2024

Name_____

Combined 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
COMBINED SCIENCE: TRILOGY

F

Foundation Tier
Physics Paper 1F

Wednesday 22 May 2019 Afternoon Time allowed: 1 hour 15 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.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- 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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

Information
- The maximum mark for this paper is 70.
- 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.

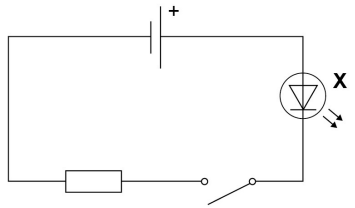
Do not write outside the box

0 1 A designer made some shoes that have lights in them.

Each shoe has a switch which closes when a person puts their foot on the floor.

Figure 1 shows the circuit.

Figure 1



0 1 . 1 What is component **X**?

[1 mark]

Tick (✓) **one** box.

Lamp ☐

LDR ☐

LED ☐

0 1 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

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

When the switch was closed, the current in component **X** was

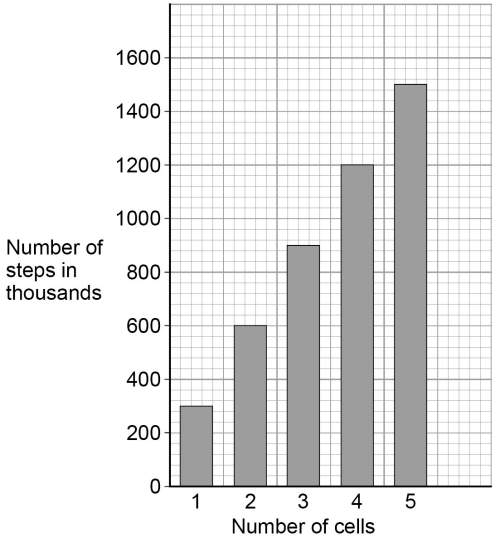
_____ the current in the resistor.

Do not write outside the box

The designer tested how the number of cells affected the number of steps that could be taken before the lights stopped working.

Figure 2 shows the results.

Figure 2



0 1 . 3 Determine how many more steps could be taken when the number of cells was increased from 3 to 5

[2 marks]

Number of steps = _____ thousand

Question 1 continues on the next page

Turn over ►

Do not write outside the box

0 1 . 4 How could the designer check the repeatability of the results?

[1 mark]

Tick (✓) **one** box.

Repeat the experiment with a different resistor in the circuit. ☐

Repeat the experiment using exactly the same method. ☐

Repeat the experiment with different types of shoe. ☐

0 1 . 5 When the potential difference across the resistor was 0.80 V, the current in the resistor was 0.020 A

Calculate the power dissipated by the resistor.

Use the equation:

power = potential difference × current

[2 marks]

Power = _____ W

0 1 . 6 Which other equation can be used to calculate the power dissipated by a resistor?

[1 mark]

Tick (✓) **one** box.

Power = $(\text{current})^2 \times \text{resistance}$ ☐

Power = $\frac{\text{current}}{(\text{resistance})^2}$ ☐

Power = $\text{current} \times (\text{resistance})^2$ ☐

Do not write outside the box

0 1 . 7 What happens to the temperature of the resistor when there is a current in it?

[1 mark]

0 1 . 8 There was a current of 0.020 A in the resistor for 180 seconds.

Calculate the charge flow through the resistor.

Use the equation:

charge flow = current × time

[2 marks]

Charge flow = _____ C

11

Turn over for the next question

Do not write outside the box

0 2 A student investigated how the area of a solar panel affected the output potential difference of the solar panel.

The student placed different sized solar panels under a lamp.

Figure 3 shows a solar panel under a lamp.

Figure 3

0 2 . 1 Which variable should be controlled?

[1 mark]

Tick (✓) **one** box.

- The area of the solar panels ☐
- The brightness of the lamp ☐
- The output potential difference of the solar panels ☐

Do not write outside the box

0 2 . 2 The student measured the output potential difference using a voltmeter.

When the voltmeter was **not** connected, the reading on the voltmeter was 0.7 V

What name is given to this type of error?

[1 mark]

Tick (✓) **one** box.

Zero error ☐

Random error ☐

Measurement error ☐

Question 2 continues on the next page

Do not write outside the box

Table 1 shows the results of the investigation.

Table 1

Solar panel	Area of solar panel in cm^2	Output potential difference in volts			
		Test 1	Test 2	Test 3	Mean
A	10	2.5	2.4	2.6	2.5
B	20	5.0	5.0	4.9	5.0
C	30	7.5	11.9	7.5	7.5
D	50	12.4	12.6	12.5	12.5

0 2 . 3 The readings for which solar panel show an anomalous result?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 2 . 4 The student did **not** have a solar panel with an area of 40 cm^2

Determine the most likely value for the mean output potential difference of a 40 cm^2 solar cell.

[1 mark]

Mean output potential difference = _____ V

Do not write outside the box

0 2 . 5 The total input energy transfer to one of the solar panels was 8.0 joules.

The useful output energy transfer was 0.96 joules.

Calculate the efficiency of the solar panel.

Use the equation:

$$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$

[2 marks]

Efficiency = _____

0 2 . 6 Solar power is a renewable energy resource.

Complete the sentence.

Choose the answer from the box.

[1 mark]

burned	**replenished**	**consumed**

A renewable energy resource is one that is _____ as it is used.

Question 2 continues on the next page

Do not write outside the box

0 2 . 7 Some homes have solar panels which generate electricity.

On a sunny day the potential difference across a solar panel is 31 volts.

A charge of 490 coulombs flows through the solar panel.

Calculate the energy transferred by the solar panel.

Use the equation:

energy transferred = charge flow × potential difference

Give your answer to 2 significant figures.

[3 marks]

Energy transferred = _____ J

0 2 . 8 Why do solar panels on homes help reduce the environmental impact of using electrical devices?

[1 mark]

Tick (✓) **one** box.

Less electricity is used in the home. ☐

Less fossil fuel is burned. ☐

The electricity from the solar panels is cheaper. ☐

11

Do not write outside the box

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 3 In an experiment, a beam of alpha particles was directed at a thin sheet of gold foil.

0 3 . 1 Most of the alpha particles passed straight through the gold foil.

Alpha particles which passed close to the nucleus of a gold atom did **not** pass straight through.

What happened to the alpha particles which passed close to the nucleus of a gold atom?

[1 mark]

0 3 . 2 The results suggested that the diameter of the nucleus of a gold atom is $\frac{1}{6000}$ of the diameter of the atom.

The diameter of a gold atom is 0.18 nm

Calculate the diameter of a gold nucleus in nm

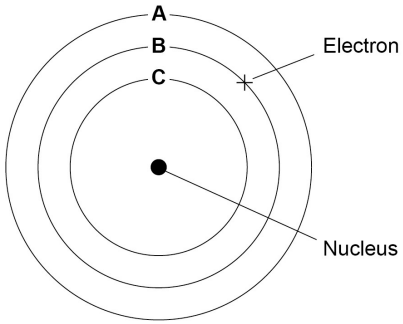
[2 marks]

Diameter = _____ nm

0 3 . 3 Further experiments showed that gold nuclei are surrounded by electrons in different energy levels.

Figure 4 shows three of the energy levels around the nucleus of a gold atom.

Figure 4



The electron in energy level **B** absorbs electromagnetic radiation.

Which energy level will the electron be in after it has absorbed the electromagnetic radiation?

[1 mark]

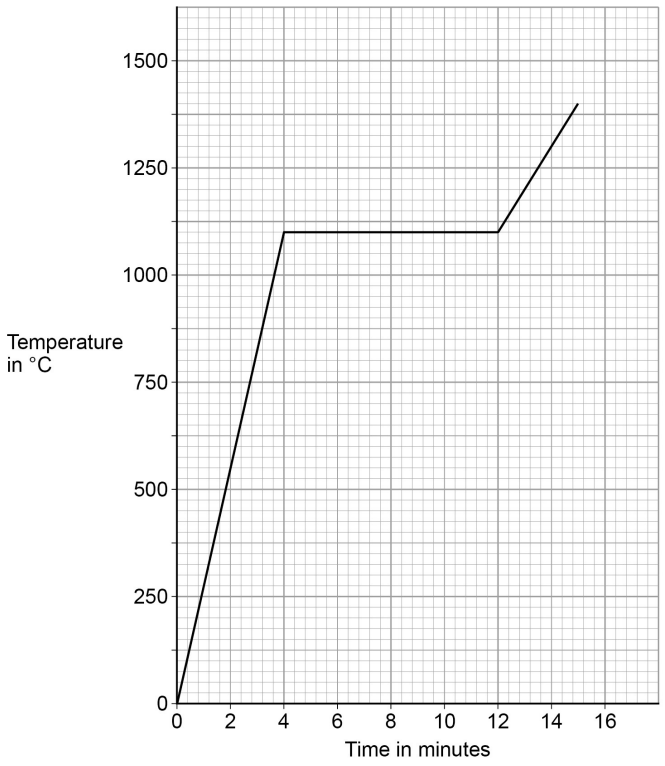
Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

Question 3 continues on the next page

Figure 5 shows how the temperature of a small sample of gold changes as it is heated from a solid to a liquid.

Figure 5



0 3 . 4 What is the melting point of the gold?

[1 mark]

Melting point = _____ °C

0 3 . 5 How many minutes did it take for all of the gold in the sample to change from solid to liquid?

[1 mark]

Time taken = _____ minutes

Do not write outside the box

0 3 . 6 What does the gradient of the graph in **Figure 5** represent?

[1 mark]

Tick (✓) **one** box.

- The internal energy of the gold ☐
- The rate of change of temperature of the gold ☐
- The specific heat capacity of the gold ☐

7

Turn over for the next question

Do not write outside the box

0 4 Protactinium (Pa) is radioactive.

0 4 . 1 An atom of one isotope of protactinium contains 91 protons and 143 neutrons.

What is the correct symbol for this atom?

[1 mark]

Tick (✓) **one** box.

- $^{143}_{91}Pa$ ☐
- $^{234}_{91}Pa$ ☐
- $^{234}_{143}Pa$ ☐
- $^{91}_{52}Pa$ ☐

A teacher investigated how the count rate from a sample of protactinium changed over time.

Table 2 shows the results.

