (of volume) need taking (of each fruit) to show that the readings are close together	allow 'the same' for 'close together'	1	AO3 4.3.1.1 RPA5
Total			**6**	

Question 5

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

		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**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	148		1	AO1 4.4.1.2
06.2	D and E		1	AO1 4.4.1.2
06.3	line between B and 86 protons same line between B and 222 mass number		1 1	AO2 4.4.2.2
06.4	can't predict which nucleus will decay next **or** can't predict when a (particular) nucleus will decay		1	AO1 4.4.2.3
06.5	one alpha decay would decrease proton number by 2 two beta decays would increase proton number by 2 so the proton / atomic number of the final nucleus is the same as the proton / atomic number of the original nucleus	 this mark is dependent on scoring the first two marks	1 1 1	AO1 4.4.2.2
Total			**8**	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	I = 0.08 (A)	an incorrect value of I from the graph can score all subsequent marks	1	AO2 4.2.4.1
	$0.230 = 0.08 \times V$	allow a correct substitution of an incorrectly/not converted value of P	1	
	$V = \frac{0.230}{0.08}$	allow a correct rearrangement using an incorrectly/not converted value of P	1	
	V = 2.875 (V)	allow a correct calculation using an incorrectly/not converted value of P	1	
	OR			
	I = 0.08 (A) (1)			
	V = 0.08 × 36 (2)			
	V = 2.88 (V) (1)			
	OR			
	$0.230 = I^2 \times 36$ (1)			
	I = 0.08 (A) (1)			
	V = 0.08 × 36 (1)			
	V = 2.88 (V) (1)			
07.2	the product of current and resistance = a constant		1	AO2
	calculation of constant (2.88) using three or more pairs of values	if no other marks scored allow for one mark a statement that doubling one quantity (R or I) halves the other quantity	1	AO3 4.2.1.3

07.3	current would be (almost) zero (in the variable resistor)		1	AO1
	(because) the switch has (effectively) zero resistance **or** the potential difference across the variable resistor is (effectively) zero	the switch's resistance is much lower than the variable resistor allow the switch creates a short circuit	1	AO2 4.2.2 4.2.1.3
Total			**8**	

Question 8

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

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	0(.0) to 12(.0)	allow 2(.0) to 12(.0) (N)	1	AO1 4.3.3.2
09.2	mass of gas (in the syringe) **or** temperature (of the gas)		1	AO3 4.3.3.2
09.3	constant = 60 × 45 **or** constant = 2700		1	AO2 4.3.3.2
	$2700 = p \times 40$		1	
	$p = \frac{2700}{40}$		1	
	p = 67.5 (kPa)	allow 68 (kPa)	1	

09.4	there is more time between collisions of particles and the walls of the syringe **or** there are less frequent collisions between the particles and the walls of the syringe (causing) a lower (average) force on the walls of the syringe (and) pressure is the total force per unit area		1 1 1	AO1 4.3.3.2
Total			**9**	

Question 10

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

Question 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.1	the gradient for ice is steeper than the gradient for water (liquid)	allow the temperature of the ice increased faster than the temperature of the water	1	AO3 4.3.2.2
	which means that less energy is needed to increase the temperature by a fixed amount		1	
11.2	water took more time to vaporise than the ice took to melt		1	AO3 4.3.2.3
	which means that less energy is needed to change the state from solid to liquid (than from liquid to vapour)		1	
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

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**	

AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
PHYSICS

H

Higher Tier Paper 1

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:
- a ruler
- a scientific calculator
- the Physics Equations Sheet (enclosed).

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- In all calculations, show clearly how you work out your answer.

Information
- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
TOTAL	

Do not write outside the box

Answer **all** questions in the spaces provided.

0 1 **Figure 1** shows a large wind farm off the coast of the UK.

Figure 1



The mean power output of the wind farm is 696 MW, which is enough power for 580 000 homes.

0 1 . 1 Calculate the mean power needed for 1 home.

Give your answer in watts.

[2 marks]

Mean power needed for 1 home = _____ W

Do not write outside the box

0 1 . 2 On one day the demand for electricity in the UK was 34 000 MW.

Suggest **two** reasons why wind power was not able to meet this demand.

[2 marks]

1

2

0 1 . 3 Some of the energy from the wind used to rotate a wind turbine is wasted.

An engineer oils the mechanical parts of a wind turbine.

Explain how oiling would affect the efficiency of the wind turbine.

