2024

Name_____

Combined Science

Higher

Physics: Paper 1

Physics Equations Sheet

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

FOR USE IN JUNE 2024 ONLY

HT = Higher Tier only equations

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

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

AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Physics Paper 1H

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.

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.

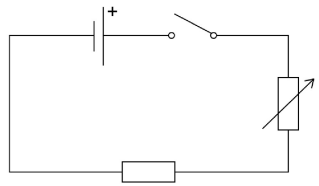
For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

Do not write outside the box

0 1 A student investigated how the current in a resistor varies with the potential difference across the resistor.

Figure 1 shows part of the circuit used.

Figure 1



0 1 . 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 1 . 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 1 . 3 How should the student change the circuit to give negative values for current and potential difference?

[1 mark]

0 1 . 4 Name the type of relationship between current and potential difference for a resistor at constant temperature.

[1 mark]

0 1 . 5 Write the equation which links current, potential difference and resistance.

[1 mark]

0 1 . 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

Turn over ►

Do not write outside the box

0 2 A scientist cooled the air inside a container.

0 2 . 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 2 . 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 2 . 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 2 continues on the next page

Do not write outside the box

0 2 . 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

Do not write outside the box

0 3 A hybrid car has an electric motor and a petrol engine.

0 3 . 1 Petrol is a non-renewable energy resource.

What is meant by a non-renewable energy resource?

[1 mark]

0 3 . 2 The electric motor in the car is powered by a battery.

To charge the battery, the car is plugged into the mains supply at 230 V

The power used to charge the battery is 6.9 kW

Calculate the current used to charge the battery.

[4 marks]

Current = _____ A

0 3 . 3 Mains electricity is an ac supply.

Explain the difference between direct and alternating potential difference.

[2 marks]

Turn over ►

Do not write outside the box

0 3 . 4 The cable used to connect the car to the mains electricity supply has a low resistance.

Explain why it is better to use a cable with a low resistance than to use a cable with a high resistance.

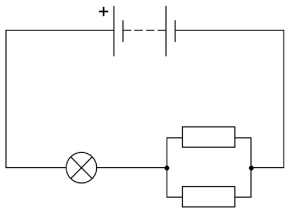
[2 marks]

9

Do not write outside the box

0 4 **Figure 2** shows a circuit that a student built.

Figure 2



0 4 . 1 The lamp has a resistance of 10 Ω

Each resistor has a resistance of 10 Ω

What is the total resistance of the circuit?

[1 mark]

Tick (✓) **one** box.

Between 20 and 30 Ω ☐

Exactly 20 Ω ☐

Exactly 30 Ω ☐

Less than 20 Ω ☐

0 4 . 2 Explain your answer to Question **04.1**

[2 marks]

Do not write outside the box

The student replaced one of the resistors with a thermistor.

0 4 . 3 Draw the circuit symbol for a thermistor in the box below.

[1 mark]

0 4 . 4 The student increased the temperature of the thermistor.

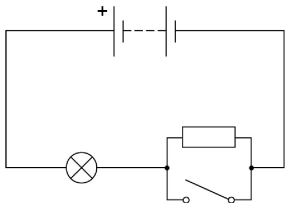
Explain how the current in the thermistor changed.

[2 marks]

Do not write outside the box

0 4 . 5 **Figure 3** shows another circuit the student built.

Figure 3



Explain how the potential difference across the resistor and the lamp will change when the switch is closed.

[4 marks]

The resistor _____

_____

_____

_____

The lamp _____

_____

_____

_____

10

Turn over for the next question

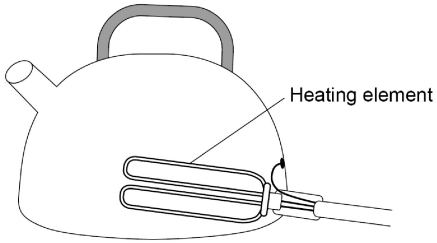
Do not write outside the box

0 5 A student investigated how the mass of water in an electric kettle affected the time taken for the water to reach boiling point.

The kettle switched off when the water reached boiling point.

Figure 4 shows the kettle.

Figure 4



0 5 . 1 The heating element of the kettle was connected to the mains supply.

Explain why the temperature of the heating element increased.

[2 marks]

_____

_____

_____

_____

_____

_____

0 5 . 2 Give **one** variable that the student should have controlled.