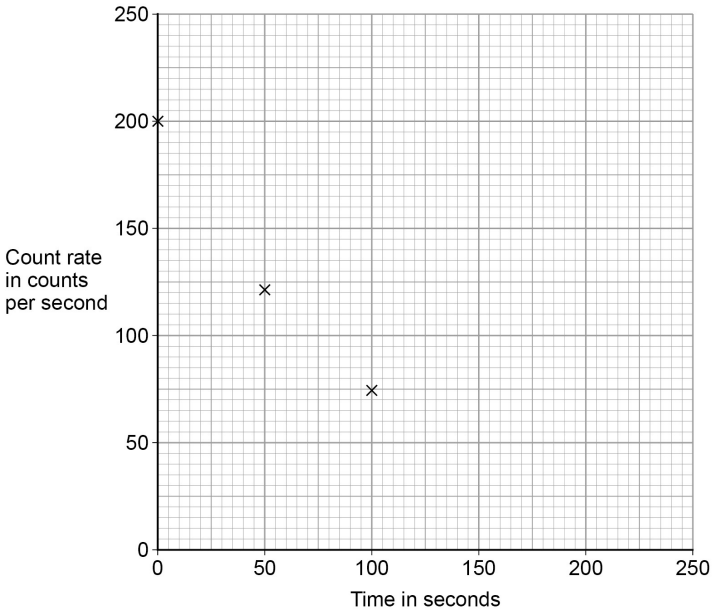
Table 2

Time in seconds	Count rate in counts per second
0	200
50	122
100	74
150	45
200	27

Do not write outside the box

Figure 6 shows some of the teacher's results.

Figure 6



0 4 . 2 Complete the graph in **Figure 6.**

Use data from **Table 2.**

Draw the line of best fit.

[2 marks]

0 4 . 3 How much time did it take for the count rate to change from 200 counts per second to 100 counts per second?

[1 mark]

Time taken = _____ s

0 4 . 4 What is the half-life of protactinium?

[1 mark]

Half-life = _____ s

Turn over ►

Do not write outside the box

0 4 . 5 The nuclear radiation from the protactinium can pass through paper.

This radiation can only be detected up to 1 metre away from the protactinium.

What type of radiation is emitted by the protactinium?

[1 mark]

Tick (✓) **one** box.

Alpha ☐

Beta ☐

Gamma ☐

Neutron ☐

0 4 . 6 The teacher read an article about the effects of radiation on the human body.

Why are articles in scientific journals generally more trustworthy than articles in newspapers?

[1 mark]

_____

_____

7

Do not write outside the box

0 5 **Figure 7** shows a toaster.

Figure 7

The toaster is connected to the mains supply using a three-core cable.

0 5 . 1 What is the function of the earth wire inside the cable?

[1 mark]

Tick (✓) **one** box.

To carry the current from the supply to the toaster ☐

To complete the circuit in the toaster ☐

To melt if a fault occurs inside the toaster ☐

To stop the metal case of the toaster becoming live if a fault occurs ☐

0 5 . 2 Complete the sentences.

Choose answers from the box.

[3 marks]

blue	**brown**	**orange**	**white**	**yellow**

The insulation around the earth wire is green and _____ .

The insulation around the live wire is _____ .

The insulation around the neutral wire is _____ .

Turn over ►

Do not write outside the box

0 5 . 3 The toaster is switched on for 120 seconds.

The power of the toaster is 850 watts.

Calculate the energy transferred by the toaster.

Use the equation:

energy transferred = power × time

[2 marks]

_____

_____

_____

Energy transferred = _____ J

0 5 . 4 Complete the sentences.

Choose answers from the box.

[2 marks]

chemical	**elastic potential**	**kinetic**	**thermal**

When bread is lowered into the toaster, a spring is stretched. The stretched spring stores _____ energy.

After the bread is toasted, the spring makes the toast move upwards. As the speed of the toast increases, the _____ energy of the toast increases.

Do not write outside the box

0 5 . 5 Write the equation which links gravitational field strength, gravitational potential energy, height and mass.

[1 mark]

0 5 . 6 The toast was moved upwards by the spring.

The change in gravitational potential energy of the toast was 0.049 J

The mass of the toast was 0.050 kg

gravitational field strength = 9.8 N/kg

Calculate the change in height of the toast.

[3 marks]

Change in height = _____ m

12

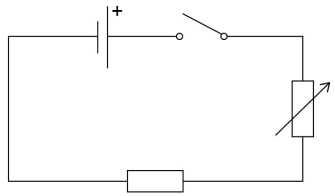
Turn over for the next question

Do not write outside the box

0 6 A student investigated how the current in a resistor varies with the potential difference across the resistor.

Figure 8 shows part of the circuit used.

Figure 8



0 6 . 1 The student connected an ammeter and a voltmeter into the circuit.

What is the correct way to connect the ammeter and the voltmeter into the circuit?

[1 mark]

Tick (✓) **one** box.

Ammeter	Voltmeter	
In parallel with the resistor	In series with the resistor	☐
In parallel with the cell	In series with the resistor	☐
In series with the resistor	In parallel with the resistor	☐
In series with the resistor	In parallel with the cell	☐

0 6 . 2 The student increased the resistance of the variable resistor.

How did increasing the resistance affect the current in the circuit?

[1 mark]

Do not write outside the box

0 6 . 3 How should the student change the circuit to give negative values for current and potential difference?

[1 mark]

0 6 . 4 Name the type of relationship between current and potential difference for a resistor at constant temperature.

[1 mark]

0 6 . 5 Write the equation which links current, potential difference and resistance.

[1 mark]

0 6 . 6 The current in the resistor was 0.12 A when the potential difference across the resistor was 3.0 V

Calculate the resistance of the resistor.

[3 marks]

Resistance = _____ Ω

8

Do not write outside the box

0 7 A scientist cooled the air inside a container.

0 7 . 1 The temperature of the air changed from 20 °C to 0 °C

The volume of the container of air stayed the same.

Explain how the motion of the air molecules caused the pressure in the container to change as the temperature decreased.

[3 marks]

0 7 . 2 The air contained water that froze at 0 °C

The change in internal energy of the water as it froze was 0.70 kJ

The specific latent heat of fusion of water is 330 kJ/kg

Calculate the mass of ice produced.

Use the Physics Equations Sheet.

[3 marks]

Mass of ice = _____ kg

Do not write outside the box

0 7 . 3 The air also contained oxygen, nitrogen and carbon dioxide.

Oxygen boils at –183 °C and freezes at –218 °C
Nitrogen boils at –195 °C and freezes at –210 °C
Carbon dioxide sublimates at –78 °C

The scientist continued to cool the air to a temperature of –190 °C

What is the state of each substance at –190 °C?

[2 marks]

Tick (✓) **one** box for **each** row of the table.

Substance	Solid	Liquid	Gas
Oxygen			
Nitrogen			
Carbon dioxide			

Question 7 continues on the next page

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0 7 . 4 The air also contained a small amount of argon.

As the temperature of the air decreased from 20 °C to –190 °C the argon changed from a gas to a liquid to a solid.

Explain the changes in the arrangement and movement of the particles of the argon as the temperature of the air decreased.

[6 marks]

14

END OF QUESTIONS

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AQA

GCSE
COMBINED SCIENCE: TRILOGY
8464/P/1F

Physics Paper 1F

Mark scheme

June 2019

Version: 1.0 Final

I96G8464pIf/MS

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.1	LED		1	AO1.1 AO1 in isolation 6.2.1.1	A
01.2	the same as		1	AO1.1 6.2.1.2	G
01.3		an answer of 600 (thousand) or 600 000 scores **2** marks		AO2.2 6.2.1.2 WS 3.2	G
		two correct readings from the graph scores **1** mark	1		
	1500 – 900	allow a range of 1480 to 1520 and a range of 880 to 920	1		
	600 (thousand)	allow an answer in the range of 560 (thousand) to 640 (thousand) consistent with their allowed readings			
01.4	repeat the experiment using exactly the same method		1	AO3.3a 6.2.1.2	A
01.5		an answer of 0.016 (W) scores **2** marks		AO2.1	E
	power = 0.80 × 0.020		1	6.2.4.1 WS 3.3	
	power = 0.016 (W)		1		
01.6	power = (current)^2 × resistance		1	AO1.1 AO1 in isolation 6.2.4.1	A
01.7	temperature increases		1	AO1.1 6.1.1.1	E

01.8	Q = 0.020 × 180 Q = 3.6 (C)	an answer of 3.6 (C) scores **2** marks	1 1	AO2.1 6.2.1.2 WS 3.3	E
Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
02.1	the brightness of the lamp		1	AO3/3a 6.1.3c WS 2.2	A
02.2	zero error		1	AO3/3b 6.1.3c WS 3.7	A
02.3	C		1	AO3/1b 6.1.3c WS 3.7	A
02.4	10.0	allow 10	1	AO3/1a 6.1.3c WS 3.5	G
02.5	$\frac{0.96}{8.0}$ = 0.12	an answer of 0.12 or 12% scores **2** marks allow 12%	1 1	AO2.1 6.1.2.2	E
02.6	replenished		1	AO1.1 in isolation 6.1.3b	G
02.7	E = 490 × 31 E = 15 190 E = 15 000 (J)	an answer of 15 000 (J) scores **3** marks allow 15 200 if correct substitution is seen allow an answer to 2 s.f. consistent with their calculated value of E using E=QV	1 1 1	AO2.1 6.2.4.2	E