[3 marks]

0 1 . 4 In most homes in the UK there are many different electrical devices.

Explain why people should be encouraged to use energy efficient electrical devices.

[2 marks]

9

Do not write outside the box

0 2 **Figure 2** shows a rock found by a student on a beach.

To help identify the type of rock, the student took measurements to determine its density.

Figure 2



0 2 . 1 Describe a method the student could use to determine the density of the rock.

[6 marks]

Do not write outside the box

The student determined the density of the rock to be 2.55 ± 0.10 g/cm^3.

0 2 . 2 What are the maximum and minimum values for the density of the rock?

[1 mark]

Maximum density = _____ g/cm^3

Minimum density = _____ g/cm^3

0 2 . 3 **Table 1** gives the density of five different types of rock.

Table 1

Type of rock	Density in g/cm^3
Basalt	2.90 ± 0.10
Chalk	2.35 ± 0.15
Flint	2.60 ± 0.10
Sandstone	2.20 ± 0.20
Slate	2.90 ± 0.20

Which two types of rock in **Table 1** could be the type of rock the student had?

[1 mark]

Tick (✓) **one** box.

Basalt or chalk ☐

Chalk or flint ☐

Flint or sandstone ☐

Sandstone or slate ☐

Question 2 continues on the next page

Do not write outside the box

0 2 . 4 The student only took one set of measurements to determine the density of the rock.

Explain why taking the measurements more than once may improve the accuracy of the density value.

[2 marks]

_____

_____

_____

_____

10

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 3 An engineering company has invented pavement tiles that generate electricity as people walk on them.

Figure 3 shows someone walking on the pavement tiles.

Figure 3



Use the Physics Equations Sheet to answer questions **03.1** and **03.2**.

0 3 . 1 What equation links current (I), potential difference (V) and power (P)?

[1 mark]

Tick (✓) **one** box.

$P = \frac{V}{I}$ ☐

$P = V \times I$ ☐

$I = P \times V$ ☐

$V = I^2 \times P$ ☐

Do not write outside the box

0 3 . 2 When a person walks on a tile, a potential difference of 40 V is induced across the tile.

The power output of the tile is 4.4 W.

Calculate the current in the tile.

[3 marks]

Current = _____ A

Question 3 continues on the next page

Do not write outside the box

Use the Physics Equations Sheet to answer questions **03.3** and **03.4**.

0 3 . 3 What equation links efficiency, total power input and useful power output?

[1 mark]

Tick (✓) **one** box.

Efficiency = $\frac{\text{useful power output}}{\text{total power input}}$ ☐

Efficiency = $\frac{\text{total power input}}{\text{useful power output}}$ ☐

Efficiency = useful power output × total power input ☐

0 3 . 4 The tiles are used to power LED lights in the pavement.

An LED light has a total power input of 4.0 W.

The efficiency of the LED light is 0.85

Calculate the useful power output of the LED light.

[3 marks]

Useful power output = _____ W

8

Do not write outside the box

Turn over for the next question

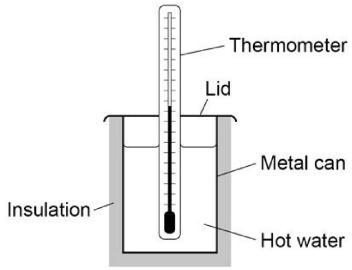
DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 4 A student investigated the insulating properties of different materials.

Figure 4 shows some of the equipment used by the student.

Figure 4



This is the method used:

1. Wrap insulating material around the can.
2. Put a fixed volume of boiling water in the can.
3. Place the lid on the top of the can.
4. Measure the time taken for the temperature of the water to decrease by a fixed amount.
5. Repeat steps 1–4 using the same thickness of different insulating materials.

0 4 . 1 Identify the independent variable and the dependent variable in this investigation.

[2 marks]

Independent variable _____

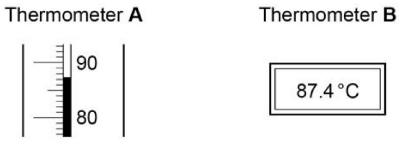
Dependent variable _____

Do not write outside the box

The student used two different types of thermometer to measure the temperature changes.

Figure 5 shows a reading on each thermometer.

Figure 5



0 4 . 2 What is the resolution of thermometer **B**?

[1 mark]

Resolution = _____ °C

0 4 . 3 Thermometer **A** is more likely to be misread.

