2024

Name_____

Triple Science

Foundation

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**	$\boldsymbol{F = B\ I\ l}$

AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
PHYSICS

F

Foundation 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.

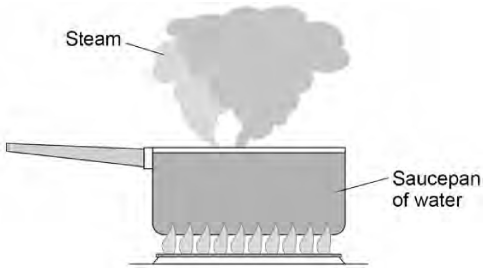
For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
TOTAL	

Do not write outside the box

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

0 1 **Figure 1** shows water being heated. Eventually the water changed into steam.

Figure 1



0 1 . 1 Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

[2 marks]

greater than	**less than**	**the same as**

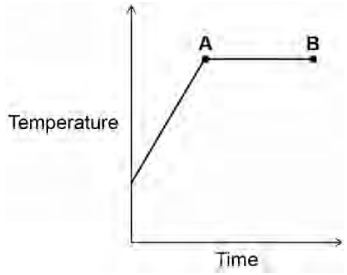
The distance between the particles in steam is _____ the distance between the particles in liquid water.

The density of steam is _____ the density of liquid water.

Do not write outside the box

Figure 2 shows how the temperature of the water varied with time.

Figure 2



0 1 . 2 What is the name of the process that is taking place between points **A** and **B**?

Give a reason for your answer.

[2 marks]

Process _____

Reason _____

_____

0 1 . 3 A mass of 0.063 kg of water was turned into steam.

The specific latent heat of vaporisation of water is 2 260 000 J/kg

Calculate the thermal energy transferred to the water to turn it into steam.

Use the equation:

thermal energy for a change of state = mass × specific latent heat

[2 marks]

_____

_____

_____

Energy = _____ J

Turn over ►

Do not write outside the box

0 1 . 4 The mass of the steam was 0.063 kg

The volume of the steam was 0.105 m^3

Calculate the density of steam.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

Choose the unit from the box.

[3 marks]

kg	**m^3 / kg**	**kg / m^3**

_____

_____

_____

Density = _____ Unit _____

9

0 2 Polonium-210 ($^{210}_{84}Po$) is a radioactive isotope that decays by emitting alpha radiation.

Do not write outside the box

0 2 . 1 Which is the correct decay equation for polonium-210?

[1 mark]

Tick (✓) **one** box.

$^{210}_{84}Po \rightarrow {}^{214}_{86}X + {}^{4}_{2}He$ ☐

$^{210}_{84}Po \rightarrow {}^{206}_{86}X + {}^{4}_{2}He$ ☐

$^{210}_{84}Po \rightarrow {}^{206}_{82}X + {}^{4}_{2}He$ ☐

0 2 . 2 Why is alpha radiation dangerous inside the human body?

[1 mark]

Tick (✓) **one** box.

Alpha radiation is electromagnetic radiation. ☐

Alpha radiation is highly ionising. ☐

Alpha radiation is very penetrating. ☐

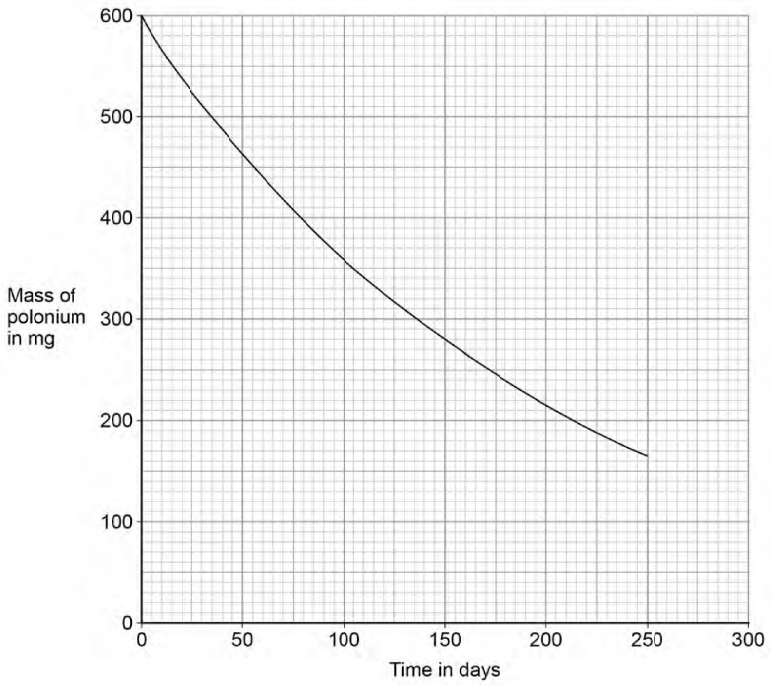
Question 2 continues on the next page

Turn over ►

Do not write outside the box

Figure 3 shows how the mass of a sample of polonium-210 changes with time.

Figure 3



0 2 . 3 Determine the change in mass of the sample of polonium-210 between 50 and 150 days.

[2 marks]

Change in mass = _____ mg

Do not write outside the box

0 2 . 4 Estimate the mass of polonium-210 remaining after 300 days.

[1 mark]

Mass = _____ mg

0 2 . 5 Nuclear radiation can cause ionisation.

Complete the sentences.

Choose answers from the box.

[2 marks]

a negative	**an electron**	**a neutron**	**a positive**	**a proton**	**a zero**

An atom becomes an ion when it loses _____.

The resulting ion has _____ charge.

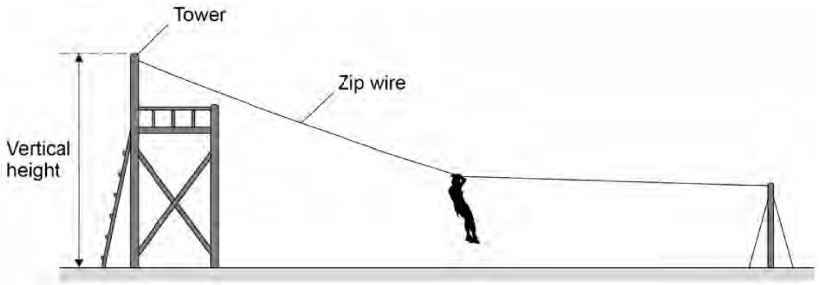
7

Turn over for the next question

Do not write outside the box

0 3 **Figure 4** shows a person sliding down a zip wire.

Figure 4



0 3 . 1 Describe how the vertical height of the tower could be measured accurately.

[2 marks]

0 3 . 2 When using the zip wire, the person moved through a vertical height of 2.0 m

The person has a mass of 45 kg

gravitational field strength = 9.8 N/kg

Calculate the change in gravitational potential energy of the person.

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

[2 marks]

Change in gravitational potential energy = _____ J

Do not write outside the box

0 3 . 3 Give **three** factors that affected the kinetic energy of the person as she reached the bottom of the zip wire.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

7

Turn over for the next question

Do not write outside the box

0 4 The ancient Greeks thought that atoms were tiny spheres that could not be divided into anything smaller.

Since then, different discoveries have led to the model of the atom changing.

Some of the discoveries are given in **Table 1**.

Table 1

The mass of an atom is concentrated in the nucleus.	**A**
Electrons orbit the nucleus at specific distances.	**B**
The nucleus contains neutrons.	**C**
The nucleus contains positively charged protons.	**D**

0 4 . 1 Which discovery was the earliest?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 4 . 2 Which discovery was the most recent?

[1 mark]

Tick (✓) **one** box.

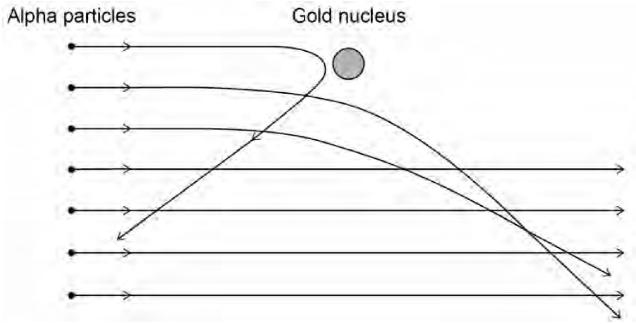
A ☐ **B** ☐ **C** ☐ **D** ☐

Do not write outside the box

0 4 . 3 The alpha particle scattering experiment led to the nuclear model of the atom.

Figure 5 shows the paths of alpha particles travelling close to a gold nucleus.

Figure 5



Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

[3 marks]

attracts	**decreases**	**does not change**
increases	**reflects**	**repels**

Alpha particles and gold nuclei are both positively charged.

The gold nucleus _____ the alpha particles.

As the alpha particle approaches the gold nucleus, the electric field strength experienced by the alpha particle _____ .

As an alpha particle approaches the gold nucleus, the force experienced by the alpha particle _____ .

Turn over ►

Do not write outside the box

0 4 . 4 The results of the alpha particle scattering experiment were reproducible.

What does reproducible mean?

[1 mark]

Tick (✓) **one** box.

- Another scientist repeats the experiment and gets the same results. ☐
- Another scientist repeats the experiment and gets different results. ☐
- The same scientist repeats the experiment and gets the same results. ☐
- The same scientist repeats the experiment and gets different results. ☐

6

Do not write outside the box

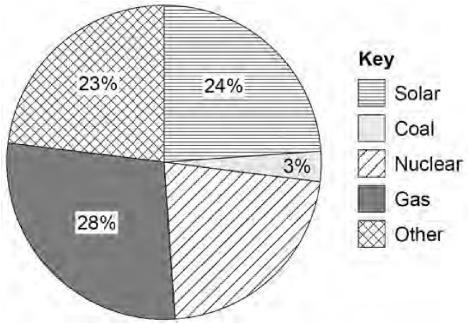
Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 5 **Figure 6** shows how different energy resources were used in the United Kingdom (UK) to generate electricity on one day in June 2018.

Figure 6



0 5 . 1 The UK government plans to stop using coal-fired power stations by 2025.

Explain **one** environmental problem caused when electricity is generated by burning coal.

[2 marks]

0 5 . 2 Give **two** renewable energy resources that could make up the 'Other' energy resources in **Figure 6**.

[2 marks]

1 _____

_____

2 _____

Do not write outside the box

0 5 . 3 Determine the percentage of electricity generated in nuclear power stations that day.

Use data from **Figure 6**.

[2 marks]

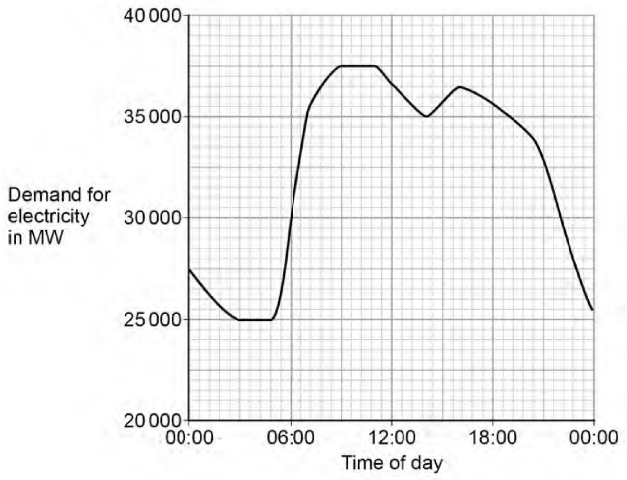
Percentage of electricity generated in nuclear power stations = _____ %

Question 5 continues on the next page

Do not write outside the box

Figure 7 shows how the demand for electricity varied with the time of day.