02.8	less fossil fuel is burned		1	AO3.2a 6.1.3e	A
Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	they changed direction	allow deflected/reflected/repelled	1	AO 1/1 6.4.1.3	E
03.2	diameter = $\frac{0.18}{6000}$ = 0.000 030 (nm)	an answer of 0.000 03 (nm) or 3.0×10^{-5} (nm) scores **2** marks allow 3.0×10^{-5} (nm)	1 1	AO2/2 6.4.1.1	E
03.3	A		1	AO 1/1 6.4.1.1	A
03.4	1100 (°C)		1	AO3/2b 6.3.2.3	G
03.5	8 (minutes)	allow 12 (minutes)	1	AO3/2b 6.3.2.3	G
03.6	the rate of change of temperature of the gold		1	AO3/1a 6.1.1.3, 6.3.2.2	A
Total			**7**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1	$^{234}_{91}Pa$		1	AO1/1 6.4.1.2	A
04.2	points correctly plotted to within 1 mm a curved line of best fit passing within 1 mm of all 5 points	 ignore any line beyond 200 seconds	1 1	AO2.2 6.4.2.3 WS 3.2	E
04.3	70 (s)	allow an answer between 65 and 75 (s) allow an answer consistent with their drawn line	1	AO2/2 6.4.2.3 WS 3.5	E
04.4	70 (s)	allow an answer between 65 and 75 (s) allow their answer to question **04.3**	1	AO3/2b 6.4.2.3	E
04.5	beta		1	AO1.1 6.4.2.1	A
04.6	articles in scientific journals are peer reviewed	allow articles in scientific journals are based on evidence/data allow newspaper articles may be oversimplified/inaccurate/biased	1	AO1.1 6.4.2.4 WS 1.6	E
Total			**7**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	to stop the metal case of the toaster becoming live if a fault occurs		1	AO1.1 6.2.3.2	A
05.2	yellow brown blue		1 1 1	AO1.1 AO1 in isolation 6.2.3.2	G
05.3	 E = 850 ×120 E = 102 000 (J)	an answer of 102 000 (J) scores **2** marks	 1 1	AO2.1 6.2.4.2 6.1.1.4 WS 3.3	E
05.4	elastic potential kinetic		1 1	AO1.1 6.1.1.1	G
05.5	gravitational potential energy = mass × gravitational field strength × height or $E_p = m\ g\ h$	allow gpe allow any correct re-arrangement	1	AO1.1 AO1 in isolation 6.1.1.2	E
05.6	 $0.049 = 0.050 \times 9.8 \times h$ $h = \frac{0.049}{0.050 \times 9.8}$ h = 0.10 (m)	an answer of 0.10 (m) scores **3** marks	 1 1 1	AO2.1 6.1.1.2 WS 3.3	E
Total			**12**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	ammeter in series with the resistor, voltmeter in parallel with the resistor		1	AO1/1 6.2.1.4 RP 16 WS 2.4	A
06.2	current decreased	ignore slows down	1	AO1/1 6.2.1.3 RP 16 WS 3.6	E
06.3	reverse the connections to the cell	allow battery for cell allow reverse the cell	1	AO1/2 6.2.1.3 RP 16 WS 2.2	E
06.4	(directly) proportional	do not allow inversely proportional do not allow indirectly proportional	1	AO1/2 6.2.1.3 RP 16 WS 3.5	G
06.5	potential difference = current × resistance **or** V=IR	allow voltage for potential difference allow any correct re-arrangement	1	AO1/1 6.2.1.3 RP 16 WS 3.3	E
06.6	 3.0 = 0.12 × R $R = \frac{3.0}{0.12}$ R = 25 (Ω)	an answer of 25 (Ω) scores **3** marks	 1 1 1	AO2/1 6.2.1.3 RP 16 WS 3.3	E
Total			**8**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
07.1	pressure decreased because molecules have less (kinetic) energy so fewer collisions (with the wall/container each second)	 allow less speed/velocity allow collide with less force allow less force on the walls	1 1 1	AO2.1 6.3.3.1	E
07.2	 0.70 = m × 330 **or** 700 = m × 330 000 $m = \frac{0.70}{330}$ **or** $m = \frac{700}{330\,000}$ m = 0.0021 (kg)	an answer of 0.0021(212121…) scores **3** marks allow correct rearrangement using converted value(s) of E to J and/or L to J/kg allow 0.0021(212121…) allow correct calculation using converted value(s) of E and/or L **3** marks can only be awarded for m = 0.0021(212121…) (kg)	 1 1 1	AO2.1 6.3.2.2 6.1.1.3	E
07.3	<table><tr><th>Substance</th><th>Solid</th><th>Liquid</th><th>Gas</th></tr><tr><td>Oxygen</td><td></td><td>✓</td><td></td></tr><tr><td>Nitrogen</td><td></td><td></td><td>✓</td></tr><tr><td>Carbon dioxide</td><td>✓</td><td></td><td></td></tr></table> 2 correct answers scores **1** mark. if more than one tick in a row, neither can score a mark		2	AO3/2b 6.3.1.1	E

07.4	**Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1.1 6.3.1.2	E
	Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4		
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2		
	No relevant content	0		
	Indicative content cooling • as the argon cools the particles slow down • particles in a liquid move slower than particles in a gas • particles in a solid move slower than particles in a liquid • as the liquid/solid cools the particles get closer together • as the liquid/solid cools the density increases gas to liquid • particles change from being spread apart to touching each other • particles will (collide with other particles more often and) change direction more often liquid to solid • particles change from a random arrangement to a regular pattern • particles change from moving freely to fixed positions • particles change from moving freely/randomly to vibrating explanation • (internal) energy (of the argon) decreases • (kinetic) energy (of the particles) decreases with temperature • (potential) energy (of the particles) changes with change of state (of the argon) • forces between particles in a gas are negligible/zero • attractive forces act between atoms when they are close to each other • attractive forces between particles are stronger in a solid than in a liquid to access level 3 there must be an explanation of changes to arrangement and movement of particles during either cooling or a change of state			

Total			**14**

AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: TRILOGY

F

Foundation Tier
Physics Paper 1F

Time allowed: 1 hour 15 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.
- 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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

Information
- The maximum mark for this paper is 70.
- 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.

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

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0 1 A student investigated the density of different types of rock.

Figure 1 shows a piece of limestone.

Figure 1

0 1 . 1 The student was **not** able to calculate the volume of the piece of limestone using measurements taken with a ruler.

What is the reason?

[1 mark]

Tick (✓) **one** box.

A ruler is not very accurate. ☐

The piece of limestone has an irregular shape. ☐

There is a large uncertainty when using a ruler. ☐

Question 1 continues on the next page

Turn over ►

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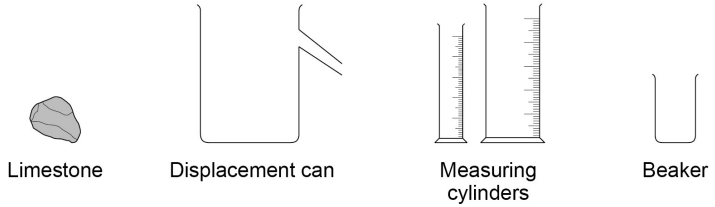
0 1 . 2 **Figure 2** shows some of the equipment given to the student.

Figure 2



Describe a method the student could use to determine the volume of the piece of limestone.

[4 marks]

Do not write outside the box

0 1 . 3 The mass of the piece of limestone was 155 g.

The volume of the piece of limestone was 62 cm^3.

Calculate the density of the piece of limestone.

Use the equation:

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

[2 marks]

Density = _____ g/cm^3

0 1 . 4 Density can be measured in g/cm^3.

What is another unit for density?

[1 mark]

Tick (✓) **one** box.

- cm/g^3 ☐
- kg/m^3 ☐
- kg^3/m ☐
- kg^3/cm ☐

Question 1 continues on the next page

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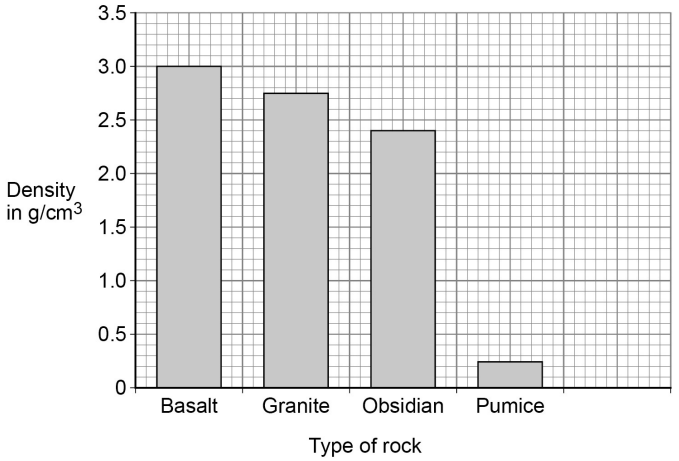
Figure 3 gives the density of some other types of rock.

Figure 3



The student has a sample of an unknown type of rock.

The density of this rock is 2.4 g/cm^3.

0 1 . 5 Draw a bar on **Figure 3** to show the density of the unknown type of rock.

[1 mark]

0 1 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

basalt	**granite**	**obsidian**	**pumice**

The data in **Figure 3** suggests that the unknown type of rock is _____ .

Do not write outside the box

0 1 . 7 The student **cannot** be certain that the unknown type of rock is one of the types of rock in **Figure 3**.

Give a reason why.

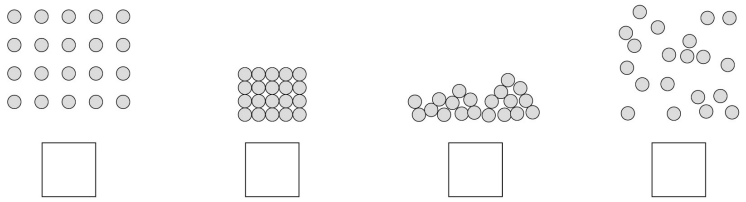
[1 mark]

Pumice is a type of rock that has holes in it. The holes contain air.

0 1 . 8 Which diagram shows the arrangement of particles in air?

[1 mark]

Tick (✓) **one** box.



0 1 . 9 Complete the sentence.

Choose the answer from the box.

[1 mark]

less than	**the same as**	**more than**

The holes containing air cause the density of pumice to

be _____ the density of other types of rock.

13

Turn over ►

Do not write outside the box

0 2 In a sport called far-leaping, an athlete uses a long pole to cross a river.

Figure 4 shows an athlete far-leaping.

Figure 4

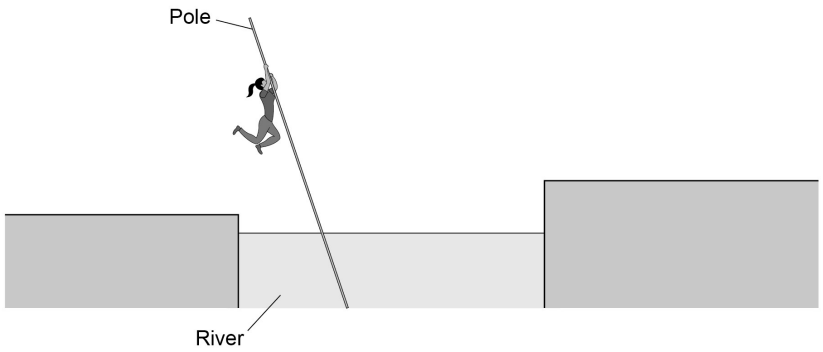
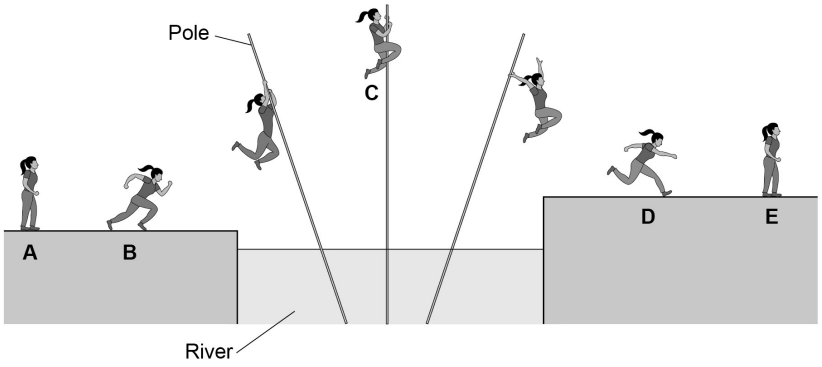


Figure 5 shows the athlete in different stages of far-leaping.