[1 mark]

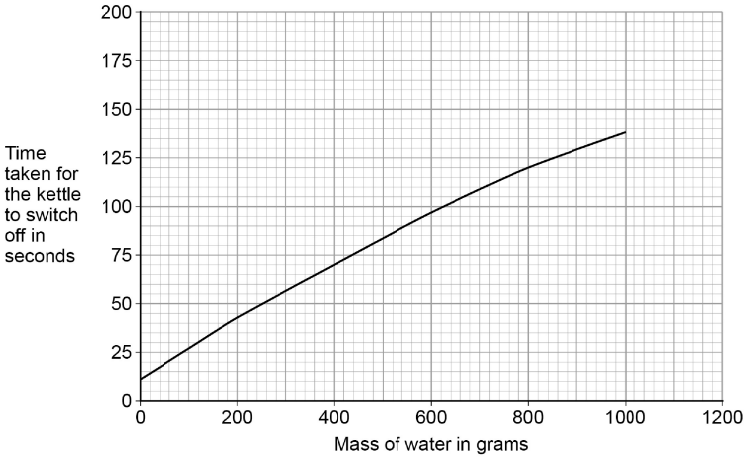
_____

_____

Do not write outside the box

Figure 5 shows how the mass of water in the kettle affected the time taken for the kettle to switch off.

Figure 5



0 5 . 3 Suggest why the line on **Figure 5** does **not** go through the origin.

[1 mark]

0 5 . 4 Suggest why the results give a non-linear pattern.

[1 mark]

Question 5 continues on the next page

Do not write outside the box

0 5 . 5 The power of the kettle was 2.6 kW

The kettle took 120 seconds to heat 0.80 kg of water from 18 °C to 100 °C

Calculate the specific heat capacity of water using this information.

Give your answer to 2 significant figures.

[6 marks]

Specific heat capacity = _____ J/kg °C

11

Do not write outside the box

0 6 Lanthanum-140 is a radioactive isotope.

0 6 . 1 A nucleus of lanthanum-140 emits gamma radiation.

What happens to the mass number and the charge of the nucleus when gamma radiation is emitted?

[1 mark]

Tick (✓) **one** box.

Mass number	Charge	
Decreases	Decreases	☐
Decreases	Stays the same	☐
Stays the same	Decreases	☐
Stays the same	Stays the same	☐

0 6 . 2 Why is it difficult to detect gamma radiation?

[1 mark]

Question 6 continues on the next page

Do not write outside the box

0 6 . 3 Activity is the rate at which a radioactive source decays.

A teacher measured the count-rate from a sample of lanthanum-140 using a Geiger-Muller (G-M) tube.

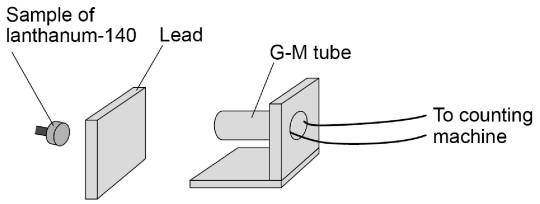
Explain why the count rate was less than the activity of the sample of lanthanum-140

[2 marks]

The teacher investigated how the thickness of lead affected the amount of gamma radiation that could pass through it.

Figure 6 shows the apparatus.

Figure 6



0 6 . 4 Explain why the teacher stood as far away from the apparatus as possible.

[2 marks]

Table 1 shows the results.

Table 1

Thickness of lead in cm	Count rate in counts per second
0.5	110
1.0	60
1.5	33
2.0	18
2.5	10

0 6 . 5 The teacher concluded that the count rate was **not** inversely proportional to the thickness of lead.

Explain why the teacher was correct.

Use the data in **Table 1**.

[3 marks]

0 6 . 6 Lanthanum-140 can also emit beta radiation and change into cerium.

Complete the equation showing the decay of lanthanum (La) 140 into cerium (Ce).

[2 marks]

$$^{140}_{57}\text{La} \longrightarrow \ ^{\ \ }_{\ \ }\text{e} + \ ^{\ \ }_{\ \ }\text{Ce}$$

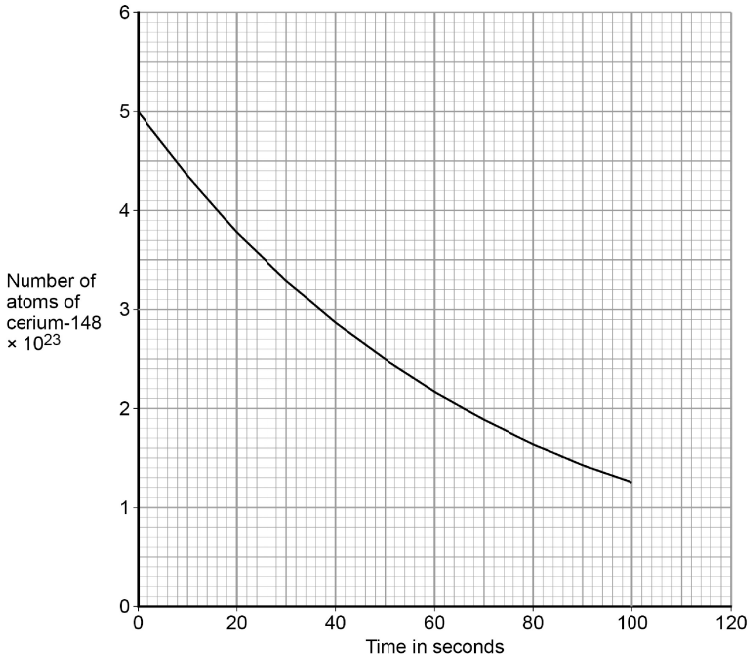
There are other isotopes of cerium which are radioactive.