Figure 7



0 5 . 4 What was the difference between the maximum demand and minimum demand for electricity during this day?

[2 marks]

Difference = _____ MW

Do not write outside the box

0 5 . 5 **Figure 7** shows that the demand for electricity increased between 06:00 and 09:00

Solar power could have met the demand if there were enough solar panels installed in the UK.

Explain why.

[2 marks]

10

Turn over for the next question

Do not write outside the box

0 6 An electric car has a motor that is powered by a battery.

A diesel car has an engine that is powered by diesel fuel.

0 6 . 1 **Table 2** compares an electric car and a diesel car.

Table 2

Power source	Maximum acceleration in m/s^2	Mass of power source in kg	Range in km	Maximum power output in kW
Battery	4.8	420	220	200
Diesel fuel	3.2	51	1120	120

Give **two** advantages of the diesel car compared with the electric car in **Table 2**.

[2 marks]

1 _____

_____

2 _____

0 6 . 2 The mass of the battery in the electric car is 420 kg

The total mass of the electric car is 1610 kg

Calculate the mass of the battery as a percentage of the total mass of the electric car.

[2 marks]

Percentage of total mass = _____ %

Do not write outside the box

0 6 . 3 Designers of electric car batteries want to increase the amount of energy that can be stored in a battery.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

Figure 8 shows an electric car being recharged.

Figure 8

0 6 . 4 Write down the equation which links energy transferred, power and time.

[1 mark]

_____

_____

0 6 . 5 The charger has a power output of 7000 W

Calculate the time taken to transfer 420 000 J of energy to the car battery.

[3 marks]

_____

_____

_____

_____

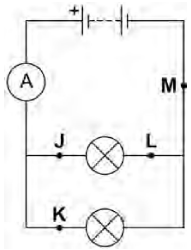
Time = _____ s

10

Do not write outside the box

0 7 **Figure 9** shows a circuit diagram.

Figure 9



0 7 . 1 In which position could a switch be placed so that both lamps can be switched on or off at the same time?

[1 mark]

Tick (✓) **one** box.

J ☐ **K** ☐ **L** ☐ **M** ☐

0 7 . 2 Draw the circuit symbol for a switch in the box below.

[1 mark]

Do not write outside the box

0 7 . 3 In 30 seconds, 24 coulombs of charge flow through the battery.

Calculate the current in the battery.

Use the equation:

$$\text{current} = \frac{\text{charge flow}}{\text{time}}$$

[2 marks]

Current = _____ A

0 7 . 4 There is a potential difference of 3.6 V across the battery.

Calculate the energy transferred by the battery when 60 coulombs of charge flows through the battery.

Use the equation:

energy transferred = charge flow × potential difference

[2 marks]

Energy transferred = _____ J

Question 7 continues on the next page

Turn over ►

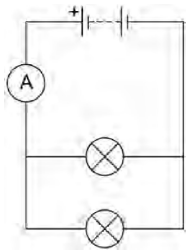
Do not write outside the box

A student built **Circuit X** and **Circuit Y** shown in **Figure 10**.

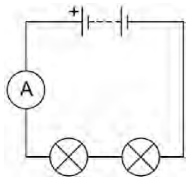
The components used in each circuit were identical.

Figure 10

Circuit X



Circuit Y



0 7 . 5 How would the reading on the ammeter in **Circuit Y** compare to the reading on the ammeter in **Circuit X**?

[1 mark]

Tick (✓) **one** box.

The reading in **Y** would be higher. ☐

The reading in **Y** would be lower. ☐

The readings would be the same. ☐

0 7 . 6 How does the total resistance of **Circuit Y** compare with the total resistance of **Circuit X**?

[1 mark]

Tick (✓) **one** box.

The total resistance of **Y** is greater. ☐

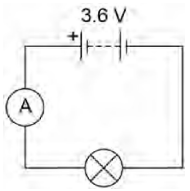
The total resistance of **Y** is less. ☐

The total resistance is the same. ☐

Do not write outside the box

The student built another circuit which is shown in **Figure 11**.

Figure 11



0 7 . 7 Write down the equation which links current, potential difference and resistance.

[1 mark]

0 7 . 8 There is a potential difference of 3.6 V across the lamp in **Figure 11**.

The current through the lamp is 0.80 A

Calculate the resistance of the lamp.

[3 marks]

Resistance = _____ Ω

12

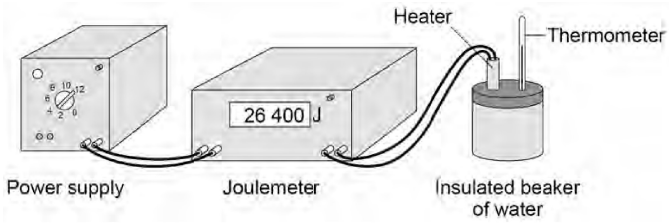
Turn over for the next question

Do not write outside the box

0 8 A student carried out an experiment to determine the specific heat capacity of water.

Figure 12 shows the equipment the student used to heat the water.

Figure 12



0 8 . 1 Why did the student insulate the beaker of water?

[1 mark]

Tick (✓) **one** box.

To increase energy transfer to the surroundings. ☐

To reduce energy transfer to the surroundings. ☐

To stop energy transfer to the surroundings. ☐

0 8 . 2 One hazard in this experiment is the hot water.

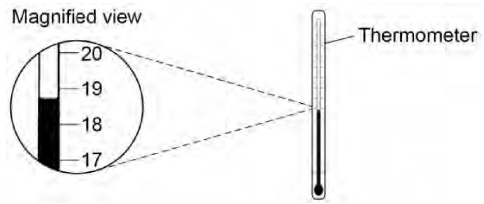
Give **one** risk to the student caused by this hazard.

[1 mark]

Do not write outside the box

0 8 . 3 **Figure 13** shows the thermometer that the student used.

Figure 13



What is the resolution of the thermometer?

[1 mark]

Tick (✓) **one** box.

1 °C ☐

3 °C ☐

19 °C ☐

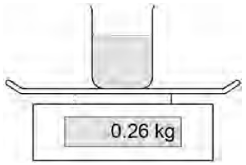
Question 8 continues on the next page

Turn over ►

Do not write outside the box

0 8 . 4 **Figure 14** shows the beaker of water on a balance.

Figure 14



The mass of the water was 0.20 kg

What was the mass of the beaker?

[1 mark]

Tick (✓) **one** box.

0.06 kg ☐

0.20 kg ☐

0.26 kg ☐

0.46 kg ☐

Do not write outside the box

0 8 . 5 The energy transferred to the water was 26 400 J

The mass of water was 0.20 kg

The temperature increase of the water was 30 °C

Calculate the specific heat capacity of water using the data from this experiment.

Use the Physics Equations Sheet.

Choose the unit from the box.

[4 marks]

J/kg	J/kg°C	J/°C

Specific heat capacity = _____ Unit _____

8

Turn over for the next question

Do not write outside the box

0 9 Light bulbs are labelled with a power input.

0 9 . 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 9 . 2 Write down the equation which links current, potential difference and power.

[1 mark]

_____

0 9 . 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 3 shows information about three different light bulbs.

Table 3

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 9 . 4 Write down the equation which links efficiency, total power input and useful power output.

[1 mark]

0 9 . 5 Calculate the value of **X** in **Table 3**.

[3 marks]

X = _____ W

0 9 . 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

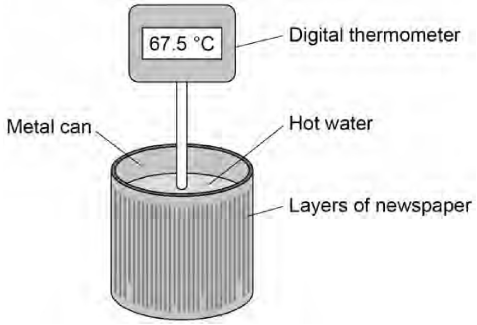
Turn over ►

Do not write outside the box

1 0 A student investigated the insulating properties of newspaper.

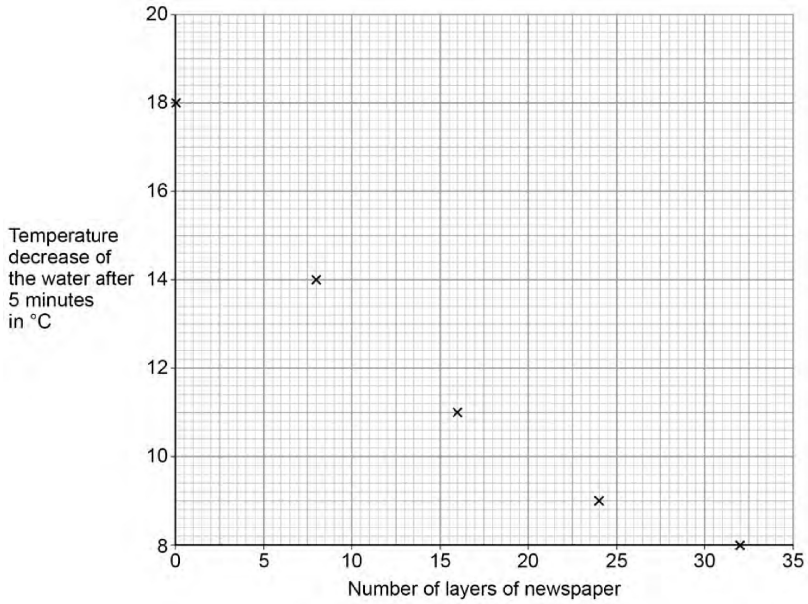
Figure 15 shows the apparatus the student used.

Figure 15



The student's results are shown in **Figure 16**.

Figure 16



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1 0 . 1 Describe a method the student could have used to obtain the results shown in **Figure 16**.

[6 marks]

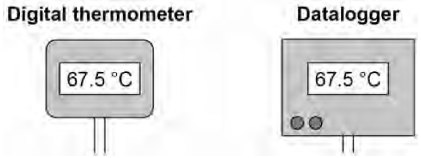
Question 10 continues on the next page

Do not write outside the box

1 0 . 2 The student could have used a datalogger with a temperature probe instead of the digital thermometer.

Figure 17 shows the readings on the digital thermometer and the datalogger.

Figure 17



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

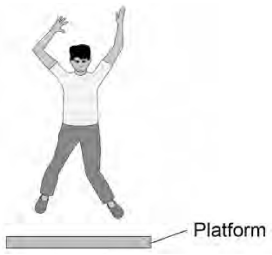
Do not write outside the box

1 1 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 18 shows a volunteer taking part in the experiment.

Figure 18



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

1 1 . 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

1 1 . 2 Write down the equation which links kinetic energy, mass and speed.

[1 mark]

1 1 . 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.