Figure 5



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0 2 . 1 Complete the sentence.

Choose answers from the box.

[2 marks]

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

Between positions **A** and **B** the athlete speeds up. There is

an increase in the athlete's _____ energy and

a decrease in the athlete's _____ store of energy.

0 2 . 2 Between positions **B** and **C** the athlete jumps to the pole and climbs up it.

Which statement describes a change in the athlete's energy between positions **B** and **C**?

[1 mark]

Tick (✓) **one** box.

Elastic potential energy decreases. ☐

Elastic potential energy increases. ☐

Gravitational potential energy decreases. ☐

Gravitational potential energy increases. ☐

Question 2 continues on the next page

Do not write outside the box

0 2 . 3 The pole falls over from position **C**. The athlete lets go of the pole and lands at position **D**.

The change in height of the athlete between positions **C** and **D** is 3.0 m.

mass of athlete = 50 kg

gravitational field strength = 9.8 N/kg

Calculate the change in gravitational potential energy of the athlete between positions **C** and **D**.

Use the equation:

change in gravitational potential energy = mass × gravitational field strength × change in height

[2 marks]

Change in gravitational potential energy = _____ J

Do not write outside the box

0 2 . 4 The kinetic energy of the athlete at position **D** is 1600 J.

mass of athlete = 50 kg

Calculate the speed of the athlete at position **D**.

Use the equation:

$$\text{speed} = \sqrt{\frac{2 \times \text{kinetic energy}}{\text{mass}}}$$

Choose the unit from the box.

[3 marks]

m/s	J/kg	J/s

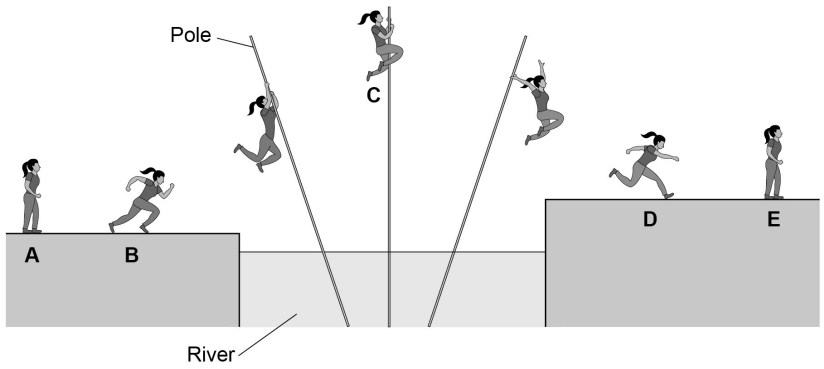
Speed = _____ Unit _____

Question 2 continues on the next page

Do not write outside the box

Figure 5 is repeated below.

Figure 5



0 2 . 5 At positions **A** and **E**, the athlete is standing still.

Why does the athlete have less energy in position **E** than in position **A**?

[1 mark]

Tick (✓) **one** box.

- Energy has been transferred from the athlete to the air. ☐
- The air temperature has decreased. ☐
- The height of the athlete above the water has increased. ☐

Do not write outside the box

0 2 . 6 Athletes have a large power output when they are far-leaping.

What is meant by the power of an athlete?

[1 mark]

Tick (✓) **one** box.

- The rate at which the athlete transfers energy. ☐
- The size of the maximum force exerted by the athlete. ☐
- The total energy transferred by the athlete. ☐

0 2 . 7 A second athlete crossed the same river by far-leaping.

The second athlete had less power than the first athlete when running between position **A** and position **B**.

Complete the sentences.

Choose answers from the box.

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

[2 marks]

less than	**the same as**	**more than**

Two factors that could explain why the second athlete had less power than the first athlete are:

1. The time taken by the second athlete to run between position **A** and position **B**

was _____ the first athlete.

2. The work done by the second athlete was _____

the first athlete.

12

Turn over ►

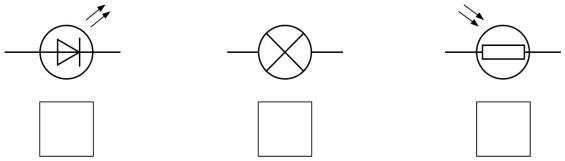
Do not write outside the box

0 3 A filament lamp breaks if the electric current in the filament becomes too big.

0 3 . 1 What is the correct symbol for a filament lamp?

[1 mark]

Tick (✓) **one** box.



☐ ☐ ☐

0 3 . 2 What is meant by an electric current?

[1 mark]

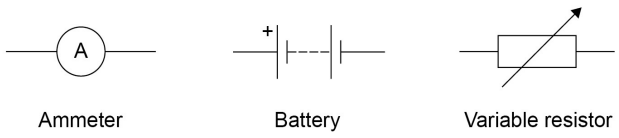
Tick (✓) **one** box.

- The energy carried by each unit of charge ☐
- The flow of electrical charge ☐
- The number of electrons in a circuit ☐
- The speed at which charge moves ☐

A manufacturer investigated the maximum current value of some filament lamps.

0 3 . 3 **Figure 6** shows the symbols for an ammeter, a battery and a variable resistor.

Figure 6



Ammeter Battery Variable resistor

The manufacturer connected an ammeter, battery, filament lamp and variable resistor in series.

Draw a circuit diagram to show the manufacturer's circuit.

Include the symbol for a filament lamp from Question **03.1**

[1 mark]

0 3 . 4 How could the manufacturer increase the current in the filament lamp?

[1 mark]

Tick (✓) **one** box.

Add an extra ammeter to the circuit. ☐

Decrease the resistance of the variable resistor. ☐

Use a battery with a smaller potential difference. ☐

Turn over ►

0 3 . 5 When the potential difference across a filament lamp was 0.75 V, the current in the filament lamp was 0.16 A.

Calculate the power of the filament lamp.

Use the equation:

power = potential difference × current

[2 marks]

Power = _____ W

0 3 . 6 Write down the equation which links charge flow (Q), current (I) and time (t).

[1 mark]

0 3 . 7 The manufacturer increased the current in the filament lamp to 200 mA.

Calculate the charge flow through the filament lamp in 15 s.

[3 marks]

Charge flow = _____ C

Do not write outside the box

0 3 . 8 The manufacturer increased the current in the filament lamp from 200 mA.

The filament in the lamp broke when the current reached 320 mA.

How many times greater than 200 mA was the current at which the filament broke?

[1 mark]

_____

_____

_____ times greater

0 3 . 9 The manufacturer tested lots of filament lamps.

The current at which the filament lamps broke was 320 ± 60 mA.

What is the range of currents at which the filament lamps broke?

[1 mark]

Tick (✓) **one** box.

60 mA to 320 mA ☐

260 mA to 320 mA ☐

320 mA to 380 mA ☐

260 mA to 380 mA ☐

Turn over for the next question

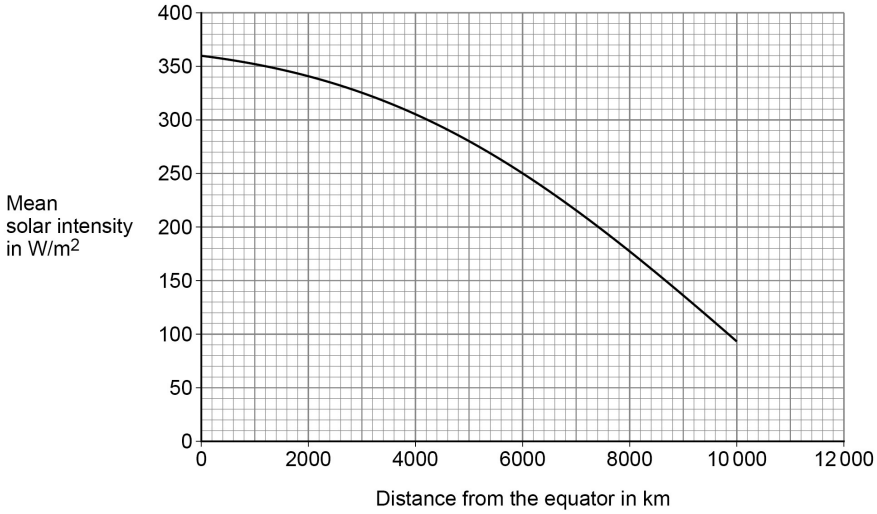
12

Do not write outside the box

0 4 Solar intensity is a measure of the radiation received from the Sun at the surface of the Earth.

Figure 7 shows how the mean solar intensity changes with the distance from the equator.

Figure 7



0 4 . 1 The city of Athens is 4200 km from the equator.

What is the mean solar intensity in Athens?

[1 mark]

Mean solar intensity = _____ W/m²

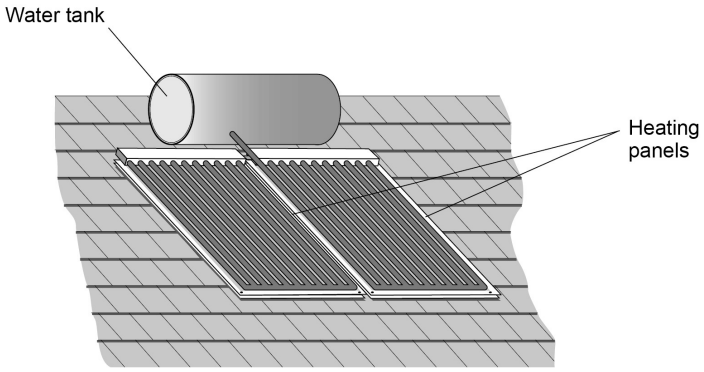
Do not write outside the box

Solar water heaters use radiation from the Sun to heat water.