Different isotopes of cerium have different half-lives.

The half-life of an isotope can be found by studying how the number of atoms changes over time.

Figure 7 shows how the number of atoms of cerium-148 in a 120 g sample changes over time.

Figure 7



Do not write outside the box

0 6 . 7 Determine the ratio of the number of cerium atoms in the sample when it was 100 seconds old compared with when the sample was 350 seconds old.

Use data from **Figure 7**.

[4 marks]

Ratio = _____

0 6 . 8 Determine the activity of the sample of cerium when the sample was 20 seconds old.

Use **Figure 7**.

[3 marks]

Activity = _____ Bq

18

END OF QUESTIONS

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

GCSE
COMBINED SCIENCE: TRILOGY
8464/P/1H

Physics Paper 1H

Mark scheme

June 2019

Version: 1.0 Final

I96G8464pIh/MS

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.1	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
01.2	current decreased	ignore slows down	1	AO1/1 6.2.1.3 RP 16 WS 3.6	E
01.3	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
01.4	(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
01.5	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
01.6	 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
02.1	pressure decreased		1	AO2.1	E
	because molecules have less (kinetic) energy	allow less speed/velocity	1	6.3.3.1	
	so fewer collisions (with the wall/container each second)	allow collide with less force allow less force on the walls	1		
02.2		an answer of 0.0021(212121…) scores **3** marks		AO2.1 6.3.2.2 6.1.1.3	E
	0.70 = m × 330 **or** 700 = m × 330 000		1		
	$m = \frac{0.70}{330}$ **or** $m = \frac{700}{330\,000}$	allow correct rearrangement using converted value(s) of E to J and/or L to J/kg	1		
	m = 0.0021 (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		
02.3			2	AO3/2b 6.3.1.1	E

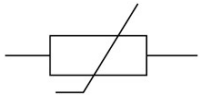
Substance	Solid	Liquid	Gas
Oxygen		✓	
Nitrogen			✓
Carbon dioxide	✓		

2 correct answers scores **1** mark.
if more than one tick in a row, neither tick can score a mark

02.4	**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**

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	an energy resource that cannot be replenished as it is used	allow an energy resource that will run out ignore cannot be re-used	1	AO1.1 AO1 in isolation 6.1.3	E
03.2		an answer of 30 (A) scores **4** marks		AO2.1 6.2.4.1	E
	6.9 k(W) = 6900 (W)		1		
	6900 = 230 × I	allow correct substitution of an incorrectly/not converted value for power	1		
	$I = \frac{6900}{230}$	allow a correct transformation using an incorrectly/not converted value for power	1		
	I = 30 (A)	allow a correct calculation using an incorrectly/not converted value for power	1		
03.3	direct potential difference is always in the same direction	allow direct current is always in the same direction	1	AO1.1 6.2.3.1	E
	alternating potential difference changes direction	allow alternating current changes direction	1		
03.4	lower potential difference across the cable	allow lower power/energy dissipation	1	AO1.1 6.1.2.2 6.2.4.1	E
	it is more efficient	allow it won't get as hot	1		
	OR (lower resistance gives) a greater current (for the same potential difference) (1) so the car battery can charge faster (1)				
Total			**9**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1	less than 20 Ω		1	AO2/1 6.2.2	A
04.2	the resistance of the lamp is added to the total resistance of the resistors in parallel	allow resistors in series add up	1	AO3/1a 6.2.2	E
	the resistors in parallel have a total resistance of less than 10 ohms	allow resistors in parallel have a smaller resistance than the lowest value resistor	1		E
04.3			1	AO1.1 AO1 in isolation 6.2.1.1	E
04.4	the current increased		1	AO1.1 AO1 in isolation 6.2.1.4 6.2.1.3	E
	(because) the resistance (of the thermistor) decreased	allow because the resistance of the circuit decreased	1		

04.5	**the resistor** the potential difference across the resistor becomes 0V because there is a short circuit across the resistor	 allow because there is no current in the resistor allow switch has no resistance If neither of the first two marking points awarded, allow **1** mark for p.d. decreases because there is less current in the resistor **or** p.d. decreases because components in parallel have less resistance **or** p.d. decreases because there is an alternative route for the current	 1 1	AO2.2 6.2.2 6.2.1.1 6.2.1.3 WS 3.6	E
	the lamp the potential difference across the lamp increases because the current increases	 allow the potential difference across the lamp will be the same as the battery allow because the resistance of the circuit decreases allow because there is less p.d. across the resistor	 1 1		
Total			**10**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	electrons collide with particles in the heating element which increases the (kinetic) energy of the particles (in the heating element)	allow there is a current in the heating element allow internal store of energy increases allow the particles (in the heating element) vibrate more rapidly	1 1	AO1.1 6.2.4.2 6.3.2.1 WS 1.2	E
05.2	the starting temperature of the water	allow the starting temperature of the kettle	1	AO3.3a 6.2.4.2 WS 2.2	E
05.3	(the heating element of) the kettle took time to heat up		1	AO3.1a 6.2.4.2 WS 3.7	E
05.4	the (rate of) energy transfer (per kg of water) to the surroundings decreases as the mass of water increases **or** the efficiency of the kettle increases as the mass of water increases	allow the (rate of) energy transfer (per kg of water) to the surroundings changes as the mass of water changes allow the efficiency of the kettle changes as the mass of water changes	1	AO3.1b 6.2.4.2 WS 3.7	E