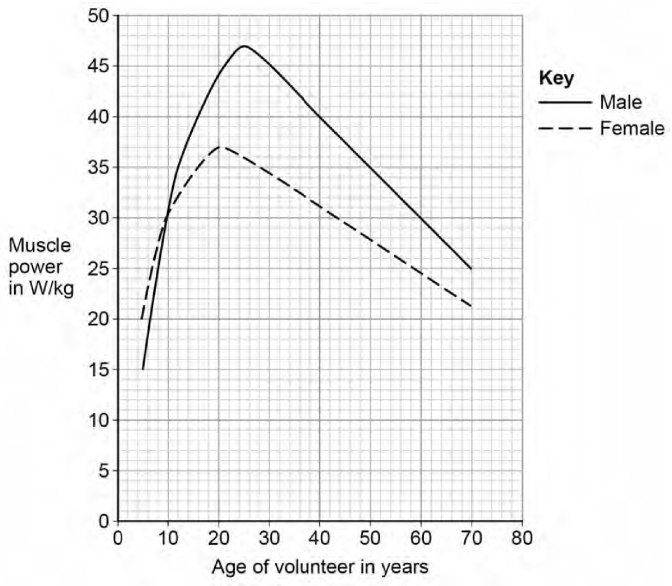
Calculate his mass.

[3 marks]

Mass = _____ kg

Figure 19 shows the scientist's results.

Figure 19



Do not write outside the box

1 1 . 4 Compare the muscle power of males with the muscle power of females.

Use data from **Figure 19** in your answer.

[4 marks]

1 1 . 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

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

PMT

AQA

GCSE
PHYSICS
8463/1F

Foundation Tier Paper 1

Mark scheme

June 2019

Version: 1.0 Final

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1.1	greater than less than	in this order only	1 1	4.3.1.1 AO1
1.2	<u>boiling</u> temperature is constant	ignore evaporation allow temperature remains the same	1 1	4.3.2.3 AO1
1.3	E = 0.063 × 2 260 000 E = 140 000 (J)	a correct answer that rounds to 140 000 (J) scores **2** marks allow 142 380 (J)	1 1	4.3.2.3 AO2
1.4	density = $\frac{0.063}{0.105}$ density = 0.6 kg / m^3	an answer of 0.6 scores **2** marks	1 1 1	4.3.1.1 AO2
Total			**9**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2.1	$^{210}_{84}Po \rightarrow {}^{206}_{82}X + {}^{4}_{2}He$		1	4.4.2.2 AO1
2.2	Alpha radiation is highly ionising		1	4.4.2.1 AO1
2.3	Change in mass = 460 – 280 Change in mass = 180 (mg)	allow reading between 460 and 465 allow reading between 278 and 282 allow an answer between 178 and 187 inclusive for **2** marks	1 1	4.4.2.3 AO2
2.4	130 (mg)	allow an answer between 126 and 150 (mg) inclusive	1	4.4.2.3 AO3
2.5	an electron a positive	in this order only	1 1	4.4.1.2 AO1
Total			**7**	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3.1	use a tape measure one person holding the top and another person holding the bottom **or** use a set square to ensure tape measure is vertical **or** take repeat readings and calculate a mean	allow use a metre rule allow use a laser measure allow use a plumb-line to ensure tape measure is vertical	1 1	4.1.1.2 AO3/3a
3.2	$E_p = 45 \times 9.8 \times 2.0$ $E_p = 880$ (J)	an answer of 880 (J) or 882 (J) scores **2** marks	1 1	4.1.1.2 AO2
3.3	any **3** from: • change in vertical height • mass / weight • speed / velocity • air resistance or drag • friction (between zip line and pulley) • gradient / angle (of the zip wire) • length of zip wire	 allow body position allow wind ignore gravitational field strength	3	4.1.1.1 AO1
Total			**7**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4.1	A		1	4.4.1.3 AO1
4.2	C		1	4.4.1.3 AO1
4.3	repels increases increases	in this order only	1 1 1	4.4.1.3 4.2.5.2 AO1
4.4	another scientist repeats the experiment and gets the same results		1	WS3.7 4.4.1.3 AO1
Total			**6**	

Question 5

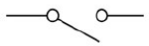
Question	Answers	Extra information	Mark	AO / Spec. Ref.
5.1	carbon dioxide released causing global warming **OR** particulates released (1) causing global dimming (1) **OR** sulfur dioxide released (1) causing acid rain (1)	greenhouse gases is insufficient carbon emissions is insufficient allow CO_2 allow climate change allow named consequence of global warming allow greenhouse effect air pollution is insufficient allow SO_2	1 1	4.1.3 WS1.4 AO1
5.2	any **2** from: • wind • tidal • wave • hydroelectric • geothermal • biofuel	do not accept solar allow pumped storage hydro is insufficient allow biomass or named biofuel eg wood	2	4.1.3 AO2
5.3	 100 – 78 22 (%)	an answer of 22 (%) scores **2** marks allow **1** mark for calculating percentage of named resources (78%)	 1 1	4.1.3 AO2

5.4	maximum demand = 37 500 (MW) **and** minimum demand = 25 000 (MW) difference in demand = 12 500 (MW)	an answer of 12 500 (MW) scores **2** marks	1 1	4.1.3 AO2
5.5	solar panels generate electricity from light power output would increase throughout the morning **or** power output would increase (between 06:00 and 09:00) **or** (between 06:00 and 09:00) the Sun is rising / shining	solar panels make energy is insufficient	1 1	4.1.3 1AO1/1 1AO3/2a
Total			**10**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6.1	(the diesel car has a) higher range (the diesel car) power source has a lower mass	allow less frequent refuelling needed allow the power source has a lower weight the diesel car has a lower mass is insufficient	1 1	4.1.3 AO3
6.2	% of total mass = $\frac{420}{1610}$ (×100) % of total mass = 26 (%)	a correct answer that rounds to 26 (%) scores **2** marks allow **1** mark for an answer of 0.26	1 1	4.1.3 AO2
6.3	any **2** from: • increase the range of electric cars • increase the time between recharges • decrease the (total) mass of the electric car • greater acceleration		2	4.1.3 AO3
6.4	energy transferred = power × time **or** $E = Pt$		1	4.1.1.4 AO1
6.5	420 000 = 7000 × t t = 420 000 / 7000 t = 60 (s)	an answer of 60 (s) scores **3** marks	1 1 1	4.1.1.4 AO2
Total			**10**	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7.1	M		1	4.2.2 AO1
7.2	 **or** 		1	4.2.1.1 AO1
7.3	current $= \frac{24}{30}$ current = 0.80 (A)	an answer of 0.8 (A) scores **2** marks	1 1	4.2.1.2 AO2
7.4	E = 60 × 3.6 E = 216 (J)	an answer of 216 (J) scores **2** marks	1 1	4.2.4.2 AO2
7.5	The reading in **Y** would be lower		1	4.2.2 AO1
7.6	The total resistance of **Y** is greater		1	4.2.2 AO1
7.7	potential difference = current × resistance **or** *V* = *IR*		1	4.2.1.3 AO1
7.8	3.6 = 0.80 × R $R = \frac{3.6}{0.80}$ R = 4.5 (Ω)	an answer of 4.5 (Ω) scores **3** marks	1 1 1	4.2.1.3 AO2
Total			**12**	

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8.1	To reduce energy transfer to the surroundings		1	4.1.1.3 RP1 AO1
8.2	scald / burn (to skin)	ignore risk of electric shock	1	4.1.1.3 RP1 AO3
8.3	1 °C		1	4.1.1.3 RP1 AO3
8.4	0.06 kg		1	4.1.1.3 RP1 AO1
8.5	26 400 = 0.20 × c × 30 $c = \frac{26\,400}{(0.20 \times 30)}$ **or** $c = \frac{26\,400}{6}$ c = 4400 J / kg °C	a numerical answer of 4400 scores **3** marks	1 1 1 1	4.1.1.3 RP1 AO2 AO1
Total			**8**	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9.1	The energy transferred each second to the bulb.		1	4.1.1.4 AO1
9.2	power = potential difference × current **or** $P = VI$		1	4.2.4.1 AO1
9.3	$40 = I \times 230$ $I = \frac{40}{230}$ I = 0.17 (A)	an answer of 0.17 (A) scores **3** marks 1 1 a correct answer that rounds to 0.17 (A) scores **3** marks 1 1		4.2.4.1 AO2
9.4	efficiency = $\frac{\text{useful power output}}{\text{total power input}}$		1	4.1.2.2 AO1
9.5	$0.30 = \frac{\text{useful power output}}{9.0}$ 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
9.6	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**	

PMT

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Question 10

Question	Answers		Mark	AO/ Spec. Ref
10.1	**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)			
10.2	the digital thermometer and the datalogger have the same resolution only need to measure the start and end temperature **or** only need 2 readings **or** only need to calculate the temperature change	allow both measure to 1 d.p. ignore accuracy ignore precision they give the same result is insufficient	1 1	RP2 WS2.3 4.1.2.1 AO3
Total			**8**	

Question 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.1	$41 = \frac{9.8 \times h}{0.12}$ $h = \frac{41 \times 0.12}{9.8}$ 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
11.2	kinetic energy = 0.5 × mass × (speed)^2 ***or*** $E_k = ½ mv^2$		1	4.1.1.2 AO1
11.3	$270 = ½ \times m \times 3^2$ $m = \frac{270}{(½ \times 3^2)}$ **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

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11.4	**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			
11.5	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**	

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

F

Foundation 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	

Do not write outside the box

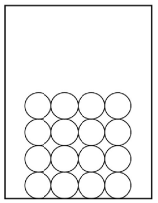
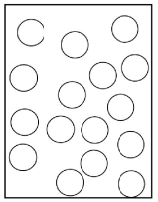
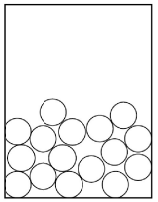
Answer **all** questions in the spaces provided.

0 1 . 1 A student investigated the three states of matter.

The arrangement of particles in the three states of matter are different.

Draw **one** line from each particle arrangement to the state of matter.

[2 marks]

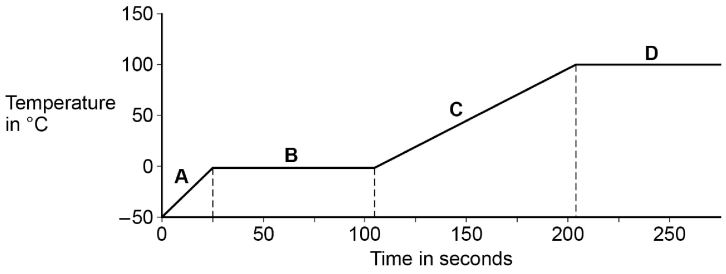
Particle arrangement	**State of matter**
	Solid
	Liquid
	Gas

Do not write outside the box

A large lump of ice was heated and changed state.

Figure 1 shows how the temperature varied with time.

Figure 1



0 1 . 2 Which part of **Figure 1** shows when the ice was melting?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 1 . 3 Which part of **Figure 1** shows when the water was boiling?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Question 1 continues on the next page

Do not write outside the box

0 1 . 4 Which property of the water particles changes as the temperature of the water increases?

[1 mark]

Tick (✓) **one** box.