The heated water is stored in a water tank.

Figure 8 shows a solar water heater on the roof of a building.

Figure 8



0 4 . 2 Cities closer to the equator have many more buildings with solar water heaters than cities further away from the equator.

Suggest why.

[1 mark]

0 4 . 3 The use of solar water heaters may reduce the need to burn fossil fuels.

Complete the sentence.

Choose the answer from the box.

[1 mark]

carbon dioxide	**nitrogen**	**oxygen**

Burning fossil fuels contributes to global warming because there is an increase in the amount of _____ in the atmosphere.

Turn over ►

Do not write outside the box

0 4 . 4 The efficiency of the solar water heater is 0.61

Calculate the useful power output when the total power input to the solar water heater is 1100 W.

Use the equation:

useful power output = efficiency × total power input

[2 marks]

Useful power output = _____ W

0 4 . 5 Different solar water heaters have different sized heating panels.

Suggest how the size of the heating panels affects the input power to a solar water heater.

[1 mark]

0 4 . 6 Water has a high specific heat capacity.

What is meant by the specific heat capacity of water?

[1 mark]

Tick (✓) **one** box.

- The energy required to change the state of 1 kg of water from liquid to gas. ☐
- The energy required to increase the temperature of 1 kg of water by 1 °C. ☐
- The power required to change the state of 1 kg of water from liquid to gas. ☐
- The power required to increase the temperature of 1 kg of water by 1 °C. ☐

Do not write outside the box

0 4 . 7 The water tank contained 80 kg of water.

The change in thermal energy of the water was 8 400 000 J.

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

Calculate the temperature change of the water.

Use the Physics Equations Sheet.

[3 marks]

Temperature change = _____ °C

0 4 . 8 The water tank is thermally insulated.

How does thermal insulation affect the rate of energy transfer from the water in the tank?

[1 mark]

Tick (✓) **one** box.

Thermal insulation decreases the rate of energy transfer. ☐

Thermal insulation does not change the rate of energy transfer. ☐

Thermal insulation increases the rate of energy transfer. ☐

Question 4 continues on the next page

Do not write outside the box

0 4 . 9 **Table 1** shows information about different materials.

Table 1

Material	Thermal conductivity in arbitrary units
A	3
B	2
C	8
D	4

Which material in **Table 1** is the best thermal insulator?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

12

Do not write outside the box

0 5 **Figure 9** shows a mobile phone with its battery removed.

Figure 9

A student measured the potential difference across the battery and then put the battery into the phone.

0 5 . 1 What is the equation linking current (I), potential difference (V) and resistance (R)?

[1 mark]

Tick (✓) **one** box.

$I = V R$ ☐

$R = I V$ ☐

$V = I R$ ☐

$V = I^2 R$ ☐

Question 5 continues on the next page

Turn over ►

Do not write outside the box

0 5 . 2 The current in the electronic circuit in the mobile phone was 0.12 A.

The potential difference across the battery was 3.9 V.

Calculate the resistance of the electronic circuit in the mobile phone.

[3 marks]

Resistance = _____ Ω

Do not write outside the box

0 5 . 3 Write down the equation which links energy (E), power (P) and time (t).

[1 mark]

0 5 . 4 The battery was fully charged when it was put into the mobile phone.

The battery discharged when the mobile phone was switched on.

The average power output of the battery as it discharged was 0.46 watts.

The time taken to fully discharge the battery was 2500 minutes.

Calculate the energy transferred by the battery.

[3 marks]

Energy transferred = _____ J

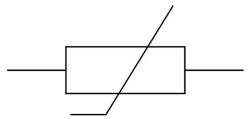
Question 5 continues on the next page

Do not write outside the box

The mobile phone includes a sensor to monitor the temperature of the battery.

Figure 10 shows the circuit symbol for a component used in the sensor.

Figure 10



0 5 . 5 What component does the circuit symbol shown in **Figure 10** represent?

[1 mark]

0 5 . 6 The temperature of the component in **Figure 10** increases.

The potential difference across the component remains constant.

Explain what happens to the current in the component.

[2 marks]

11

Do not write outside the box

0 6 A radioactive source emits alpha, beta and gamma radiation.

0 6 . 1 An alpha particle is the same as a helium nucleus.

How many times bigger is the radius of a helium atom than the radius of an alpha particle?

[1 mark]

Tick (✓) **one** box.

- Less than 100 times bigger ☐
- Exactly 5000 times bigger ☐
- More than 10 000 times bigger ☐

0 6 . 2 Alpha particles can ionise atoms in the air.

What happens to an atom when it is ionised by an alpha particle?

[2 marks]

Tick (✓) **two** boxes.

- A neutron in the atom becomes a proton. ☐
- The atom becomes a positive ion. ☐
- The atom gains a neutron. ☐
- The atom gains a proton. ☐
- The atom loses an electron. ☐

Question 6 continues on the next page

Do not write outside the box

0 6 . 3 A spark detector is a device that can be used to detect alpha radiation.

A spark detector works by alpha particles ionising atoms in the air near a wire mesh.

A large potential difference creates a spark when the air near the wire mesh is ionised.

Suggest why a spark detector **cannot** detect beta radiation.

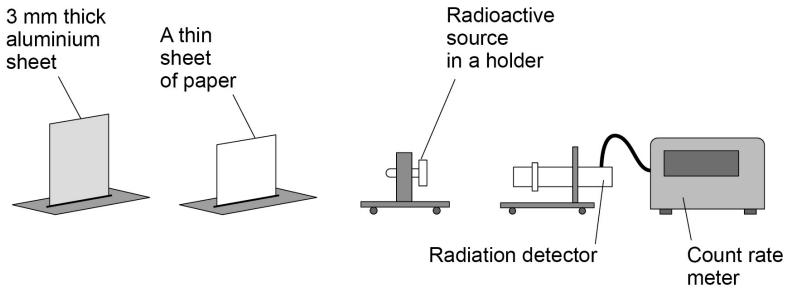
[1 mark]

Do not write outside the box

0 6 . 4 A teacher wants to demonstrate that the radioactive source emits alpha, beta and gamma radiation.

Figure 11 shows the equipment the teacher has.

Figure 11



Describe a method the teacher could use.

[6 marks]

10

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

AQA

GCSE
COMBINED SCIENCE: TRILOGY
8464/P/1F

Physics Paper 1F

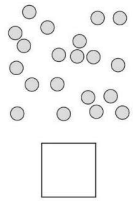
Mark scheme

June 2021

Version: 1.0 Final Mark Scheme

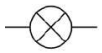
216G8464P1F/MS

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	the piece of limestone has an irregular shape		1	AO1 6.3.1.1 RPA17
01.2	**Level 2:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.		3–4	AO1 6.3.1.1 RPA17
	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 • add water to the displacement can until level with the spout • place the limestone in the water • avoid splashing water out of the displacement can • collect the displaced water in the beaker or measuring cylinder • measure the volume of the displaced water • using a measuring cylinder OR • use the large measuring cylinder • part fill the measuring cylinder water • measure the initial volume on the measuring cylinder • submerge the limestone in the water • measure the final volume on the measuring cylinder • volume of limestone = final volume − initial volume To access level 2 the answer must refer to submerging the limestone in water and using the measuring cylinder.			
01.3	density = $\frac{155}{62}$ density = 2.5 (g/cm^3)		2	AO2 6.3.1.1 RPA17

01.4	kg/m^3		1	AO1 6.3.1.1 RPA17
01.5	bar drawn to 2.4 g/cm^3		1	AO2 6.3.1.1 RPA17
01.6	obsidian		1	AO3 6.3.1.1 RPA17
01.7	other types of rock may have the same density as obsidian	allow not all rock types are plotted on the bar chart	1	AO3 6.3.1.1 RPA17
01.8	4th box ticked 		1	AO1 6.3.1.1
01.9	less than		1	AO3 6.3.1.1
Total			**13**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	kinetic chemical	answers must be in this order	1 1	AO1 6.1.1.1
02.2	gravitational potential energy increases		1	AO1 6.1.1.1
02.3	$E_p = 50 \times 9.8 \times 3.0$ $E_p = 1470$ (J)	 allow 1500 (J)	1 1	AO2 6.1.1.1 6.1.1.2
02.4	speed = $\sqrt{2 \times \frac{1600}{50}}$ speed = 8 m/s	allow 8.0	1 1 1	AO2 AO2 AO1 6.1.1.1 6.1.1.2
02.5	energy has been transferred from the athlete to the air		1	AO3 6.1.2.1
02.6	the rate at which the athlete transfers energy		1	AO1 6.1.1.4

02.7	more than less than	answers must be in this order	1 1	AO1 6.1.1.4
Total			**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1			1	AO1 6.2.1.1
03.2	the flow of electrical charge		1	AO1 6.2.1.2
03.3	all 4 components connected in a series circuit	allow a cell instead of a battery allow an LED or LDR symbol instead of a lamp ignore the + sign on the battery symbol	1	AO3 6.2.1.1 6.2.2
03.4	decrease the resistance of the variable resistor		1	AO1 6.2.1.3
03.5	P = 0.75 × 0.16 P = 0.12 (W)		1 1	AO2 6.2.4.1
03.6	charge flow = current × time Q = **I**t		1	AO1 6.2.1.2

03.7	200 mA = 0.2 A charge flow = 0.2 × 15 charge flow = 3.0 (C)	 allow a correct substitution using an incorrectly/not converted value for current allow a correct calculation using an incorrectly/not converted value for current	1 1 1	AO2 6.2.1.2
03.8	1.6		1	AO3 6.2.1.2
03.9	260 mA to 380 mA		1	AO2 6.2.1.2
Total			**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	300 (W/m^2)		1	AO2 6.1.3
04.2	(cities closer to the equator) receive a greater solar intensity	allow (cities closer to the equator) receive more radiation/energy ignore they get more sunshine ignore they are hotter	1	AO2 6.1.3
04.3	carbon dioxide		1	AO1 6.1.3
04.4	0.61 × 1100 671 (W)	 allow 670 (W)	1 1	AO2 6.1.2.2
04.5	larger heating panels have a greater input power	allow larger heating panels have a greater input energy (per second)	1	AO3 6.1.3
04.6	the energy required to increase the temperature of 1kg of water by 1 °C		1	AO1 6.1.1.3 6.3.2.2
04.7	8 400 000 = 80 × 4200 × Δθ $\Delta\theta = \frac{8400000}{80 \times 4200}$ Δθ = 25 (°C)		1 1 1	AO2 6.1.1.3 6.3.2.2