05.5		an answer of 4800 (J/kg °C) scores **6** marks a correct answer given to more than 2 s.f. scores **5** marks		AO2.1 6.3.2.2 6.1.1.3 6.1.1.4 WS 3.3	E
	E = 2600 × 120	allow a correct substitution of an incorrectly/not converted value of P and/or t.	1		
	E = 312 000 (J)	this answer only the equation E=Pt must have been used to score subsequent marks.	1		
	312 000 = 0.80 × c × (100-18) **or** 312 000 = 0.80 × c × (82)	allow use of their value of E calculated using E =Pt for this and subsequent steps	1		
	$c = \frac{312\,000}{0.80 \times 82}$		1		
	c = 4 756		1		
	c = 4 800 (J/kg °C) (2 s.f.)	this mark can only be scored for a correct rounding of a value of c calculated using correct equations	1		

Total			**11**

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	mass number stays the same, charge stays the same		1	AO1.1 6.4.2.2	A
06.2	gamma radiation is only weakly ionising **or** most gamma radiation will pass through any detector	 allow gamma radiation is very penetrating	1	AO1.1 6.4.2.1	E
06.3	any two from • the radiation spreads out in all directions • only some of the radiation goes into the G-M tube • only some of the radiation passing into the GM tube is detected	allow **2** marks for only some of the radiation passing into the GM tube is detected because gamma is weakly ionising	2	AO1.1 6.4.2.4	E
06.4	to reduce the amount of radiation received because radiation increases the risk of cancer or (genetic) mutation	allow to reduce irradiation (of the teacher) allow causes cancer or (genetic) mutation ignore references to contamination	1 1	AO1.1 6.4.2.1 WS 1.4	E

06.5	a calculation of the product of thickness and count rate a second calculation of the product of thickness and count rate a comparison of the calculated values and a recognition that they are different **OR** A calculation of half the count rate (1) A comparison with the count rate for double that thickness (1) A recognition that the values are different (1)	examples of calculations 0.5 × 110 = 55 1.0 × 60 = 60 1.5 × 33 = 50 2.0 × 18 = 36 2.5 × 10 = 25 e.g. $\frac{110}{2}$ = 55 the first two marks may be scored for a count rate divided by 3, 4 or 5 compared with the corresponding count rate for 3, 4 or 5 times the thickness e.g. 55 ≠ 60	1 1 1	AO3.1b 6.4.2.1	E
06.6	$^{140}_{57}La \longrightarrow {}^{0}_{-1}e + {}^{140}_{58}Ce$	allow **1** mark for correct numbers on electron allow **1** mark for correct numbers on Ce	2	AO1.1 AO1 in isolation AO1.2 6.4.2.2	E

06.7	half-life = 50 seconds 250 seconds difference in age = 5 half lives ratio = $\left(\frac{1}{2}\right)^5$ **or** ratio = $\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}$ ratio = $\frac{1}{32}$ **or** ratio = 1:32	an answer of $\frac{1}{32}$ or equivalent scores **4** marks this may be indicated on Figure 7 allow 100 seconds = 2 half lives **and** 350 seconds = 7 half lives allow this mark if they have halved 1.25(× 10^{23}) five times to get 0.0390625(× 10^{23}) for example 1.25(× 10^{23}) → 0.625(× 10^{23})→ 0.3125(× 10^{23})→ 0.15625(× 10^{23}) → 0.078125(× 10^{23})→0.0390625(× 10^{23}) allow ratio = 0.031 allow 32:1 **or** 32	1 1 1 1	AO3.1a 6.4.2.3	E
06.8	tangent drawn on graph use of gradient = $\frac{(\Delta \text{ no. of atoms})}{\Delta \text{ time}}$ gradient = 5.3 (× 10^{21}) (Bq)	do not allow a line drawn that crosses the graph line values must be taken from their tangent drawn at 20 seconds allow gradient = 0.053 (× 10^{23}) (Bq) allow a range between 4.7 (× 10^{21}) (Bq) and 5.9 (× 10^{21}) (Bq)	1 1 1	AO2.2 6.4.2.1	E
Total			**18**		

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

H

Higher Tier
Physics Paper 1H

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 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

Do not write outside the box

0 1 **Figure 1** shows a mobile phone with its battery removed.

Figure 1

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

0 1 . 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 1 continues on the next page

Do not write outside the box

0 1 . 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 1 . 3 Write down the equation which links energy (E), power (P) and time (t).