The kinetic energy of the particles ☐

The mass of each particle ☐

The number of particles ☐

0 1 . 5 Calculate the thermal energy needed to melt 0.250 kg of ice at 0 °C.

specific latent heat of fusion of water = 334 000 J/kg

Use the equation:

thermal energy = mass × specific latent heat

[2 marks]

Thermal energy = _____ J

Do not write outside the box

0 1 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

condenses	**evaporates**	**ionises**	**sublimates**

A substance is heated and changes directly from a solid to a gas.

The substance _____ .

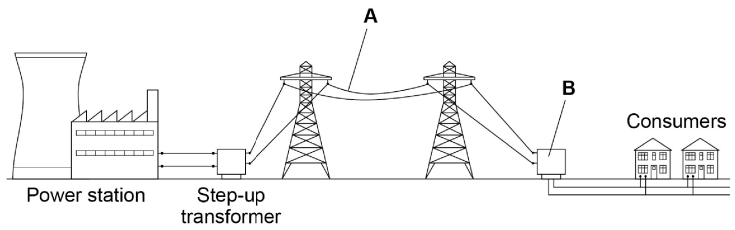
8

Turn over for the next question

Do not write outside the box

0 2 **Figure 2** shows part of the National Grid linking a power station to consumers.

Figure 2



0 2 . 1 Name the parts of **Figure 2** labelled **A** and **B**.

[2 marks]

A _____

B _____

0 2 . 2 Electricity is transmitted through **A** at a very high potential difference.

What is the advantage of transmitting electricity at a very high potential difference?

[1 mark]

Tick (✓) **one** box.

A high potential difference is safer for consumers. ☐

Less thermal energy is transferred to the surroundings. ☐

Power transmission is faster. ☐

Do not write outside the box

0 2 . 3 The power station generates electricity at a potential difference of 25 000 V.

The energy transferred by the power station in one second is 500 000 000 J.

Calculate the charge flow from the power station in one second.

Use the equation:

$$\text{charge flow} = \frac{\text{energy}}{\text{potential difference}}$$

[2 marks]

Charge flow in one second = _____ C

Question 2 continues on the next page

Do not write outside the box

The electricity supply to a house has a potential difference of 230 V.

Table 1 shows the current in some appliances in the house.

Table 1

Appliance	Current in amps
Dishwasher	6.50
DVD player	0.10
Lamp	0.40
TV	0.20

0 2 . 4 Calculate the total power of all the appliances in **Table 1**.

Use the equation:

power = potential difference × current

[3 marks]

Total power = _____ W

Do not write outside the box

0 2 . 5 Each appliance in **Table 1** is switched on for 2 hours.

Which appliance will transfer the most energy?

Give a reason for your answer.

[2 marks]

Appliance _____

Reason _____

_____

_____

0 2 . 6 The average energy transferred from the National Grid every second for each person in the UK is 600 J.

There are 32 000 000 seconds in one year.

Calculate the average energy transferred each year from the National Grid for each person in the UK.

[2 marks]

_____

_____

_____

Average energy transferred = _____ J

12

Turn over for the next question

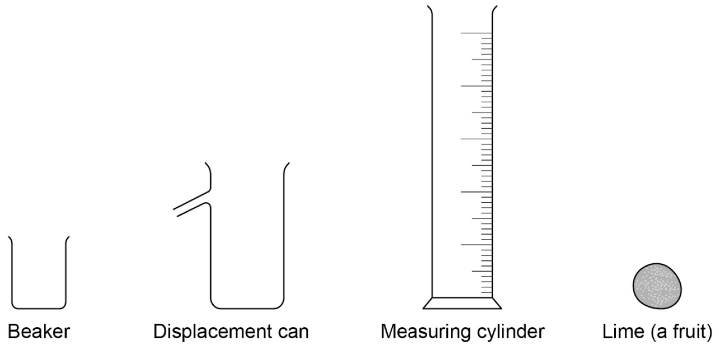
Do not write outside the box

0 3 A student investigated the density of different fruits.

To determine the density of each fruit, the student measured the volume of each fruit.

Figure 3 shows the equipment the student could have used.

Figure 3



0 3 . 1 Describe a method the student could have used to measure the volume of the lime.

[4 marks]

Do not write outside the box

0 3 . 2 The student measured the volume of each fruit three times and then calculated a mean value.

The three measurements for a grape were

2.1 cm^3 2.1 cm^3 2.4 cm^3

Calculate the mean value.

[2 marks]

Mean value = _____ cm^3

0 3 . 3 What are the advantages of taking three measurements and calculating a mean value?

[2 marks]

Tick (✓) **two** boxes.

- Allows anomalous results to be identified and ignored. ☐
- Improves the resolution of the volume measurement. ☐
- Increases the precision of the measured volumes. ☐
- Reduces the effect of random errors when using the equipment. ☐
- Stops all types of error when using the equipment. ☐

Question 3 continues on the next page

Do not write outside the box

0 3 . 4 The mass of an apple was 84.0 g.

The volume of the apple was 120 cm^3.

Calculate the density of the apple.

Give your answer in g/cm^3.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

[2 marks]

Density = _____ g/cm^3

10

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 4 A student investigated how the current in a circuit varied with the number of lamps connected in parallel in the circuit.

Figure 4 shows the circuit with three identical lamps connected in parallel.

Figure 4

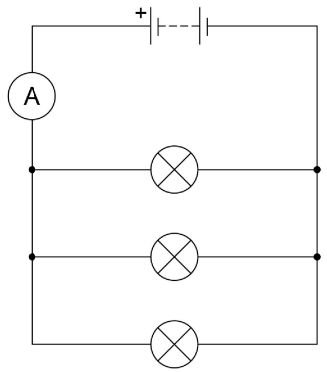
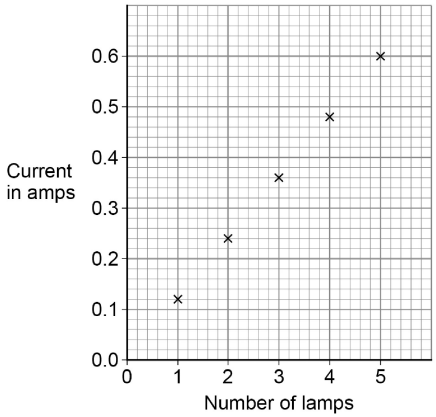


Figure 5 shows the results.

Figure 5



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0 4 . 1 Complete the sentences.

Choose answers from the box.

Each answer can be used once, more than once or not at all.

decreased	stayed the same	increased

[3 marks]

As the number of lamps increased, the current _____.

As the number of lamps increased, the total resistance of the circuit _____.

As the number of lamps increased, the potential difference across the battery _____.

0 4 . 2 When there were three lamps in the circuit the ammeter reading kept changing between 0.35 A and 0.36 A.

What type of error would this lead to?

[1 mark]

Tick (✓) **one** box.

Random error ☐

Systematic error ☐

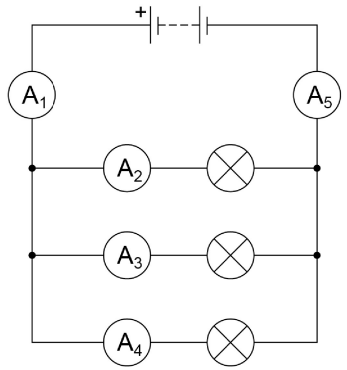
Zero error ☐

Question 4 continues on the next page

Do not write outside the box

Figure 6 shows a circuit with five ammeters and three identical lamps.

Figure 6



0 4 . 3 Complete **Table 2** to show the readings on ammeters A_2 and A_5.

[2 marks]

Table 2

Ammeter	A_1	A_2	A_3	A_4	A_5
Current in amps	0.36		0.12	0.12	

Do not write outside the box

0 4 . 4 The resistance of one lamp is 15 Ω.

The current in the lamp is 0.12 A.

Calculate the power output of the lamp.

Use the equation:

power = (current)^2 × resistance

[2 marks]

Power = _____ W

8

Turn over for the next question

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There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

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0 5 Atoms of different elements have different properties.

0 5 . 1 Which of the following is the same for all atoms of the same element?

[1 mark]

Tick (✓) **one** box.

- Atomic number ☐
- Mass number ☐
- Neutron number ☐

0 5 . 2 Which of the following is different for isotopes of the same element?

[1 mark]

Tick (✓) **one** box.

- Number of electrons ☐
- Number of neutrons ☐
- Number of protons ☐

Question 5 continues on the next page

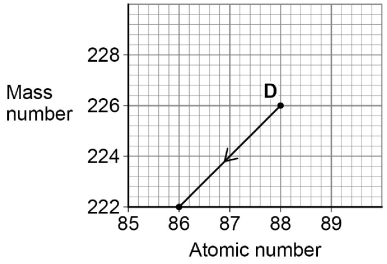
Do not write outside the box

0 5 . 3 A nucleus emits radiation.

Figure 7 shows how the mass number and the atomic number change.

The nucleus is labelled **D**.

Figure 7



Which type of radiation is emitted when nucleus **D** decays?

[1 mark]

Tick (✓) **one** box.

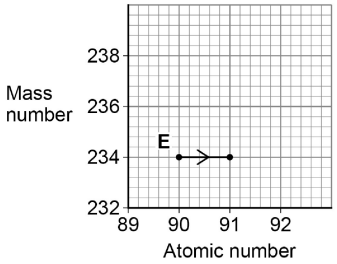
- Alpha ☐
- Beta ☐
- Neutron ☐

Do not write outside the box

0 5 . 4 Nucleus **E** also emits radiation.

Figure 8 shows how the mass number and the atomic number change for nucleus **E**.

Figure 8



Which type of radiation is emitted when nucleus **E** decays?

[1 mark]

Tick (✓) **one** box.

Alpha ☐

Beta ☐

Neutron ☐

Question 5 continues on the next page

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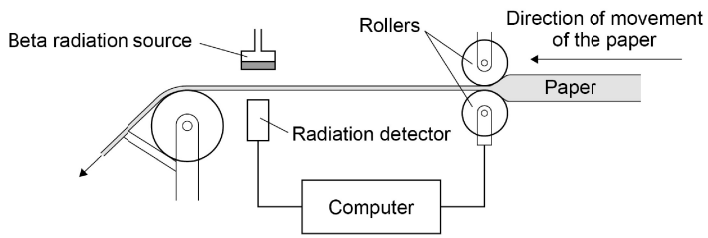
Beta radiation can be used to monitor the thickness of paper during production.

Figure 9 shows how the radiation is used.

Figure 9



The computer uses information from the radiation detector to change the size of the gap between the rollers.

0 5 . 5 Complete the sentences.

Choose answers from the box.

Each answer can be used once, more than once or not at all.

decrease	**stay the same**	**increase**

The thickness of the paper between the beta source and the detector increases.

[2 marks]

The reading on the detector will _____.

This is because the amount of radiation absorbed by the paper

will _____.

Do not write outside the box

0 5 . 6 All radioactive elements have a half-life.

What is meant by 'half-life'?

[1 mark]

Tick (✓) **one** box.

- The time it takes for all the nuclei in a radioactive sample to split in half. ☐
- The time it takes for the count rate of a radioactive sample to halve. ☐
- The time it takes for the radiation to travel half of its range in air. ☐

0 5 . 7 Why should the radiation source used in **Figure 9** have a long half-life?

[1 mark]

Tick (✓) **one** box.