04.8	thermal insulation decreases the rate of energy transfer		1	AO1 6.1.2.1
04.9	B		1	AO2 6.1.2.1
Total			**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$V = I\ R$		1	AO1 6.2.1.3
05.2	3.9 = 0.12 × R $R = \frac{3.9}{0.12}$ R = 32.5 (Ω)	 allow R = 33 (Ω)	1 1 1	AO2 6.2.1.3
05.3	energy = power × time **or** E = P t		1	AO1 6.2.4.2
05.4	time = 150 000s energy = 0.46 × 150 000 energy = 69 000 (J)	 allow a substitution using an incorrectly/not converted value of time allow a correct calculation using an incorrectly/not converted value of time	1 1 1	AO2 6.2.4.2
05.5	thermistor		1	AO1 6.2.1.1
05.6	the current will increase (because) the resistance decreases		1 1	AO1 6.2.1.4
Total			**11**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	more than 10 000 times bigger		1	AO1 6.4.1.1
06.2	the atom becomes a positive ion the atom loses an electron		1 1	AO1 6.4.1.2
06.3	beta radiation is only weakly ionising		1	AO3 6.4.2.1

Question	Answers	Mark	AO / Spec. Ref.
06.4	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO3 6.4.2.1
	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 • move the detector very close to the source • record the count rate • position the paper between the source and the detector • record the new count rate • alpha radiation will not penetrate through paper • if the count rate with the paper is (significantly) less than without then the source emits alpha radiation • remove the paper and position the aluminium between the source and the detector • record the new count rate • (alpha and) beta radiation will not penetrate through the aluminium • if the count rate has (significantly) reduced compared with using paper then beta radiation is present • if radiation penetrates through the aluminium then gamma radiation is present • the experiment should be repeated and mean results calculated because radioactivity is a random process To access level 3, the candidate must use the paper sheet, the aluminium sheet and no sheet, and describe how the results would indicate the presence of alpha, beta or gamma radiation.		
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
COMBINED SCIENCE: TRILOGY

F

Foundation Tier
Physics Paper 1F

Time allowed: 1 hour 15 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.
- 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.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

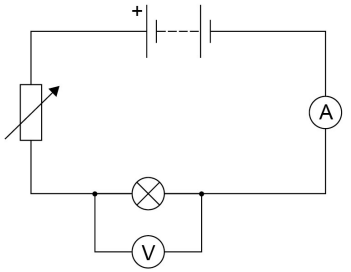
Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Do not write outside the box

0 1 A student investigated how the potential difference across a filament lamp affects the current in the lamp.

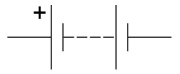
Figure 1 shows the circuit the student used.

Figure 1



0 1 . 1 **Figure 2** shows a circuit symbol.

Figure 2



What component does the symbol represent?

[1 mark]

Tick (✓) **one** box.

Ammeter ☐

Battery ☐

Lamp ☐

Variable resistor ☐

Do not write outside the box

0 1 . 2 Which component from **Figure 1** did the student use to adjust the potential difference across the lamp?

[1 mark]

_____

0 1 . 3 When the voltmeter was **not** connected to the circuit it gave a reading of 0.4 volts.

How can the student correct all the readings taken from the voltmeter?

[1 mark]

Tick (✓) **one** box.

Add 0.4 volts to each reading ☐

Divide each reading by 0.4 volts ☐

Multiply each reading by 0.4 volts ☐

Subtract 0.4 volts from each reading ☐

Question 1 continues on the next page

Do not write outside the box

0 1 . 4 The student recorded three values of current for each potential difference.

Table 1 shows the results for 2.5 volts.

Table 1

Potential difference in volts	Current in amps		
	1	2	3
2.5	0.54	0.58	0.53

Calculate the mean current in the lamp.

[2 marks]

_____

_____

_____

_____

Mean current = _____ A

0 1 . 5 Calculate the power of the lamp when the potential difference across the lamp was 4.8 V

The current in the lamp was 0.75 A

Use the equation:

power = potential difference × current

[2 marks]

_____

_____

_____

_____

Power = _____ W

Do not write outside the box

0 1 . 6 Calculate the resistance of the lamp when the potential difference across the lamp was 4.8 V

The current in the lamp was 0.75 A

Use the equation:

$$\text{resistance} = \frac{\text{potential difference}}{\text{current}}$$

[2 marks]

Resistance = _____ Ω

0 1 . 7 Complete the sentence.

Choose answers from the box.

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

[2 marks]

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

Increasing the current in a filament lamp makes the temperature

of the lamp _____ and the

resistance of the lamp _____ .

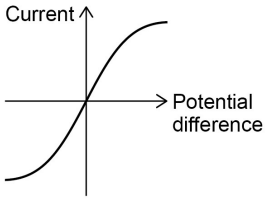
Question 1 continues on the next page

Do not write outside the box

0 1 . 8 Which graph shows the relationship between potential difference and current for a filament lamp?

[1 mark]

Tick (✓) **one** box.



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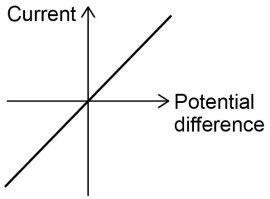

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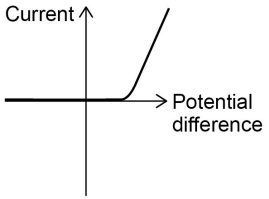


☐

12

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

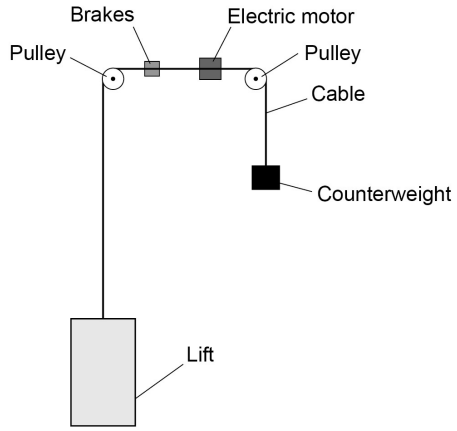
0 2 **Figure 3** shows a lift near the bottom of a building.

The lift is attached by a cable to a counterweight.

An electric motor moves the lift.

The lift is moving up.

Figure 3



0 2 . 1 As the lift moves up, how far does the counterweight move down?

[1 mark]

Tick (✓) **one** box.

A shorter distance than the lift. ☐

The same distance as the lift. ☐

A longer distance than the lift. ☐

Do not write outside the box

0 2 . 2 What happens to the gravitational potential energy of the counterweight as it moves down?

[1 mark]

Tick (✓) **one** box.

It decreases ☐

It stays the same ☐

It increases ☐

0 2 . 3 Calculate the change in gravitational potential energy of the lift when it moves up 4.0 m

The mass of the lift is 1300 kg

gravitational field strength = 9.8 N/kg

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

[2 marks]

Change in gravitational potential energy = _____ J

Question 2 continues on the next page

Do not write outside the box

0 2 . 4 Complete the sentences.

Choose answers from the box.

[2 marks]

chemical	**elastic potential**	**gravitational potential**
internal		**kinetic**

Friction between the brakes and the cable causes the speed of the lift to decrease.

As the speed decreases, there is a decrease in the _____ energy of the lift.

As the speed decreases, there is an increase in the _____ energy of the brakes.

0 2 . 5 The motor transfers different amounts of energy each time people use the lift.

Which factors affect the amount of energy transferred by the motor as the lift moves?

[2 marks]

Tick (✓) **two** boxes.

The distance moved by the lift ☐

The height of the building ☐

The length of the steel cable ☐

The maximum power of the motor ☐

The weight of the people in the lift ☐

Do not write outside the box

0 2 . 6 The weight of the lift and the counterweight stretch the cable by 0.015 m

The cable acts like a spring with a spring constant of 880 000 N/m

Calculate the elastic potential energy of the stretched cable.

Use the equation:

$$\text{elastic potential energy} = 0.5 \times \text{spring constant} \times (\text{extension})^2$$

[2 marks]

Elastic potential energy = _____ J

0 2 . 7 A lift system using a counterweight is more efficient than a lift system that does not use a counterweight.

How does having a more efficient system affect the energy transferred by the motor?

[1 mark]

Tick (✓) **one** box.

- Less energy is transferred. ☐
- The same amount of energy is transferred. ☐
- More energy is transferred. ☐

11

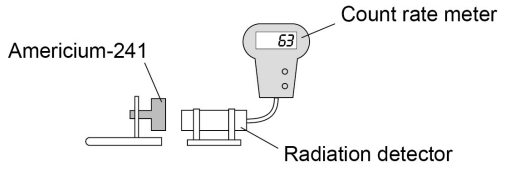
Turn over for the next question

Do not write outside the box

0 3 A teacher demonstrated that the radioactive isotope americium-241 emits alpha particles.

Figure 4 shows the equipment used.

Figure 4



0 3 . 1 An americium-241 nucleus (Am) emits an alpha particle and turns into a neptunium nucleus (Np).

Which is the correct nuclear equation for this decay?

Tick (✓) **one** box.

[1 mark]

- $^{241}_{95}\text{Am} \longrightarrow {}^{237}_{93}\text{Np} + {}^{4}_{2}\text{He}$ ☐
- $^{241}_{95}\text{Am} \longrightarrow {}^{245}_{93}\text{Np} + {}^{4}_{2}\text{He}$ ☐
- $^{241}_{95}\text{Am} \longrightarrow {}^{237}_{97}\text{Np} + {}^{4}_{2}\text{He}$ ☐

0 3 . 2 What is the furthest distance that alpha radiation can travel in air?

Tick (✓) **one** box.

[1 mark]

- A few millimetres ☐
- A few centimetres ☐
- A few metres ☐

Do not write outside the box

0 3 . 3 The teacher placed a piece of paper between the americium-241 and the radiation detector.

The reading on the count rate meter decreased by a large amount.

Why does the decreased reading show that americium-241 emits alpha radiation?

Tick (✓) **one** box.

[1 mark]

Paper stops alpha radiation. ☐

Paper stops all types of radiation. ☐

Paper stops beta and gamma radiation. ☐

The teacher replaced the americium-241 with a source of beta radiation.

0 3 . 4 Which symbol represents a beta particle?

[1 mark]

Tick (✓) **one** box.

$^{0}_{-1}e$ ☐

$^{0}_{0}e$ ☐

$^{-1}_{-1}e$ ☐

$^{-1}_{0}e$ ☐

Question 3 continues on the next page

Do not write outside the box

0 3 . 5 The count rate from the source was 119 ± 7 counts per second.