Give **one** reason why.

[1 mark]

_____

_____

_____

Question 4 continues on the next page

Do not write outside the box

0 4 . 4 For one type of insulating material, the temperature of the water decreased from 85.0 °C to 65.0 °C.

The energy transferred from the water was 10.5 kJ.

specific heat capacity of water = 4200 J/kg °C

Calculate the mass of water in the can.

Use the Physics Equations Sheet.

[3 marks]

_____

_____

_____

_____

_____

Mass = _____ kg

Do not write outside the box

0 4 . 5 **Table 2** shows the results for two insulating materials.

Table 2

Material	Time for temperature to decrease by 20 °C in seconds
X	450
Y	745

Explain how the results in **Table 2** can be used to compare the thermal conductivity of the two materials.

[2 marks]

9

Turn over for the next question

Do not write outside the box

0 5 A student rubbed a plastic rod with a cloth.

The rod became negatively charged and the cloth became positively charged.

0 5 . 1 Explain why the cloth became positively charged.

[3 marks]

Figure 6 shows the negatively charged rod on a balance.

Figure 6

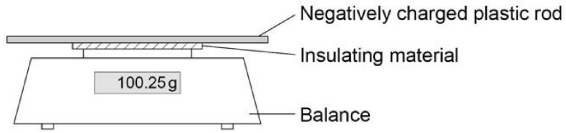
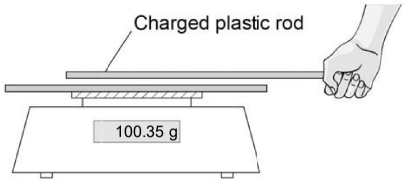


Figure 7 shows another charged rod being held stationary above the rod on the balance.

The rods do not touch each other.

Figure 7



Do not write outside the box

0 5 . 2 Explain why the reading on the balance increases.

[3 marks]

0 5 . 3 The balance had a zero error.

The zero error is not important in this experiment.

Give the reason why.

[1 mark]

0 5 . 4 A negatively charged rod is held near an earthed conductor.

Explain why a spark jumps between the negatively charged rod and the earthed conductor.

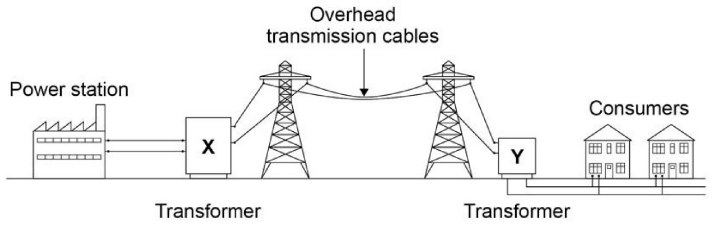
[3 marks]

10

Do not write outside the box

0 6 **Figure 8** shows how electricity is supplied to consumers by the National Grid.

Figure 8



0 6 . 1 Explain why transformer **X** is used in the National Grid.

[4 marks]

0 6 . 2 Explain why transformer **Y** is used in the National Grid.

[2 marks]

Do not write outside the box

0 6 . 3 The town of Hornsdale in Australia has electricity supplied by a huge battery.

On one day the battery transferred 3.24×10^{11} J of energy to the town.

The potential difference of the town's electricity supply is 230 V.

Calculate the charge flow to the town on this day.

Use the Physics Equations Sheet.

Give your answer to **3** significant figures.

[4 marks]

Charge flow (3 significant figures) = _____ C

10

Turn over for the next question

Do not write outside the box

0 7 Alpha particles, beta particles and gamma rays are types of nuclear radiation.

0 7 . 1 What does an alpha particle consist of?

[1 mark]

0 7 . 2 A krypton (Kr) nucleus decays into a rubidium (Rb) nucleus by emitting a beta particle.

Complete the nuclear equation for this decay by writing the missing number in each box.

[2 marks]

$$\square_{36}\mathrm{Kr} \longrightarrow {}^{85}_{\square}\mathrm{Rb} + {}^{0}_{-1}\mathrm{e}$$

0 7 . 3 Internal contamination of the human body means radioactive material is inside the human body.

Explain how the risk from internal contamination is different to the risk from external irradiation by a source of alpha radiation.