- So the activity of the source is approximately constant. ☐
- So the amount of radiation decreases quickly. ☐
- So the radiation has a long range in air. ☐

Turn over for the next question

8

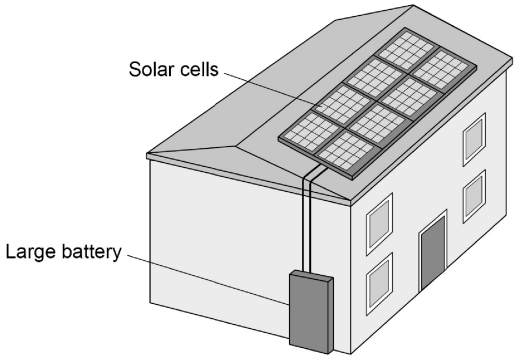
Do not write outside the box

0 6 **Figure 10** 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 10



0 6 . 1 The solar cells on the roof of the house always face in the same direction.

Explain **one** disadvantage caused by the solar cells only facing in one direction.

[2 marks]

Do not write outside the box

0 6 . 2 The mean current from the solar cells to the battery is 3.5 A.

Calculate the charge flow from the solar cells to the battery in 3600 seconds.

Use the equation:

charge flow = current × time

[2 marks]

Charge flow = _____ C

0 6 . 3 Write down the equation which links efficiency, total power input and useful power output.

[1 mark]

0 6 . 4 At one time in the day, the total power input to the solar cells was 7500 W.

The efficiency of the solar cells was 0.16

Calculate the useful power output of the solar cells.

[3 marks]

Useful power output = _____ W

Question 6 continues on the next page

Do not write outside the box

0 6 . 5 The wasted energy that is **not** usefully transferred by the solar cells is dissipated.

What happens to energy that has been dissipated?

[1 mark]

Tick (✓) **one** box.

- The energy becomes less useful. ☐
- The energy is destroyed. ☐
- The energy is used to generate electricity. ☐

0 6 . 6 Why is it unlikely that all the UK's electricity needs could be met by solar power systems?

[1 mark]

Tick (✓) **one** box.

- A very large area would need to be covered with solar cells. ☐
- Solar power is a non-renewable energy resource. ☐
- The efficiency of solar cells is too high. ☐

10

Do not write outside the box

Turn over for the next question

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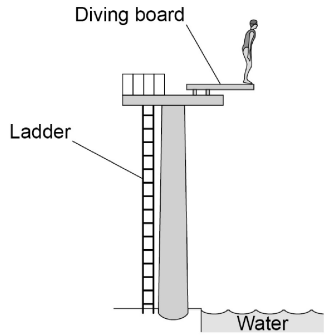
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 7 **Figure 11** shows a diver about to dive off a diving board.

Figure 11



0 7 . 1 Complete the sentences.

Choose answers from the box.

[2 marks]

elastic potential	**gravitational potential**	**kinetic**	**nuclear**

As the diver falls towards the water there is a decrease in

her _____ energy.

As the diver falls towards the water there is an increase in

her _____ energy.

Do not write outside the box

0 7 . 2 Write down the equation which links kinetic energy (E_k), mass (m) and speed (v).

[1 mark]

_____

0 7 . 3 At the instant the diver hits the water, the kinetic energy of the diver is 5040 J.

The speed of the diver is 12 m/s.

Calculate the mass of the diver.

[3 marks]

_____

_____

_____

_____

Mass = _____ kg

0 7 . 4 Most of the kinetic energy of the diver is transferred to the water.

How does this affect the thermal energy of the water?

[1 mark]

Tick (✓) **one** box.

The thermal energy decreases. ☐

The thermal energy stays the same. ☐

The thermal energy increases. ☐

7

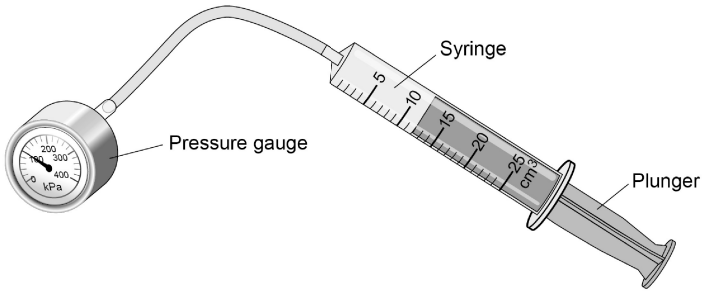
Turn over for the next question

Do not write outside the box

0 8 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



0 8 . 1 What is the range of the syringe?

[1 mark]

Tick (✓) **one** box.

From 0 to 1 cm^3 ☐

From 0 to 5 cm^3 ☐

From 0 to 25 cm^3 ☐

0 8 . 2 The relationship between the pressure and volume of a gas is given by the equation:

pressure × volume = constant

Complete the sentence.

[1 mark]

For this equation to apply, both the mass of gas and the _____

of the gas must stay the same.

Do not write outside the box

0 8 . 3 The initial volume of the gas in the syringe was 12 cm^3.

The initial pressure of the gas in the syringe was 101 000 Pa.

Calculate the constant in the equation below.

pressure × volume = constant

[2 marks]

Constant = _____ Pa cm^3

0 8 . 4 The teacher pulled the plunger slowly outwards and the gas expanded.

The new volume of the gas was 24 cm^3.

Calculate the new pressure in the gas.

The constant has the same value as in Question **08.3**

[3 marks]

New pressure = _____ Pa

Question 8 continues on the next page

Do not write outside the box

0 8 . 5 Which change occurs when the plunger is pulled slowly outwards?

[1 mark]

Tick (✓) **one** box.

The gas particles stop moving. ☐

There are more frequent collisions between the gas particles. ☐

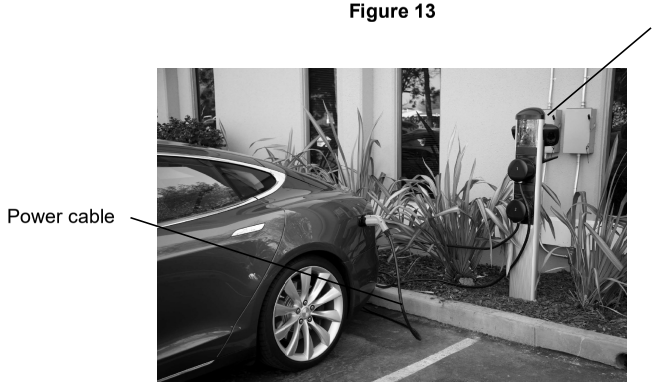
There is more space between the gas particles. ☐

8

Do not write outside the box

0 9 **Figure 13** shows an electric car being recharged.

Figure 13



0 9 . 1 The charging station applies a direct potential difference across the battery of the car.

What does 'direct potential difference' mean?

[1 mark]

Question 9 continues on the next page

Do not write outside the box

0 9 . 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 9 . 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 9 . 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 9 . 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 9 continues on the next page

Do not write outside the box

0 9 . 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

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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1 0 Energy from the Sun is released by nuclear fusion.

1 0 . 1 Complete the sentences.

[2 marks]

Nuclear fusion is the joining together of _____.

During nuclear fusion the total mass of the particles _____.

1 0 . 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 Equations Sheet.

[3 marks]

Energy = _____ J

Do not write outside the box

1 0 . 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 _____

_____

_____

1 0 . 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

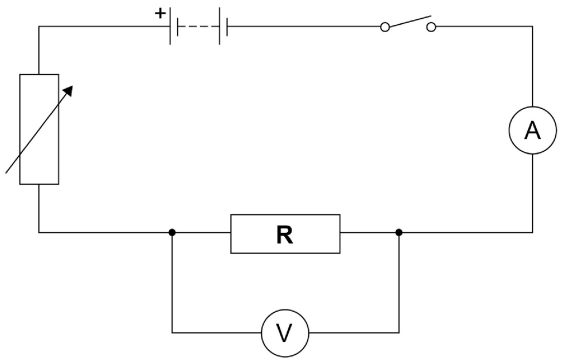
Do not write outside the box

1 1 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 14 shows the circuit Student **A** used.

Figure 14



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

[6 marks]

_____

_____

_____

_____

_____

_____

_____

_____

_____

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11.2 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 11 continues on the next page

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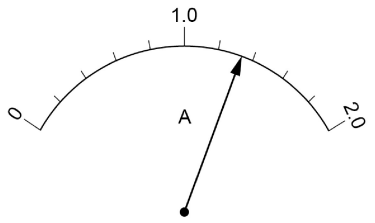
Figure 15 shows the scale on a moving coil ammeter at one time in the investigation.

Figure 15



11.3 What is the resolution of the moving coil ammeter?

[1 mark]

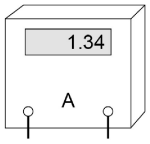
Resolution = _____ A

Do not write outside the box

1 1 . 4 Student **B** replaced the moving coil ammeter with a digital ammeter.

Figure 16 shows the reading on the digital ammeter.

Figure 16



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

END OF QUESTIONS

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

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AQA

GCSE
PHYSICS
8463/1F

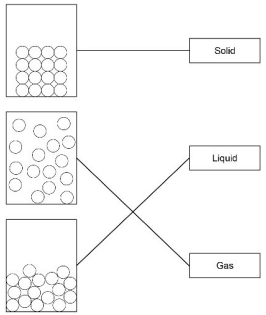
Paper 1 Foundation Tier

Mark scheme

June 2021

Version: 1.0 Final Mark Scheme

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1		2 marks for all correct 1 mark for 1 or 2 correct	2	AO1 4.3.1.1
01.2	**B**		1	AO1 4.3.2.3
01.3	**D**		1	AO1 4.3.2.3
01.4	the kinetic energy of the particles		1	AO1 4.3.2.1 4.3.3.1
01.5	E = 0.250 × 334 000 E = 83 500 (J)		1 1	AO2 4.3.2.3
01.6	sublimates		1	AO1 4.3.1.2
Total			**8**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	A: transmission / power cables B: step-down transformer	allow transmission / power lines allow cables ignore wires	1 1	AO1 4.2.4.3
02.2	less thermal energy is transferred to the surroundings.		1	AO1 4.2.4.3
02.3	charge flow = $\frac{500\,000\,000}{25\,000}$ charge flow = 20 000 (C)		1 1	AO2 4.2.4.2
02.4	total current = 7.20 (A) P = 230 × 7.20 P = 1656 (W)	 allow a correct substitution of an incorrect total current allow a correct calculation using an incorrect total current	1 1 1	AO2 4.2.4.1
02.5	dishwasher has the largest current **or** has the largest power (input)		1 1	AO3 4.2.4.1 4.2.4.2
02.6	E = 600 × 32 000 000 E = 19 200 000 000 (J) **or** E = 1.92×10^{10} (J)		1 1	AO2 4.1.1.4
Total			**12**	

Question 3

Question	Answers	Mark	AO/ Spec. Ref
03.1	**Level 2**: The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	3–4	AO1 4.3.1.1 RPA5
	Level 1: The method would not necessarily lead to a valid outcome. Some steps are identified, but the method is not fully logically sequenced.	1–2	
	No relevant content	0	
	Indicative content • use a eureka/displacement can • fill the eureka/displacement can with water • fill the eureka/displacement can up to the spout • place lime in eureka/displacement can • collect water that overflows • use a measuring cylinder to measure volume of water **OR** • use a measuring cylinder • part fill the measuring cylinder with water • measure the initial volume of water • place lime in measuring cylinder • record new volume of water • volume of lime = new volume – initial volume		