Calculate the smallest count rate this could have been.

[1 mark]

Smallest count rate = _____ counts per second

A teacher investigated how the distance between a different radioactive source and the detector affects the count rate.

0 3 . 6 Draw **one** line from each type of variable to the description.

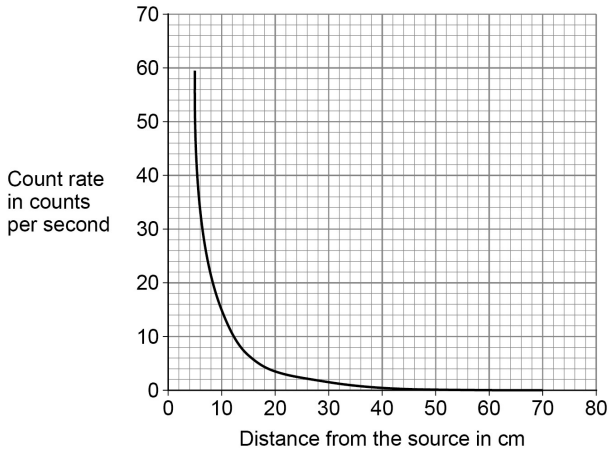
[3 marks]

Type of variable	Description
Control variable	Count rate
Dependent variable	Distance between the source and detector
Independent variable	Radioactive source
	Time

Do not write outside the box

0 3 . 7 **Figure 5** shows how the count rate from the different radioactive source changed with the distance from the source.

Figure 5



Describe the relationship between the distance from the source and the count rate.

[2 marks]

10

Turn over for the next question

Do not write outside the box

0 4 **Figure 6** shows a swimmer wearing a wetsuit.

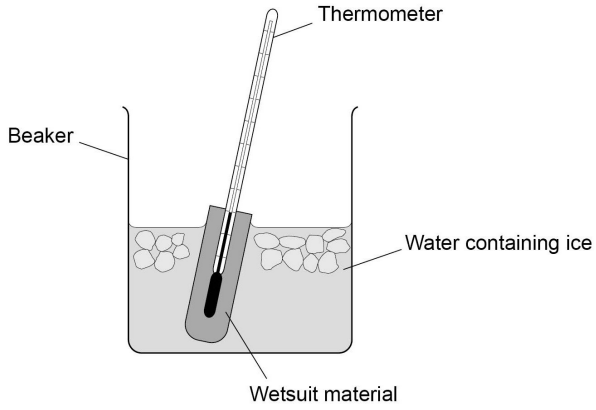
The wetsuit helps to keep the swimmer warm.

Figure 6

A student wrapped a thermometer in a piece of wetsuit material and placed the thermometer in water containing ice.

Figure 7 shows the apparatus.

Figure 7



Do not write outside the box

0 4 . 1 After 30 seconds in the water the temperature of the thermometer had decreased by 7.5 °C

Calculate the average decrease in temperature each second.

[2 marks]

Average decrease in temperature each second = _____ °C

Question 4 continues on the next page

Do not write outside the box

The student recorded the temperature of the thermometer after 30 seconds for four materials. Each piece of material was the same size and thickness.

In each test the starting temperature of the thermometer was 21.0 °C

Table 2 shows the results.

Table 2

Material	W	X	Y	Z
Temperature in °C	13.5	8.0	16.0	12.0

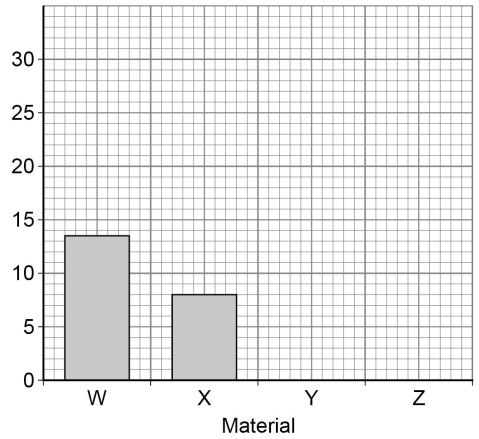
0 4 . 2 Complete **Figure 8** using the data in **Table 2.**

You should:

- label the *y*-axis
- draw the bars for materials Y and Z.

[2 marks]

Figure 8



Do not write outside the box

0 4 . 3 Which material is the best thermal insulator?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

W ☐ **X** ☐ **Y** ☐ **Z** ☐

Reason _____

_____

0 4 . 4 The student tested a new material with a greater thermal conductivity than material Z.

The piece of new material was the same size and thickness as the piece of material Z.

What was the temperature of the thermometer after 30 seconds?

[1 mark]

Tick (✓) **one** box.

Less than 12.0 °C ☐

Exactly 12.0 °C ☐

Greater than 12.0 °C ☐

Question 4 continues on the next page

Do not write outside the box

0 4 . 5 During the investigation 0.0150 kg of the ice melted. The temperature of the water and ice did not change.

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

Calculate the energy needed to melt the ice.

Use the equation:

energy to melt the ice = mass × specific latent heat

[2 marks]

_____

_____

_____

_____

Energy needed to melt the ice = _____ J

The student wanted to determine the density of a wetsuit material.

The student measured the length of one side of a cube of wetsuit material with:

- a micrometer
- a ruler.

Table 3 shows the results.

Table 3

Equipment	Length in cm		
	Measurement 1	**Measurement 2**	**Measurement 3**
Micrometer	0.581	0.557	0.576
Ruler	0.6	0.6	0.6

Do not write outside the box

0 4 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

calibration	**precision**	**reproducibility**	**resolution**

The results show that compared to the ruler the micrometer has a higher

_____ .

Use the Physics Equations Sheet to answer questions **04.7** and **04.8**.

0 4 . 7 Write down the equation that links density (ρ), mass (m) and volume (V).

[1 mark]

_____

_____

0 4 . 8 The student calculated the volume of the cube of wetsuit material to be 0.186 cm^3

The density of the cube was 0.300 g/cm^3

Calculate the mass of the cube.

Give your answer in grams.

[3 marks]

_____

_____

_____

_____

_____

_____

Mass = _____ g

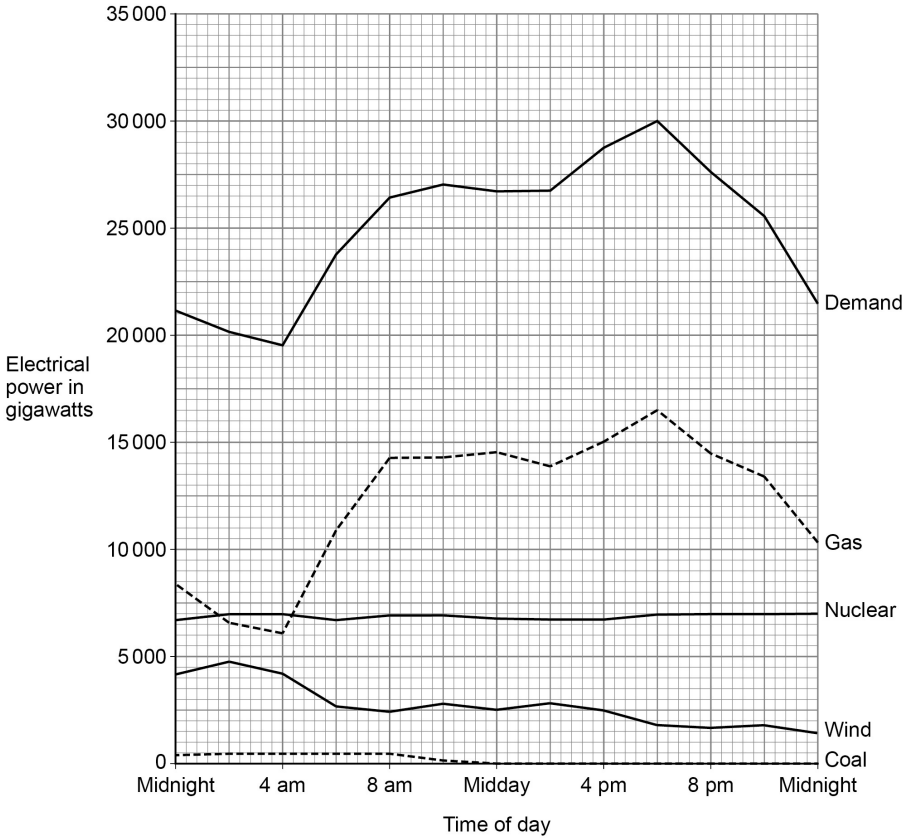
14

Turn over ►

Do not write outside the box

0 5 **Figure 9** shows some of the energy resources used to meet the demand for electrical power in the UK on one day in 2020.

Figure 9



Do not write outside the box

0 5 . 1 The maximum demand for electrical power on that day was at 6 pm.

Determine the percentage of the maximum demand for electrical power that was generated using gas.

[3 marks]

Percentage = _____ %

0 5 . 2 The UK government wants to reduce carbon emissions as much as possible.

Which energy resources need to be used less to achieve this?

[1 mark]

Tick (✓) **one** box.

- Coal and gas ☐
- Gas and nuclear ☐
- Wind and coal ☐
- Wind and nuclear ☐

Question 5 continues on the next page

Do not write outside the box

A network of transformers and transmission cables transfers electrical power from power stations to consumers.

0 5 . 3 What is this network called?

[1 mark]

0 5 . 4 Explain how using step-up transformers makes the network efficient.

[3 marks]

8

Do not write outside the box

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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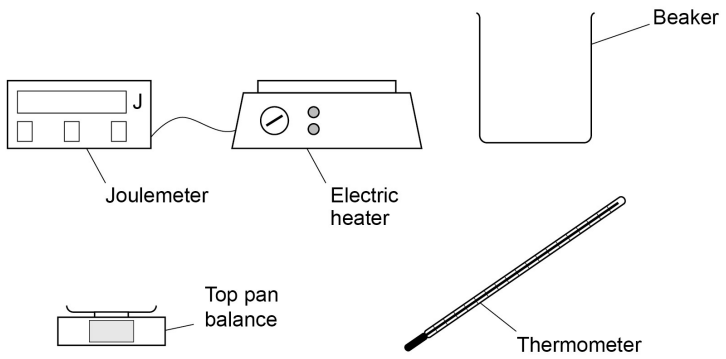
0 6 A student made measurements to determine the specific heat capacity of vegetable oil.