[1 mark]

0 1 . 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

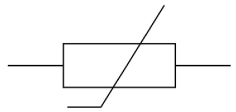
Question 1 continues on the next page

Do not write outside the box

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

Figure 2 shows the circuit symbol for a component used in the sensor.

Figure 2



0 1 . 5 What component does the circuit symbol shown in **Figure 2** represent?

[1 mark]

0 1 . 6 The temperature of the component in **Figure 2** 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 2 A radioactive source emits alpha, beta and gamma radiation.

0 2 . 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 2 . 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 2 continues on the next page

Do not write outside the box

0 2 . 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.

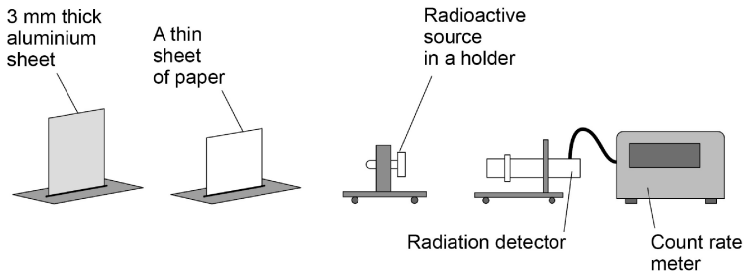
[1 mark]

Do not write outside the box

0 2 . 4 A teacher wants to demonstrate that the radioactive source emits alpha, beta and gamma radiation.

Figure 3 shows the equipment the teacher has.

Figure 3



Describe a method the teacher could use.

[6 marks]

10

Do not write outside the box

0 3 **Figure 4** shows a sailing boat crossing an ocean.

Figure 4

There is a wind turbine on the boat.

0 3 . 1 The wind turbine generates electricity to charge a battery on the boat.

Name one **other** renewable energy resource that could be used on the boat to generate electricity.

[1 mark]

0 3 . 2 The boat also has a generator that burns a fossil fuel.

The battery can be charged by either the wind turbine **or** the generator.

Give **two** reasons why this is useful.

[2 marks]

1

2

Do not write outside the box

0 3 . 3 Explain **one** environmental impact of using fossil fuels to generate electricity.

[2 marks]

0 3 . 4 The kinetic energy of the boat is 81 kJ.

mass of boat = 8000 kg

Calculate the speed of the boat.

[4 marks]

Speed = _____ m/s

Question 3 continues on the next page

Do not write outside the box

0 3 . 5 As the boat passes over a wave, the gravitational potential energy of the boat increases by 19 600 J.

mass of boat = 8000 kg

gravitational field strength = 9.8 N/kg

Calculate the change in height of the centre of mass of the boat as it passes over the wave.

[3 marks]

Change in height = _____ m

12

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

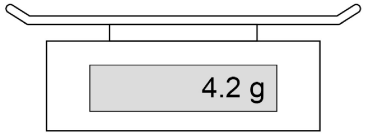
Do not write outside the box

0 4 A student determined the density of a cube made of bronze.

The student used a balance to measure the mass of the bronze cube.

Figure 5 shows the balance before the cube was added.

Figure 5



0 4 . 1 What type of error is shown on the balance?

[1 mark]

0 4 . 2 How could the student get a correct value for the mass of the cube from the balance?

[1 mark]

Do not write outside the box

0 4 . 3 The student measured the length of the bronze cube using Vernier callipers and then using a micrometer.

Table 1 shows the results.

Table 1

Equipment	Length in mm
Vernier callipers	20.1
Micrometer	20.14

Complete the sentence.

[1 mark]

The results in **Table 1** show that the Vernier callipers and the micrometer have

a different _____ .

Question 4 continues on the next page

Do not write outside the box

The student wanted to determine the density of a bronze coin.

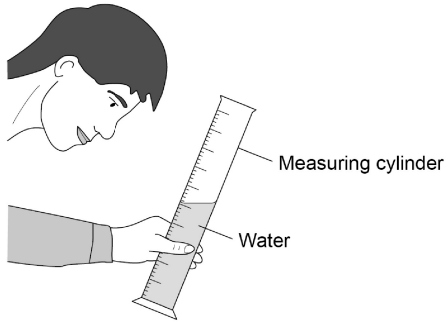
The student had several identical coins.

The volume of each coin was very small.

0 4 . 4 The student added water to a measuring cylinder.

Figure 6 shows the student reading the volume of water in the measuring cylinder.

Figure 6



Give **two** changes the student should make to increase the accuracy of the volume measurement.

[2 marks]

1 _____

_____

2 _____

Do not write outside the box

0 4 . 5 Describe how the student could use a displacement method to determine an accurate value for the volume of a single coin.

[3 marks]

Question 4 continues on the next page

Do not write outside the box

0 4 . 6 Old penny coins were made from a disc of bronze.

New penny coins are made from a disc of a different metal.

Figure 7 shows a disc of metal.