Question	Answers		Mark	AO/ Spec. Ref
03.2	mean = $\frac{(2.1+2.1+2.4)}{3}$ mean = 2.2 (cm^3)		1 1	AO2 4.3.1.1 RPA5
03.3	allows anomalous results to be identified and ignored reduces the effect of random errors when using the equipment		1 1	AO1 4.3.1.1 RPA5

03.4	density = $\frac{84}{120}$ density = 0.70 (g/cm^3)		1 1	AO2 4.3.1.1 RPA5
Total			**10**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	increased decreased stayed the same		1 1 1	AO3 4.2.1.3 4.2.2
04.2	random error		1	AO3 4.2.1.3 4.2.2
04.3	A_2 = 0.12 (A) A_5 = 0.36 (A)		1 1	AO1 4.2.2
04.4	P = 0.12^2 × 15 P = 0.216 (W)		1 1	AO2 4.2.4.1
Total			**8**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	atomic number		1	AO1 4.4.1.2
05.2	number of neutrons		1	AO1 4.4.1.2
05.3	Alpha		1	AO3 4.4.2.2 4.4.2.1
05.4	Beta		1	AO3 4.4.2.2
05.5	decrease increase	this order only	1 1	AO3 AO1 4.4.2.1
05.6	the time it takes for the count rate of a sample to halve		1	AO1 4.4.2.3
05.7	so the activity of the source is approximately constant		1	AO3 4.4.2.3
Total			**8**	

Question 6

Question	Answers	Extra information	Mark	AO/ Spec. Ref
06.1	(fixed) solar cells aren't always pointed (directly) at the Sun **or** (fixed) solar cells don't track the Sun (through the sky) (fixed) solar cells don't (always) receive maximum intensity of solar radiation	 allow solar cells won't receive as much (solar) energy allow solar cells won't generate as much electricity	1 1	AO3 4.1.3
06.2	Q = 3.5 × 3600 Q = 12 600 (C)		1 1	AO2 4.2.1.2
06.3	efficiency = $\frac{\text{useful power output}}{\text{total power input}}$		1	AO1 4.1.2.2
06.4	0.16 = $\frac{\text{useful power output}}{7500}$ useful power output = 0.16 × 7500 useful power output = 1200 (W)		1 1 1	AO2 4.1.2.2
06.5	the energy becomes less useful		1	AO1 4.1.2.1
06.6	a very large area would need to be covered with solar cells		1	AO3 4.1.3
Total			**10**	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	gravitational potential kinetic	this order only	1 1	AO1 4.1.1.2 4.1.1.1
07.2	kinetic energy = 0.5 × mass × speed^2 **or** $E_k = ½mv^2$		1	AO1 4.1.1.2
07.3	$5040 = 0.5 \times m \times 12^2$ $m = \frac{5040}{0.5 \times 12^2}$ m = 70 (kg)		1 1 1	AO2 4.1.1.2
07.4	the thermal energy increases.		1	AO1 4.1.1.1
Total			**7**	

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	0 to 25 cm^3		1	AO2 4.3.3.2
08.2	temperature		1	AO1 4.3.3.2
08.3	101 000 × 12 = constant constant = 1 212 000 (Pa cm^3)		1 1	AO2 4.3.3.2
08.4	p × 24 = 1 212 000 $p = \frac{1\,212\,000}{24}$ p = 50 500 (Pa)	allow ecf from question **08.3**	1 1 1	AO2 4.3.3.2
08.5	there is more space between the gas particles		1	AO1 4.3.3.2
Total			**8**	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	the polarity (of the supply) does not change	allow potential difference in one direction (only)	1	AO1 4.2.3.1
09.2	energy transferred = power × time		1	AO1 4.1.1.4 4.2.4.2
09.3	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
09.4	$V = I \times R$		1	AO1 4.2.1.3
09.5	480 = 15 × R $R = \frac{480}{15}$ R = 32 (Ω)		1 1 1	AO2 4.2.1.3
09.6	time taken using system **A** is double the time of system **B**		1	AO3 4.2.4.1
Total			**10**	

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	nuclei decreases	do not accept atoms	1 1	AO1 4.4.4.2
10.2	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
10.3	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

10.4	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 11

Question	Answers	Mark	AO/ Spec. Ref
11.1	**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.
11.2	current and p.d. would not be directly proportional **or** I-V graph would not be straight **or** I-V graph would be curved (because) resistance of **R** would increase		1 1	AO3 4.2.1.4 RPA4
11.3	0.2 (A)		1	AO3 4.2.2 RPA4
11.4	any **one** from: • less chance of misreading • no parallax error • it can give a reading closer to the true value	 allow position of eye(s) does not affect reading allow 'it is more accurate' ignore 'no human error' ignore 'easier to read'	1	AO3 4.2.2 RPA4
Total			**10**	

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

F

Foundation 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.

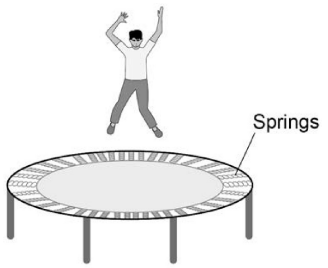
For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
TOTAL	

Do not write outside the box

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

0 1 **Figure 1** shows a boy bouncing on a trampoline.

Figure 1



0 1 . 1 The boy falls from the position in **Figure 1** towards the trampoline.

Complete the sentences.

Choose answers from the box.

[2 marks]

chemical	**elastic potential**	**gravitational potential**
kinetic	**nuclear**	

As the boy falls, there is a decrease in his _____ energy.

As the boy falls, there is an increase in his _____ energy.

Do not write outside the box

0 1 . 2 As the boy lands on the trampoline, each spring stretches 0.015 m.

spring constant of each spring = 120 000 N/m

Calculate the energy stored by each spring.

Use the equation:

elastic potential energy = 0.5 × spring constant × (extension)^2

[2 marks]

Elastic potential energy = _____ J

0 1 . 3 There are 40 springs on the trampoline.

Calculate the total energy stored by the 40 springs when each spring is stretched by 0.015 m.

Use your answer from Question **01.2**

[1 mark]

Total energy stored = _____ J

Question 1 continues on the next page

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0 1 . 4 The kinetic energy of the boy as he lands on the trampoline is 600 J.

The maximum kinetic energy of the boy after he bounces is 45% of his kinetic energy as he lands.

Calculate the maximum kinetic energy of the boy after he bounces.

[2 marks]

Maximum kinetic energy = _____ J

0 1 . 5 Why is the kinetic energy of the boy after he bounces less than his kinetic energy as he lands?

[1 mark]

Tick (✓) **one** box.

- Energy is not conserved. ☐
- Energy is transferred to the surroundings. ☐
- The springs transfer energy to the boy. ☐

8

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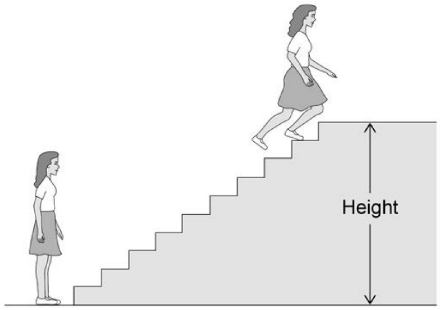
0 2 A girl ran to the top of some stairs.

Figure 2 shows the stairs.

Figure 2



0 2 . 1 The girl measured the height of the stairs.

What measuring instrument should she have used?

[1 mark]

0 2 . 2 The height of the stairs was 1.7 m.

The mass of the girl was 50 kg.

gravitational field strength = 9.8 N/kg

Calculate the change in gravitational potential energy of the girl.

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

[2 marks]

Gravitational potential energy = _____ J

Turn over ►

Do not write outside the box

0 2 . 3 A boy ran up the same stairs and did 1800 J of work.

The time it took the boy to run up the stairs was 1.44 s.

Calculate the power of the boy.

Use the equation:

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

[2 marks]

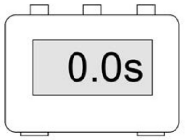
Power = _____ W

0 2 . 4 Which stop-clock was used to measure the time the boy took to run up the stairs?

[1 mark]

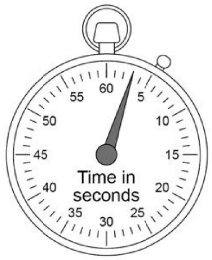
Tick (✓) **one** box.

Stop-clock A



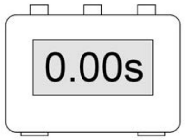
☐

Stop-clock B



☐

Stop-clock C



☐

Do not write outside the box

0 2 . 5 The boy had a speed of 2.0 m/s at the top of the stairs.

The mass of the boy was 70 kg.

Calculate the kinetic energy of the boy at the top of the stairs.

Use the equation:

kinetic energy = 0.5 × mass × (speed)^2

[2 marks]

Kinetic energy = _____ J

8

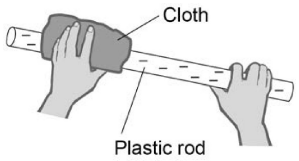
Turn over for the next question

Do not write outside the box

0 3 **Figure 3** shows a plastic rod being rubbed with a cloth.

The plastic rod becomes negatively charged.

Figure 3



0 3 . 1 Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

[2 marks]

electrons	neutrons	protons

The plastic rod becomes charged because it gains _____ .

The cloth also becomes charged because it loses _____ .

0 3 . 2 What charge is left on the cloth?

[1 mark]

Tick (✓) **one** box.

A negative charge ☐

A neutral charge ☐

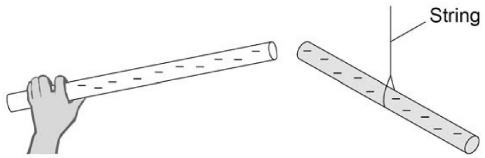
A positive charge ☐

Do not write outside the box

0 3 . 3 The negatively charged plastic rod is put near another negatively charged plastic rod that is hanging from a string.

Figure 4 shows the two rods.

Figure 4



What force is exerted on the two rods?

Tick (✓) **one** box.

Give a reason for your answer.

[2 marks]

A force of attraction ☐

A force of repulsion ☐

There is no force ☐

Reason _____

_____

_____

Question 3 continues on the next page

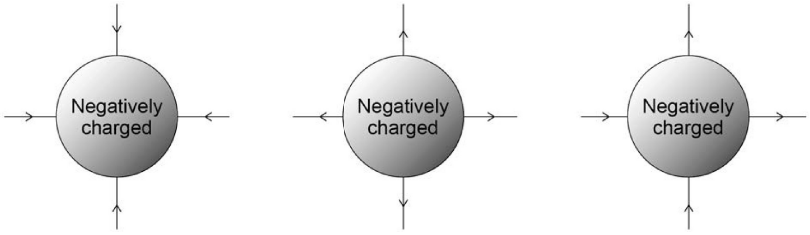
Do not write outside the box

0 3 . 4 There is an electric field around any charged object.

Which diagram shows the electric field pattern around a negatively charged sphere?

[1 mark]

Tick (✓) **one** box.