Figure 10 shows the equipment used.

Figure 10



0 6 . 1 Describe how the student could use the equipment shown in **Figure 10** to determine the specific heat capacity of vegetable oil.

[6 marks]

Do not write outside the box

0 6 . 2 Give **one** risk when using the equipment in **Figure 10**.

[1 mark]

A different student did not have a joulemeter and calculated the energy transferred by the electric heater.

Use the Physics Equations Sheet to answer questions **06.3** and **06.4**.

0 6 . 3 Write down the equation linking energy transferred (*E*), power (*P*) and time (*t*).

[1 mark]

0 6 . 4 The electric heater had a power output of 50 watts.

Calculate the time taken for the electric element to transfer 4750 joules of energy to the vegetable oil.

[3 marks]

Time taken = _____ s

Question 6 continues on the next page

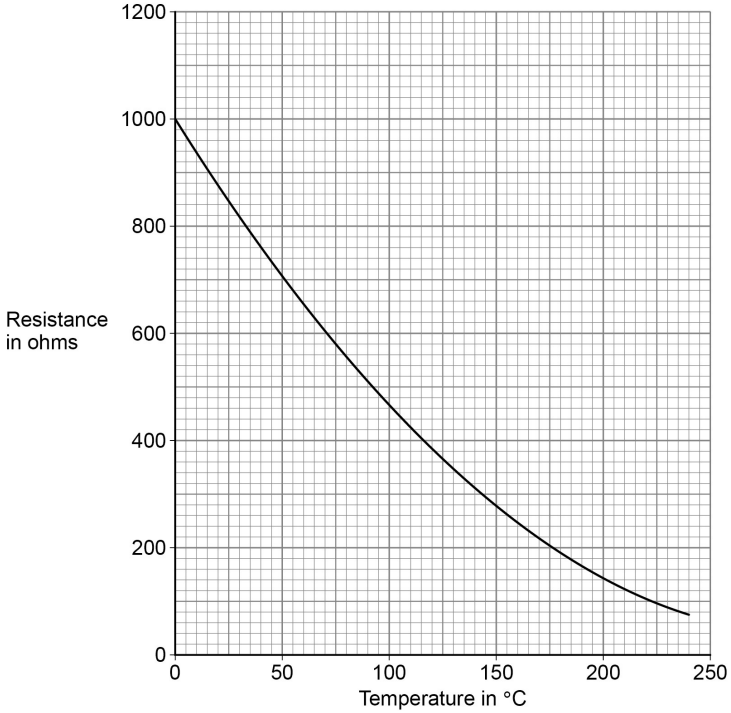
Do not write outside the box

In a deep fryer, vegetable oil is heated by an electric heating element. Food is then cooked in the hot vegetable oil.

The deep fryer contains an electrical component to monitor the temperature of the vegetable oil.

Figure 11 shows how the resistance of this electrical component changes with temperature.

Figure 11



0 6 . 5 What electrical component is used to monitor the temperature of the vegetable oil?

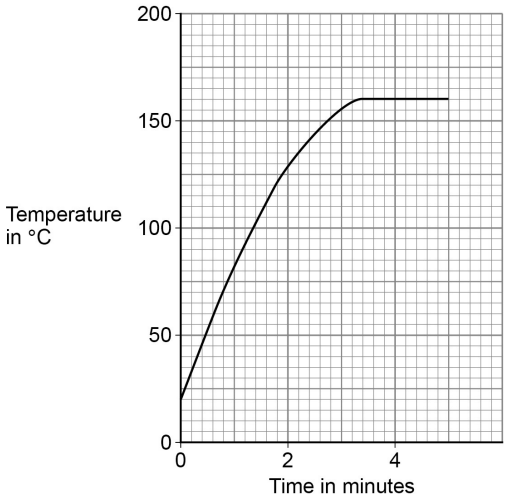
[1 mark]

Do not write outside the box

0 6 . 6 The electric heating element in the deep fryer automatically switches off when the vegetable oil reaches a certain temperature.

Figure 12 shows how the temperature of the vegetable oil changed after the deep fryer was switched on.

Figure 12



Determine the resistance of the electrical component when the electric heating element automatically switched off.

Use **Figure 11** and **Figure 12.**

[2 marks]

Resistance = _____ Ω

Question 6 continues on the next page

Turn over ►

Do not write outside the box

0 6 . 7 Some chips were put in the deep fryer.

In the deep fryer, water in the chips underwent a physical change and became steam.

Why is this a physical change?

[1 mark]

Tick (✓) **one** box.

All water can change to steam. ☐

No chemicals are involved when water changes to steam. ☐

The change from water to steam can be detected visually. ☐

The water will recover its original properties if the steam is cooled. ☐

15

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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Do not write outside the box

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AQA

GCSE
COMBINED SCIENCE: TRILOGY
8464/P/1F

Physics Paper 1F

Mark scheme

June 2022

Version: 1.0 Final Mark Scheme

226G8464P1F/MS

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	battery		1	AO1 6.2.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	variable resistor	allow resistor allow battery / cells allow correct circuit symbol	1	AO1 6.2.2

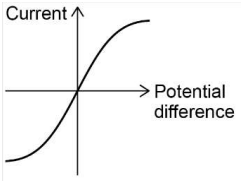
Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	subtract 0.4 volts from each reading		1	AO1 6.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	mean = $\frac{0.54+0.58+0.53}{3}$ mean = 0.55 (A)	allow mean = $\frac{1.65}{3}$	1 1	AO2 6.2.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	$P = 4.8 \times 0.75$ $P = 3.6$ (W)		1 1	AO2 6.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	$R = \frac{4.8}{0.75}$ $R = 6.4$ (Ω)		1 1	AO2 6.2.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	increase increase		1 1	AO1 6.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.8			1	AO1 6.2.1.4

Total Question 1		12

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	the same distance as the lift		1	AO2 6.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	it decreases		1	AO2 6.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	$E = 1300 \times 9.8 \times 4.0$ $E = 50960$ (J)	 allow 51000 (J)	1 1	AO2 6.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	 kinetic internal	this order only	 1 1	AO1 6.1.1.1 6.3.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	the distance moved by the lift the weight of the people in the lift		1 1	AO2 6.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2.6	$E_e = 0.5 \times 880\,000 \times 0.015^2$ $E_e = 99$ (J)		1 1	AO2 6.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2.7	less energy is transferred		1	AO1 6.1.2.2

Total Question 2		11

Question 3

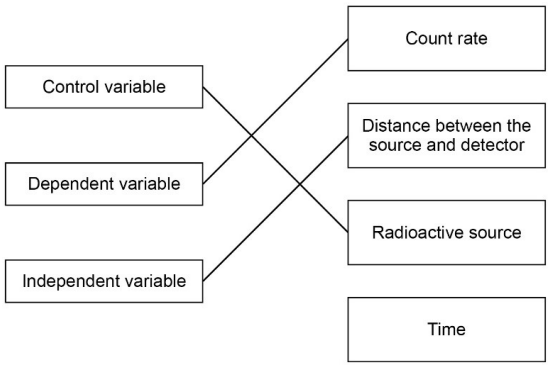
Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	$^{241}_{95}Am \longrightarrow {}^{237}_{93}Np + {}^{4}_{2}He$	first box ticked	1	AO2 6.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	a few centimetres		1	AO1 6.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	paper stops alpha radiation		1	AO1 6.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	$^{0}_{-1}e$		1	AO1 6.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	112		1	AO2 6.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	 do **not** accept more than one line from a box on the left		1 1 1	AO3 6.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	as distance increases the count rate decreases (between 40 cm and 50 cm) the count rate becomes zero		1 1	AO3 6.4.2.1

Total Question 3		10

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	$\Delta\theta = \frac{7.5}{30}$ $\Delta\theta$ = 0.25 (°C)		1 1	AO2 6.1.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	bar Y drawn to 16 **and** bar Z drawn to 12 *y*-axis labelled 'temperature in °C'	allow ± half a small square unit must be present	1 1	AO2 6.1.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	Y because it showed the smallest change in temperature	 reason only scores if Y is chosen	1 1	AO3 6.1.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	less than 12.0 °C		1	AO3 6.1.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	$E = 0.0150 \times 334\,000$ $E = 5010$ (J)		1 1	AO2 6.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	resolution		1	AO3 6.3.1.1 RPA17

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	density $= \frac{\text{mass}}{\text{volume}}$ **or** $\rho = \frac{m}{V}$		1	AO1 6.3.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.8	$0.300 = \frac{m}{0.186}$ $m = 0.300 \times 0.186$ $m = 0.0558$ (g)		1 1 1	AO2 6.3.1.1

Total Question 4		**14**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	16 500(GW) **and** 30 000 (GW) read from graph percentage $= \frac{16500}{30000}$ (×100%) percentage = 55 (%)	 allow a correct substitution using a value of 15300 or 18000 for gas allow an answer consistent with a value of 15300 or 18000 for gas	1 1 1	AO3 6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	coal and gas		1	AO1.1 6.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	the national grid		1	AO1 6.2.4.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	potential difference increases current is reduced so there is less / low energy loss (to the surroundings)	allow large potential difference allow small current allow less / low heating in the transmission cables ignore resistance do **not** allow no energy loss	1 1 1	AO1 6.2.4.3

Total Question 5		8

Question 6

Question	Answers	Mark	AO / Spec. Ref.
06.1	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 6.1.1.3 6.3.2.2 RPA14
	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 mass of oil using the top pan balance • measure start temperature of oil using the thermometer • place beaker of oil on heater • switch on heater to heat oil • measure final temperature of oil using the thermometer • measure energy transferred using joulemeter • calculate increase in temperature ($\Delta\theta$) • use the equation $E = mc\Delta\theta$ to determine c		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	burns / scalds	allow cuts from broken glass ignore the heater / oil is hot	1	AO1 6.1.1.3 RPA14

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	power = $\frac{\text{energy transferred}}{\text{time}}$ **or** $P = \frac{E}{t}$		1	AO1 6.1.1.4 6.2.4.2 RPA14

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	$50 = \frac{4750}{t}$ **or** $4750 = 50 \times t$ $t = \frac{4750}{50}$ t = 95 (s)		1 1 1	AO2 6.1.1.4 6.2.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	thermistor		1	AO1 6.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	250 (Ω)	allow an answer in the range 240 (Ω) to 260 (Ω) allow **1** mark for temperature = 160 (°C)	2	AO3 6.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7	the water will recover its original properties if the steam is cooled		1	AO1 6.3.1.2

Total Question 6		**15**