Figure 7

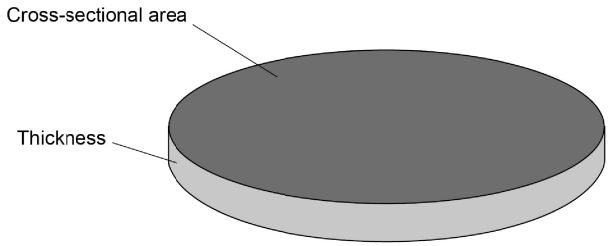


Table 2 shows information about the discs used to make each coin.

Table 2

Disc	Mass in g	Density in g/cm^3	Thickness in cm
Old penny	3.6	8.9	0.16
New penny	3.6	**X**	0.17

The discs used to make the old and the new coins have the **same** cross-sectional area.

Calculate value **X** in **Table 2**.

Give your answer to 2 significant figures.

The volume of a disc can be calculated using the equation:

volume of a disc = cross-sectional area × thickness

[5 marks]

Density (2 significant figures) = _____ g/cm^3

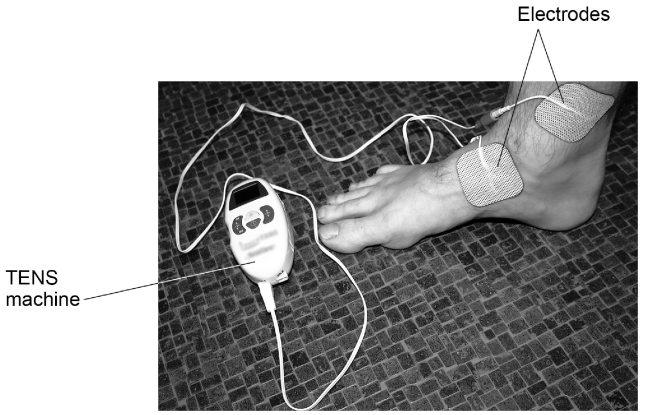
13

Turn over for the next question

0 5 A TENS machine uses an electrical current to relieve pain.

Figure 8 shows the electrodes of a TENS machine connected across an ankle.

Figure 8



0 5 . 1 The maximum power of the TENS machine is 240 mW.

The potential difference across the battery in the TENS machine is 2.5 V.

Calculate the maximum current from the battery.

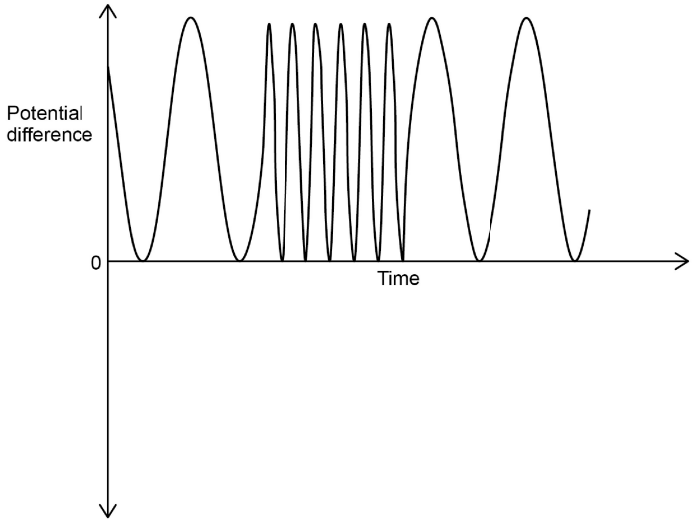
[4 marks]

Maximum current = _____ A

Do not write outside the box

0 5 . 2 **Figure 9** is a sketch graph showing how the potential difference across the electrodes varies with time.

Figure 9



A student concluded that there was an alternating potential difference across the electrodes.

How does **Figure 9** show that the student was **not** correct?

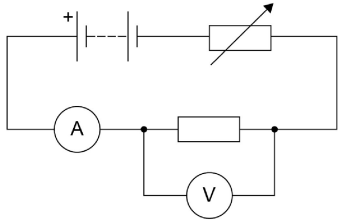
[1 mark]

Question 5 continues on the next page

Do not write outside the box

Figure 10 shows a circuit the student built using the battery from the TENS machine.

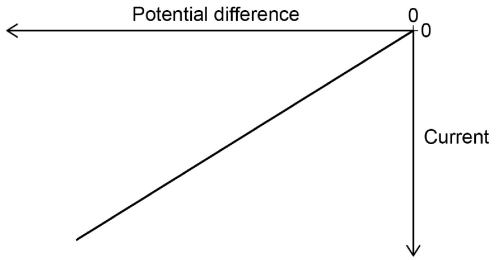
Figure 10



The student recorded how the current in the resistor varied with the potential difference across the resistor.

Figure 11 shows a sketch graph of the results.