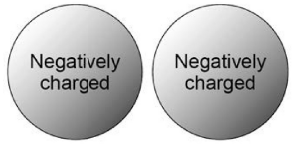


☐ ☐ ☐

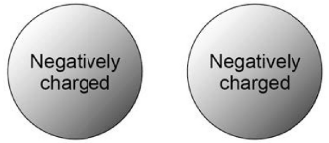
0 3 . 5 In which position do two charged spheres experience the greatest electrostatic force?

[1 mark]

Tick (✓) **one** box.

A 

☐

B 

☐

C 

☐

7

Do not write outside the box

0 4 Radioactive isotopes emit different types of nuclear radiation.

0 4 . 1 What does an alpha particle consist of?

[1 mark]

Tick (✓) **one** box.

- 2 protons and 2 electrons ☐
- 2 protons and 2 neutrons ☐
- 4 protons ☐
- 4 neutrons ☐

0 4 . 2 What is a beta particle?

[1 mark]

Tick (✓) **one** box.

- An electron ☐
- A neutron ☐
- Electromagnetic radiation ☐

0 4 . 3 A krypton (Kr) nucleus decays into a rubidium (Rb) nucleus by emitting a beta particle.

What is the correct equation for this decay?

[1 mark]

Tick (✓) **one** box.

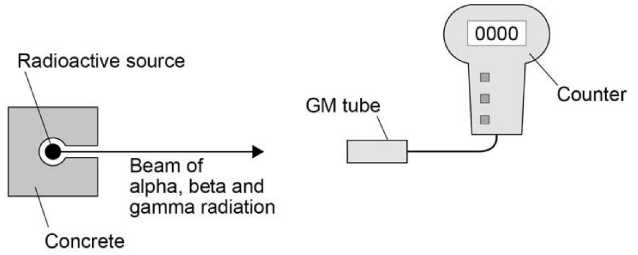
- $^{85}_{36}Kr + {}^{0}_{-1}e \longrightarrow {}^{85}_{37}Rb$ ☐
- $^{85}_{36}Kr \longrightarrow {}^{85}_{37}Rb + {}^{0}_{-1}e$ ☐
- $^{85}_{37}Rb \longrightarrow {}^{85}_{36}Kr + {}^{0}_{-1}e$ ☐

Do not write outside the box

0 4 . 4 **Figure 5** shows an experiment to demonstrate how alpha, beta and gamma radiation penetrate different materials.

The experiment takes place in a vacuum.

Figure 5



Three different materials are used:

- a sheet of paper
- a 0.5 cm thick sheet of aluminium
- a 10 cm block of lead.

Each material is placed one at a time between the radioactive source and the GM tube.

The GM tube and counter show whether the material has stopped the radiation.

Complete **Table 1** to show how alpha, beta and gamma radiation penetrate the materials in **Figure 5**.

Use the words **Yes** and **No**.

Part of **Table 1** has been completed for you.

[3 marks]

Table 1

Type of radiation	Most radiation is stopped by:		
	the sheet of paper	the sheet of aluminium	the block of lead
Alpha			Yes
Beta	No		
Gamma		No	

Do not write outside the box

0 4 . 5 Alpha, beta and gamma radiation have different ionising powers.

Draw **one** line from each radiation type to the correct ionising power.

[3 marks]

Radiation type	Ionising power
Alpha	Zero
Beta	Low
Gamma	Medium
	High

0 4 . 6 Some sources of background radiation are natural and other sources are man-made.

Which of the following is a man-made source of background radiation?

[1 mark]

Tick (✓) **one** box.

- Cosmic rays ☐
- Nuclear accidents ☐
- Rocks ☐

0 4 . 7 The average background radiation dose per year in the UK is 2.0 millisieverts.

A dental X-ray gives a patient a radiation dose of 0.005 millisieverts.

Calculate how many dental X-rays would be the same as the average background radiation dose per year.

[2 marks]

Number of dental X-rays = _____

12

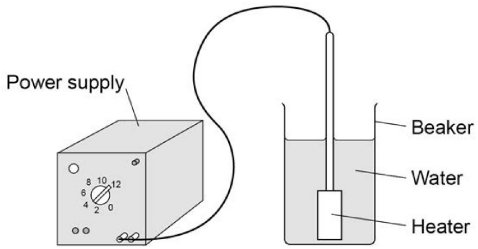
Turn over ►

Do not write outside the box

0 5 A student determined the specific latent heat of vaporisation of water.

Figure 6 shows some of the equipment used.

Figure 6



0 5 . 1 The student measured a mass of water and put it into the beaker.

What measuring instrument should the student have used to measure the mass of the water?

[1 mark]

Tick (✓) **one** box.

- balance ☐
- joulemeter ☐
- newtonmeter ☐
- thermometer ☐

Do not write outside the box

0 5 . 2 The power output of the heater stayed the same throughout the experiment.

What type of variable was the power output of the heater?

[1 mark]

Tick (✓) **one** box.

- Categoric variable ☐
- Control variable ☐
- Dependent variable ☐
- Independent variable ☐

0 5 . 3 The student turned on the heater and heated the water until it reached boiling point.

The student continued to heat the water so that it boiled for several minutes.

The mass of the water remaining in the beaker was measured again.

Give **one** way the beaker of boiling water could be moved safely to measure its new mass.

[1 mark]

Question 5 continues on the next page

Do not write outside the box

0 5 . 4 The mass of water that turned into steam was 0.0090 kg.

The heater transferred 25 200 J of energy to the water to turn it into steam.

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

Use the Physics Equations Sheet.

Choose the unit from the box.

[4 marks]

J	kg	J/kg

Specific latent heat of vaporisation = _____ Unit _____

0 5 . 5 What was a source of error in the student's experiment?

[1 mark]

Tick (✓) **one** box.

- The transfer of thermal energy from the heater to the water ☐
- The transfer of thermal energy from the surroundings to the water ☐
- The transfer of thermal energy from the water to the heater ☐
- The transfer of thermal energy from the water to the surroundings ☐

8

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

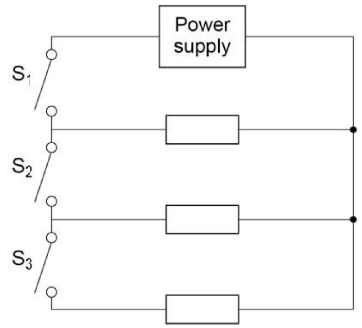
Do not write outside the box

0 6 A hair dryer contains three heating elements.

Figure 7 shows the circuit diagram for the heating elements in the hair dryer.

In **Figure 7** the heating elements are represented by resistor symbols.

Figure 7



0 6 . 1 Complete the sentence.

[1 mark]

The three resistors in **Figure 7** are connected in _____ with the power supply.

0 6 . 2 Which switch must always be closed for the hair dryer to work?

[1 mark]

Tick (✓) **one** box.

S_1 ☐

S_2 ☐

S_3 ☐

Do not write outside the box

0 6 . 3 Which switches must be closed for the hair dryer to work at maximum power output?

[1 mark]

Tick (✓) **one** box.

S_1 and S_2 ☐

S_1 and S_3 ☐

S_1, S_2 and S_3 ☐

Use the Physics Equations Sheet to answer questions **06.4** and **06.5**.

0 6 . 4 Write down the equation which links energy transferred (E), power (P) and time (t).

[1 mark]

0 6 . 5 The heating elements have a maximum power output of 1200 W.

The energy transferred to the heating elements to reach normal operating temperature is 3600 J.

Calculate the time taken for the heating elements to reach normal operating temperature at maximum power output.

[3 marks]

Time = _____ s

Turn over ►

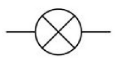
Do not write outside the box

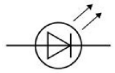
0 6 . 6 The hair dryer has LEDs to indicate the power setting.

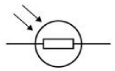
What is the circuit symbol for an LED?

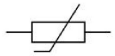
[1 mark]

Tick (✓) **one** box.

 ☐

 ☐

 ☐

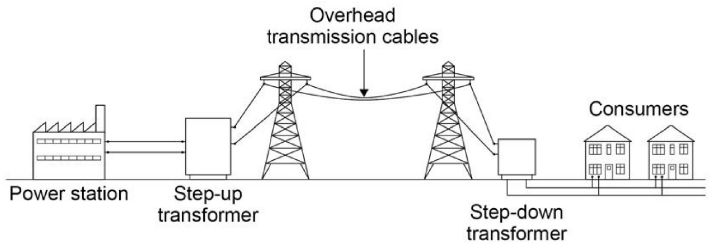
 ☐

8

Do not write outside the box

0 7 **Figure 8** shows how electricity is supplied to consumers.

Figure 8



0 7 . 1 Electricity from the power station can be generated using renewable or non-renewable energy resources.

Complete **Table 2** to show which energy resources are renewable and which are non-renewable.

[2 marks]

Tick (✓) **one** box in **each** row.

Table 2

Energy resource	Renewable	Non-renewable
biofuel		
coal		
nuclear		
tides		

Question 7 continues on the next page

Do not write outside the box

0 7 . 2 Transformers are used to make power transmission an efficient process.

Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

[4 marks]

charge	**current**	**energy**
potential difference	**resistance**	

The step-up transformer increases the _____ and decreases the _____ .

Using the transformers decreases the _____ transfer from the overhead transmission cables to the surroundings.

The step-down transformer decreases the _____ .

Do not write outside the box

Use the Physics Equations Sheet to answer questions **07.3** and **07.4**.

0 7 . 3 Write down the equation which links charge flow (Q), current (I) and time (t).

[1 mark]

0 7 . 4 The town of Hornsdale in Australia has electricity supplied by a huge battery.

The battery supplies a current of 130 000 A.

Calculate the charge flow from the battery in 5 minutes.

Choose the unit from the box.

[4 marks]

coulombs	newtons	watts

Charge flow = _____ Unit _____

11

Turn over for the next question

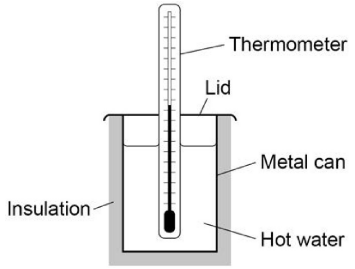
Do not write outside the box

0 8 A student investigated the insulating properties of two different materials.

The same thickness of each material was used.

Figure 9 shows some of the equipment used by the student.

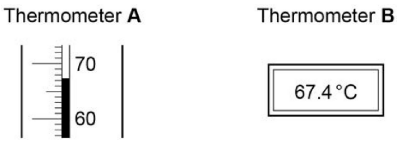
Figure 9



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

Figure 10 shows a reading on each thermometer.

Figure 10



0 8 . 1 What is the resolution of thermometer **B**?

[1 mark]

Tick (✓) **one** box.