[5 marks]

8

Do not write outside the box

Turn over for the next question

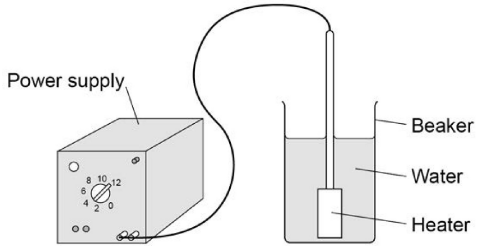
DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 8 A student determined the specific latent heat of vaporisation of water.

Figure 9 shows some of the equipment used.

Figure 9



This is the method used:

1. Put 50 cm^3 of water in a beaker.
2. Measure the mass of the beaker and water.
3. Use a heater to boil the water and keep it boiling for 600 seconds.
4. Measure the mass of the beaker and water after 600 seconds.

0 8 . 1 What measuring instrument should be used to measure the volume of water?

[1 mark]

0 8 . 2 What is a hazard in the student's investigation?

[1 mark]

Tick (✓) **one** box.

burns ☐

boiling water ☐

heatproof gloves ☐

safety goggles ☐

Do not write outside the box

0 8 . 3 The initial mass of the beaker and water was 0.080 kg.

The final mass of the beaker and water was 0.071 kg.

The energy transferred by the immersion heater as the water boiled was 25 200 J.

Calculate the specific latent heat of vaporisation of water given by the student's data.

Give the unit.

Use the Physics Equations Sheet.

[5 marks]

Specific latent heat of vaporisation = _____ Unit _____

Question 8 continues on the next page

Do not write outside the box

0 8 . 4 Some thermal energy was transferred to the surroundings while the water was being heated.

Explain how this affected the student's value for the specific latent heat of vaporisation of water.

[2 marks]

0 8 . 5 Some of the water evaporated before its temperature reached 100 °C.

Explain how this affected the student's value for the specific latent heat of vaporisation of water.

[2 marks]

11

Do not write outside the box

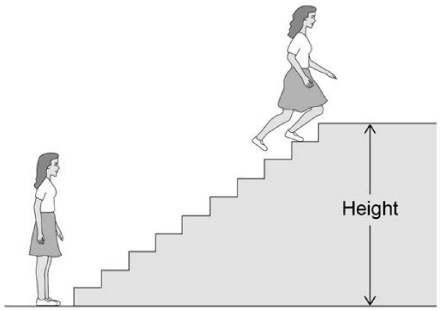
Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 9 **Figure 10** shows a girl doing an experiment to determine her power output by running to the top of some stairs.

Figure 10



0 9 . 1 The mass of the girl was 60.0 kg.

The height of the stairs was 175 cm.

The girl ran to the top of the stairs in 1.40 s.

gravitational field strength = 9.8 N/kg

Calculate the power output of the girl.

Use the Physics Equations Sheet.

[5 marks]

Power = _____ W

Do not write outside the box

0 9 . 2 The **total** power output of the girl was greater than the answer to question **09.1**.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

0 9 . 3 A boy took more than 1.40 s to run up the same stairs.

The power output of the boy was the same as the power output of the girl.

What conclusion can be made about the boy's mass?

[1 mark]

Tick (✔) **one** box.

The boy's mass was greater than the girl's mass. ☐

The boy's mass was lower than the girl's mass. ☐

The boy's mass was the same as the girl's mass. ☐

8

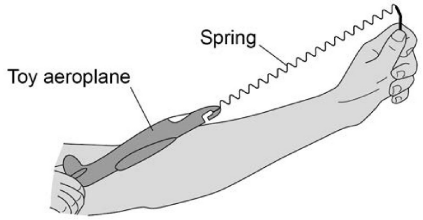
Turn over for the next question

Do not write outside the box

1 0 **Figure 11** shows a student launching a toy aeroplane.

To launch the aeroplane, the student pulls on it to stretch the spring and then releases it.

Figure 11



1 0 . 1 Just before the toy aeroplane is released, the spring has an extension of 0.12 m.

mass of aeroplane = 0.020 kg

spring constant of the spring = 50 N/m

Calculate the maximum speed of the toy aeroplane just after it is launched.

Use the Physics Equations Sheet.

Give the unit.

[6 marks]

Speed = _____ Unit _____

Do not write outside the box

1 0 . 2 Complete the sentence.

[1 mark]

As the aeroplane moves upwards through the air there is a decrease

in the _____ energy of the aeroplane.

1 0 . 3 Give **one** factor which would increase the distance the toy aeroplane travels horizontally before hitting the ground.