Figure 11



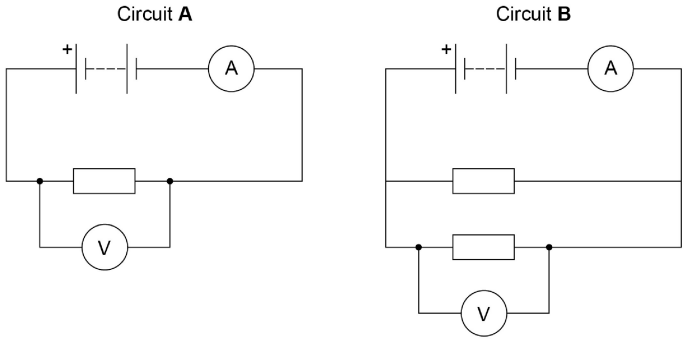
0 5 . 3 What relationship does **Figure 11** show?

[1 mark]

Do not write outside the box

0 5 . 4 **Figure 12** shows two more circuits that the student built using the battery from the TENS machine.

Figure 12



The resistors all have the same resistance.

Compare the readings on the voltmeter and ammeter in circuit **A** and circuit **B**.

[3 marks]

Voltmeter _____

_____

_____

Ammeter _____

_____

_____

9

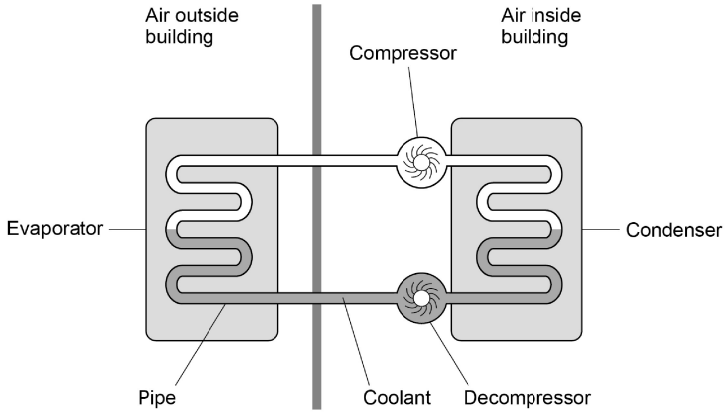
Turn over for the next question

Do not write outside the box

0 6 An air source heat pump transfers energy from the air outside a building to increase the temperature of the air inside the building.

Figure 13 shows an air source heat pump.

Figure 13



The compressor is connected to the mains electricity supply.

The pipe in the heat pump contains a substance called coolant.

In the evaporator, energy is transferred from the air outside the building to the liquid coolant.

The temperature of the coolant increases and it evaporates.

0 6 . 1 Explain what happens to the internal energy of the coolant as its temperature increases.

[2 marks]

_____

_____

_____

_____

Do not write outside the box

0 6 . 2 What name is given to the energy needed to change the state of the liquid coolant?

[1 mark]

0 6 . 3 What happens to the mass of the coolant as it evaporates and becomes a vapour?

[1 mark]

Tick (✓) **one** box.

Decreases ☐

Stays the same ☐

Increases ☐

0 6 . 4 The compressor increases the density and temperature of the coolant vapour inside the pipe.

Explain why the pressure in the pipe increases.

[2 marks]

Question 6 continues on the next page

Do not write outside the box

0 6 . 5 The condenser transfers energy from the coolant to the air in the building.

When the total energy input to the heat pump system is 1560 kJ the temperature of the air in the building increases from 11.6 °C to 22.1 °C.

The efficiency of the heat pump system is 87.5%.

The mass of the air inside the building is 125 kg.

Calculate the specific heat capacity of the air in the building.

Give your answer in standard form.

[6 marks]

Specific heat capacity (standard form) = _____ J/kg °C

Do not write outside the box

0 6 . 6 The air in the building gains 400 J for every 100 J of energy transferred from the mains electricity supply to the compressor.

An advertisement claims that the heat pump system has an efficiency of 400%.

Explain why the advertisement is **not** correct.

[3 marks]

15

END OF QUESTIONS

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

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

Do not write outside the box

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

Do not write outside the box

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

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

AQA

GCSE
COMBINED SCIENCE: TRILOGY
8464/P/1H

Physics Paper 1H

Mark scheme

June 2021

Version: 1.0 Final Mark Scheme

216G8464P1H/MS

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	$V = I R$		1	AO1 6.2.1.3
01.2	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
01.3	energy = power × time **or** E = P t		1	AO1 6.2.4.2
01.4	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
01.5	thermistor		1	AO1 6.2.1.1
01.6	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.
02.1	more than 10 000 times bigger		1	AO1 6.4.1.1
02.2	the atom becomes a positive ion the atom loses an electron		1 1	AO1 6.4.1.2
02.3	beta radiation is only weakly ionising		1	AO3 6.4.2.1

Question	Answers	Mark	AO / Spec. Ref.
02.4	**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**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	solar	allow biofuel / biodiesel allow wave power	1	AO1 6.1.3
03.2	sometimes there is no wind (but the battery can still be charged using the generator) when there is wind less fuel is burned	allow if the generator breaks then the turbine can still generate electricity allow a disadvantage of burning fossil fuel	1 1	AO1 6.1.3
03.3	carbon dioxide increases global warming **OR** sulfur dioxide or NOx emissions (1) increases acid rain (1) **OR** particulates or NOx emissions (1) can harm living organisms (1)	allow increases the greenhouse effect	1 1	AO1 6.1.3