- 0.1 °C ☐
- 0.4 °C ☐
- 67.0 °C ☐
- 67.4 °C ☐

Do not write outside the box

0 8 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

a smaller	**the same**	**a bigger**

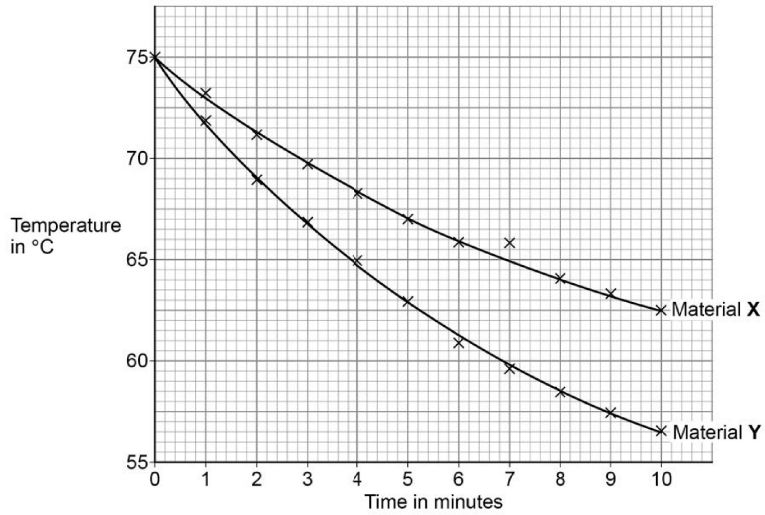
Thermometer **A** has _____ chance of being misread than thermometer **B**.

Question 8 continues on the next page

Do not write outside the box

Figure 11 shows the results.

Figure 11



0 8 . 3 The mass of water used was 0.12 kg.

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

Determine the total change in thermal energy of the water when Material **X** was used.

Use values from **Figure 11**.

Use the Physics Equations Sheet.

[4 marks]

Total change in thermal energy = _____ J

Do not write outside the box

0 8 . 4 There is an anomalous result on **Figure 11**.

Draw a ring around the anomalous result.

[1 mark]

0 8 . 5 Give **two** conclusions that can be made from **Figure 11**.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

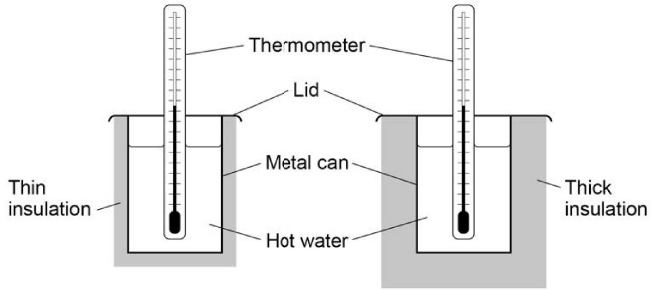
Question 8 continues on the next page

Do not write outside the box

Another student investigated how the thickness of the insulation affected the rate of cooling of hot water.

Figure 12 shows some of the equipment used.

Figure 12



0 8 . 6 How would using thick insulation affect the rate of cooling of hot water compared with using thin insulation?

[1 mark]

Tick (✓) **one** box.

The rate of cooling would be higher. ☐

The rate of cooling would be lower. ☐

The rate of cooling would not change. ☐

0 8 . 7 Predict how using thick insulation would affect the temperature of the water after 10 minutes compared with using thin insulation.

[1 mark]

Tick (✓) **one** box.

The temperature would be higher. ☐

The temperature would be lower. ☐

The temperature would be the same. ☐

11

Do not write outside the box

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 9 **Figure 13** shows a large wind farm off the coast of the UK.

Figure 13

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

0 9 . 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 9 . 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 9 . 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 9 . 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

1 0 **Figure 14** 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 14

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

[6 marks]

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

1 0 . 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

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

Table 3

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 3** 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 10 continues on the next page

1 0 . 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

1 1 An engineering company has invented pavement tiles that generate electricity as people walk on them.

Figure 15 shows someone walking on the pavement tiles.

Figure 15

Use the Physics Equations Sheet to answer questions **11.1** and **11.2**.

1 1 . 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

11.2 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 11 continues on the next page

Do not write outside the box

Use the Physics Equations Sheet to answer questions **11.3** and **11.4**.

11.3 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 ☐

11.4 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

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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

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ANSWER IN THE SPACES PROVIDED

AQA

GCSE
PHYSICS
8463/1F

Paper 1 Foundation Tier

Mark scheme

June 2022

Version: 1.0 Final Mark Scheme

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

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	gravitational potential kinetic	this order only	1 1	AO1 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	$E_e = 0.5 \times 120\,000 \times 0.015^2$ $E_e = 13.5$ (J)		1 1	AO2 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	$E = 540$ (J)	allow their answer from question **01.2** x 40	1	AO2 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	$E_k = 0.45 \times 600$ $E_k = 270$ (J)		1 1	AO2 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	energy is transferred to the surroundings		1	AO2 4.1.1.1

Total Question 1		**8**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	tape measure **or** metre rule	allow ruler ignore metre stick	1	AO3 4.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	$E_p = 50 \times 9.8 \times 1.7$ $E_p = 833$ (J)		1 1	AO2 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	$P = \frac{1800}{1.44}$ $P = 1250$ (W)		1 1	AO2 4.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	stop-clock C		1	AO3 4.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	$E_K = 0.5 \times 70 \times 2.0^2$ $E_K = 140$ (J)		1 1	AO2 4.1.2.1

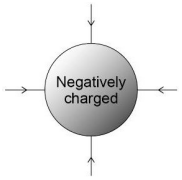
Total Question 2		**8**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	electrons electrons		1 1	AO1 4.2.5.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	a positive charge		1	AO1 4.2.5.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	a force of repulsion the rods have the same charge **or** the rods are both negatively charged	dependent on scoring first marking point	1 1	AO1 4.2.5.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4			1	AO1 4.2.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	 **A**		1	AO1 4.2.5.2

Total Question 3		7

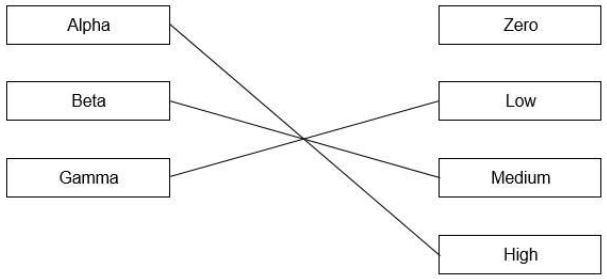
Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	2 protons and 2 neutrons		1	AO1 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	an electron		1	AO1 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	$^{85}_{36}Kr \longrightarrow {}^{85}_{37}Rb + {}^{0}_{-1}e$		1	AO1 4.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	<table><tr><th rowspan="2">Type of radiation</th><th colspan="3">Most radiation is stopped by:</th></tr><tr><th>the sheet of paper</th><th>the sheet of aluminium</th><th>the block of lead</th></tr><tr><td>Alpha</td><td>Yes</td><td>Yes</td><td>Yes</td></tr><tr><td>Beta</td><td>No</td><td>Yes</td><td>Yes</td></tr><tr><td>Gamma</td><td>No</td><td>No</td><td>Yes</td></tr></table> **1** mark for each correct row allow ticks and crosses in place of yes and no any incorrect answer on a row negates the mark for the row		3	AO1 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	 **1** mark for each correct line if more than one line drawn from radiation type list principle applies		1 1 1	AO1 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	nuclear accidents		1	AO1 4.4.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	number = $\frac{2.0}{0.005}$ number = 400		1 1	AO2 4.4.3.1

Total Question 4		12

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	balance		1	AO3 4.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	control variable		1	AO3 4.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	use tongs / gloves **or** use a heatproof mat	allow other sensible methods of avoiding contact with hot beaker eg using a cloth allow wait for the beaker (and hot water) to cool down	1	AO2 4.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	25 200 = 0.0090 L $L = \frac{25\,200}{0.0090}$ L = 2 800 000 **or** $L = 2.8 \times 10^6$ J/kg		1 1 1 1	AO2 AO2 AO2 AO1 4.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	the transfer of thermal energy from the water to the surroundings		1	AO3 4.3.2.3 4.1.2.1

Total Question 5		**8**

Question 6

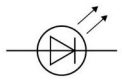
Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	parallel		1	AO1 4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	S_1		1	AO1 4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	S_1, S_2 and S_3		1	AO2 4.2.2

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	$3600 = 1200 \times t$ $t = \frac{3600}{1200}$ $t = 3$ (s)		1 1 1	AO2 4.2.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6			1	AO1 4.2.1.1

Total Question 6		8

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	<table><tr><th>Energy resources</th><th>Renewable</th><th>Non-renewable</th></tr><tr><td>biofuel</td><td>✓</td><td></td></tr><tr><td>coal</td><td></td><td>✓</td></tr><tr><td>nuclear</td><td></td><td>✓</td></tr><tr><td>tides</td><td>✓</td><td></td></tr></table> 4 correct scores **2** marks 3 correct scores **1** mark		2	AO1 4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	potential difference current energy potential difference	this order only allow p.d.	1 1 1 1	AO1 4.2.4.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	charge flow = current × time **or** $Q = It$		1	AO1 4.2.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	t = 300 (s)		1	AO2
	Q = 130 000 × 300	allow a correct substitution using an incorrectly / not converted value of t	1	AO2
	Q = 39 000 000 ***or*** $Q = 3.9 \times 10^7$	allow a correct calculation using an incorrectly / not converted value of t	1	AO2
	coulombs / C		1	AO1 4.2.1.2

Total Question 7		**11**

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	0.1 °C		1	AO3 4.1.2.1 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	a bigger		1	AO3 4.1.2.1 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	identifies 75 (°C) **and** 62.5 (°C)		1	AO2 4.1.1.3 RPA2
	$\Delta\theta$ = 12.5 (°C)	allow a correct calculation of temperature change from misread values	1	
	E = 0.12 × 4200 × 12.5	allow a correct substitution using an incorrect temperature change	1	
	E = 6300 (J)	allow an answer consistent with an incorrect temperature change	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	point at 7 minutes for material **X** ringed		1	AO3 4.1.2.1 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	any **two** from: • water wrapped in material X cooled more slowly • material X is a better insulator **or** the thermal conductivity of material X is lower • the rate of cooling decreased with time (for both X and Y)	allow converse answers for material Y allow water wrapped in material X transfers less energy to the surroundings (in 10 minutes) allow water wrapped in material X has a higher final temperature allow material X is a worse (thermal) conductor allow temperature decreased with time (for both X and Y)	2	AO3 4.1.2.1 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	the rate of cooling would be lower		1	AO3 4.1.2.1 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.7	the temperature would be higher		1	AO3 4.1.2.1 RPA2

Total Question 8		**11**

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	*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.
09.2	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.
09.3	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.
09.4	more efficient devices waste less energy **or** more efficient devices need a lower energy input (for the same energy output) which would minimise the electricity / energy demand **or** which would minimise the environmental impact from (fossil fuel) electricity generation	ignore use less electricity 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 1	AO3 4.1.2.2 4.1.3

Total Question 9		9

Question 10

Question	Answers	Mark	AO / Spec. Ref.
10.1	**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.
10.2	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.
10.3	chalk or flint		1	AO3 4.3.1.1 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.4	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 10		**10**

Question 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.1	$P = V \times I$		1	AO1 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.2	$4.4 = 40 \times I$ $I = \frac{4.4}{40}$ $I = 0.11$ (A)		1 1 1	AO2 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.3	$\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}}$		1	AO1 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.4	$0.85 = \frac{P}{4.0}$ $P = 0.85 \times 4.0$ $P = 3.4$ (W)		1 1 1	AO2 4.1.2.2

Total Question 11		**8**