[1 mark]

_____

_____

8

Turn over for the next question

Do not write outside the box

1 1 **Figure 12** shows some hair straighteners.

Hair straighteners contain heating elements.

Figure 12



1 1 . 1 When the hair straighteners reach normal operating temperature, an LED turns on.

Draw the circuit symbol for an LED in the box.

[1 mark]

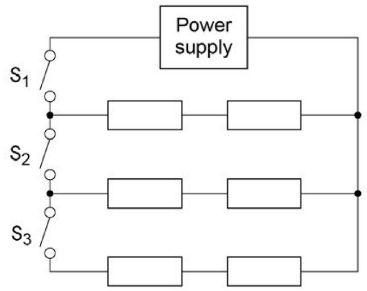
Do not write outside the box

Figure 13 shows the circuit diagram for the hair straighteners.

Each resistor represents a heating element.

The power output of the hair straighteners can be changed by closing different switches.

Figure 13



1 1 . 2 Why do the hair straighteners **not** turn on when only switch S_2 is closed?

[1 mark]

Question 11 continues on the next page

Do not write outside the box

1 1 . 3 The hair straighteners have a maximum power output of 120 W.

The energy transferred to the hair straighteners to reach normal operating temperature is 3.6 kJ.

Calculate the time taken for the hair straighteners to reach normal operating temperature when operating at maximum power.

Use the Physics Equations Sheet.

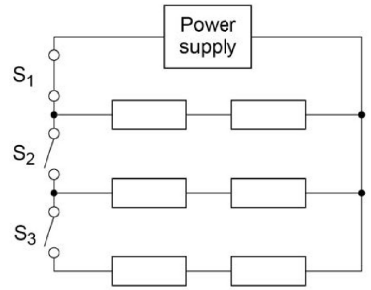
[4 marks]

Time = _____ seconds

Do not write outside the box

1 1 . 4 **Figure 14** shows the hair straighteners circuit with switch S_1 closed.

Figure 14



Switch S_2 and switch S_3 are then closed at the same time.

Explain what happens to the power output of the power supply.

[3 marks]

9

END OF QUESTIONS

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

Question number	**Additional page, if required. Write the question numbers in the left-hand margin.**

Do not write outside the box

Question number	**Additional page, if required. Write the question numbers in the left-hand margin.**
	Copyright information For confidentiality purposes, all acknowledgements of third-party copyright material are published in a separate booklet. This booklet is published after each live examination series and is available for free download from www.aqa.org.uk. Permission to reproduce all copyright material has been applied for. In some cases, efforts to contact copyright-holders may have been unsuccessful and AQA will be happy to rectify any omissions of acknowledgements. If you have any queries please contact the Copyright Team. Copyright © 2022 AQA and its licensors. All rights reserved.

AQA

GCSE
PHYSICS
8463/1H

Paper 1 Higher Tier

Mark scheme

June 2022

Version: 1.0 Final Mark Scheme

2 2 6 G 8 4 6 3 / 1 H / M S

Question 1

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

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

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

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

Total Question 1		**9**

Question 2

Question	Answers	Mark	AO / Spec. Ref.
02.1	**Level 3**: The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 4.3.1.1 RPA5
	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 mass using a balance / scales • part fill a measuring cylinder with water and measure initial volume • place rock in water and measure final volume • volume of rock = final volume − initial volume • fill a displacement / eureka can with water level with spout • place rock in water and collect displaced water • measuring cylinder used to determine volume of displaced water • volume of rock = volume of displaced water • use mass and volume to calculate density • use of: density = $\frac{\text{mass}}{\text{volume}}$		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	maximum density = 2.65 (g/cm^3) minimum density = 2.45 (g/cm^3)	both required	1	AO3 4.3.1.1 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	chalk or flint		1	AO3 4.3.1.1 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	a mean can be calculated which reduces the effect of random errors	 allow anomalies can be identified / removed	1 1	AO3 4.3.1.1 RPA5

Total Question 2		**10**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	$P = V \times I$		1	AO1 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	$4.4 = 40 \times I$ $I = \frac{4.4}{40}$ $I = 0.11$ (A)		1 1 1	AO2 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	efficiency = $\frac{\text{useful power output}}{\text{total power input}}$		1	AO1 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	$0.85 = \frac{P}{4.0}$ $P = 0.85 \times 4.0$ $P = 3.4$ (W)		1 1 1	AO2 4.1.2.2

Total Question 3		**8**

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 (°C)		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

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

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

Total Question 4		**9**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1		any mention of transfer of positive charge scores 0 any mention of positive electrons scores 0		AO1 4.2.5.1
	electrons transferred from the cloth (to the rod)		1	
	electrons are negatively charged	this mark only scores if linked to the first marking point	1	
	(so) there are more positive charges than negative charges on the cloth	ignore more protons than electrons unqualified	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	there is an additional (downwards) force on the balance (increasing the mass reading)		1	AO3 AO3
	(because) the (held) rod is negatively charged	allow both rods have the same (negative) charge	1	AO1
	(and rods with) like charges repel **or** (and rods with) negative charges repel each other		1	4.2.5.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	only the change in reading / mass is being observed	allow difference / increase for 'change in'	1	AO3 4.2.5.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	the (large) potential difference between the two objects	allow (strong) electric field causes breakdown of air do not accept earthed conductor is positively charged	1	AO1 4.2.5.2
	(causes negative) electrons / charges to move (through the air)	allow there is a current in the air (between the two objects)	1	
	(from the rod) to the conductor		1	

Total Question 5		**10**

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	

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**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	two protons and two neutrons	allow helium nucleus ignore symbols	1	AO1 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	85 37	this order only	1 1	AO1 4.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	alpha radiation has a low penetrating ability (so externally) alpha radiation is stopped by skin (so is low risk) internally, alpha radiation is absorbed by living tissue / organs (as) alpha radiation is highly ionising (internal) contamination will cause greater (risk of) harm to cells / tissues / organs / DNA / genes	 allow absorbed for stopped ignore reference to range of alpha particles through other materials allow (internal) contamination will increase the radiation dose allow contamination causes greater chance of developing cancer allow greater chance of mutations	1 1 1 1 1	AO1 4.4.2.4

Total Question 7		8

Question 8

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

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

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

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

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

Total Question 8		**11**

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	h = 1.75 (m) E_p = 60 × 9.8 × 1.75 E_p = 1029 (J) $P = \frac{1029}{1.40}$ P = 735 (W)	 allow a correct substitution using an incorrectly / not converted value of h allow a correct calculation using an incorrectly / not converted value of h allow a correct substitution using their calculated value of E_p allow an answer consistent with their value for E_p	1 1 1 1 1	AO2 4.1.1.4 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	girl increases her kinetic energy (as well as increasing her gravitational potential energy) some energy is wasted in her muscles **or** some energy transferred as thermal energy (to surroundings)	 allow some energy transferred due to air resistance ignore unqualified references to friction ignore references to sound	1 1	AO2 4.1.1.1 4.1.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	the boy's mass was greater than the girl's mass		1	AO3 4.1.1.1

Total Question 9		**8**

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	$E_e = 0.5 \times 50 \times 0.12^2$		1	AO2 4.1.1.2
	$E_e = 0.36$ (J)		1	
	$0.36 = 0.5 \times 0.020 \times v^2$	allow a correct substitution of their calculated value of E_e	1	
	$v^2 = \frac{0.36}{0.5 \times 0.020}$ **or** $v^2 = 36$	allow a correct rearrangement of their calculated value of E_e	1	
	speed = 6.0	allow an answer consistent with their calculated value of E_e	1	
	m/s **or** metres/second		1	
		Alternative approach: ($F = ke$) ($F = 50 \times 0.12$) (maximum) $F = 6.0$ (N) (1) ($F = ma$) ($6.0 = 0.020 \times a$) (maximum) $a = 300$ (m/s^2) (1) mean $a = 150$ (m/s^2) (1) ($v^2 - u^2 = 2as$) $v^2 = 2 \times 150 \times 0.12$ (1) **or** $v^2 = 36$ $v = 6.0$ (1) m/s (1) **or** metres/second		

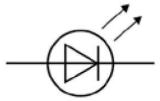
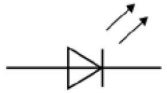
Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	kinetic		1	AO1 4.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	increasing the extension of the spring **or** more elastic potential energy **or** increase the angle of release (to the horizontal by a small amount)	allow other factors that would increase the horizontal distance travelled eg a tail-wind ignore factors without a change specified e.g. extension unqualified would not score ignore changing the spring or changes to the toy aeroplane	1	AO2 4.1.1.1

Total Question 10		**8**

Question 11

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

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

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

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

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

Total Question 11		**9**