03.4	81 kJ = 81 000 J $81000 = 0.5 \times 8000 \times v^2$ $v = \sqrt{\frac{81\,000}{0.5 \times 8000}}$ v = 4.5 (m/s)	allow a correct substitution using an incorrectly/not converted value of energy allow a correct re-arrangement using an incorrectly/not converted value of energy allow a correct calculation using an incorrectly/not converted value of energy	1 1 1 1	AO2 6.1.1.2
03.5	$19600 = 8000 \times 9.8 \times \Delta h$ $\Delta h = \frac{19\,600}{8000 \times 9.8}$ Δh = 0.25 m		1 1 1	AO2 6.1.1.2
Total			**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	zero error	allow systematic error	1	AO1 6.3.1.1 RPA17
04.2	reset the balance to zero g	allow subtract the reading shown on the balance from the reading taken	1	AO1 6.3.1.1 RPA17
04.3	resolution	this answer only	1	AO1 6.3.1.1 RPA17
04.4	place the measuring cylinder on a horizontal surface view with eye in line with the level of the water	 allow read from the bottom of the meniscus	1 1	AO1 6.3.1.1 RPA17
04.5	add several coins to the measuring cylinder measure the change in the water level in the measuring cylinder divide by the number of coins added	allow a minimum of 5 coins if a number of coins is given	1 1 1	AO3 AO1 AO3 6.3.1.1 RPA17

04.6	$8.9 = \frac{3.6}{\text{area} \times 0.16}$	allow $8.9 = \frac{3.6}{\text{volume}}$	1	AO3
	$\text{area} = \frac{3.6}{8.9 \times 0.16}$	allow area = 2.5(28…) (cm^2)	1	AO3
	$\text{density} = \frac{3.6}{2.528 \times 0.17}$	allow $\frac{3.6}{\text{their calculated area} \times 0.17}$	1	AO3
	density = 8.37… (g/cm^3)	allow a correct calculation using their calculated area	1	AO3
	density = 8.4 g/cm^3	this mark can only be scored for a correct rounding of a value of density calculated using correct equations	1	AO2 6.3.1.1 RPA17
Total			**13**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	240 mW = 0.24 W		1	AO2 6.2.4.1
	$0.24 = 2.5 \times I$	allow a correct substitution using an incorrectly/not converted value of power	1	
	$I = \frac{0.24}{2.5}$	allow a correct re-arrangement using an incorrectly/not converted value of power	1	
	$I = 0.096$ (A)	allow a correct calculation using an incorrectly/not converted value of power	1	
05.2	because the potential difference is always positive	allow because potential difference does not change direction	1	AO1 6.2.3.1
05.3	potential difference is (directly) proportional to current		1	AO2 6.2.1.4
05.4	voltmeter: the reading is the same in both circuits		1	AO2 6.2.2
	ammeter: the reading in circuit **B** is twice the reading of circuit **A**	allow **1** mark for the reading in circuit **B** is bigger than circuit **A**	2	
Total			**9**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	the kinetic energy (and the potential energy) of the particles increases	allow the speed of the particles increases	1	AO1 6.3.2.1 6.3.2.3
	so the internal energy increases because it is the sum of kinetic and potential energy (of the particles)		1	
06.2	latent heat (of vaporisation)	allow specific latent heat (of vaporisation)	1	AO1 6.3.2.3
06.3	stays the same		1	AO1 6.3.1.2
06.4	more collisions per second		1	AO1 6.3.3.1
	a greater force per collision		1	

06.5	$0.875 = \frac{\text{useful output energy transfer}}{1\ 560\ 000}$	allow a correct substitution using incorrectly/not converted values of efficiency and/or energy	1	AO2 6.1.2.2 6.1.1.3 6.3.2.2
	useful output energy transfer = 1 365 000(J)	this answer only	1	
		the equation $\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$ must have been used to score subsequent marks		
	1 365 000 = 125 × c × (22.1–11.6)	allow a correct substitution using their calculated value of useful output energy	1	
	$c = \frac{1\ 365\ 000}{125 \times 10.5}$	allow a correct re-arrangement using their value of useful output energy	1	
	c = 1040 (J/kg °C)	allow a correct calculation using with their value of useful output energy	1	
	$c = 1.04 \times 10^3$ (J/kg °C)	this mark can only be awarded for a calculation using the correct equations	1	

06.6	the advertisement has ignored the energy input from the surrounding air		1	AO3
	so the total energy input is greater than the energy supplied from the electricity	an answer that the total energy input comes from the electricity supply and the air outside the building gains the first two marking points	1	AO2
	the efficiency must be less than 100%		1	AO1 6.1.2.2
Total			**15**	

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

H

Higher Tier
Physics Paper 1H

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 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.

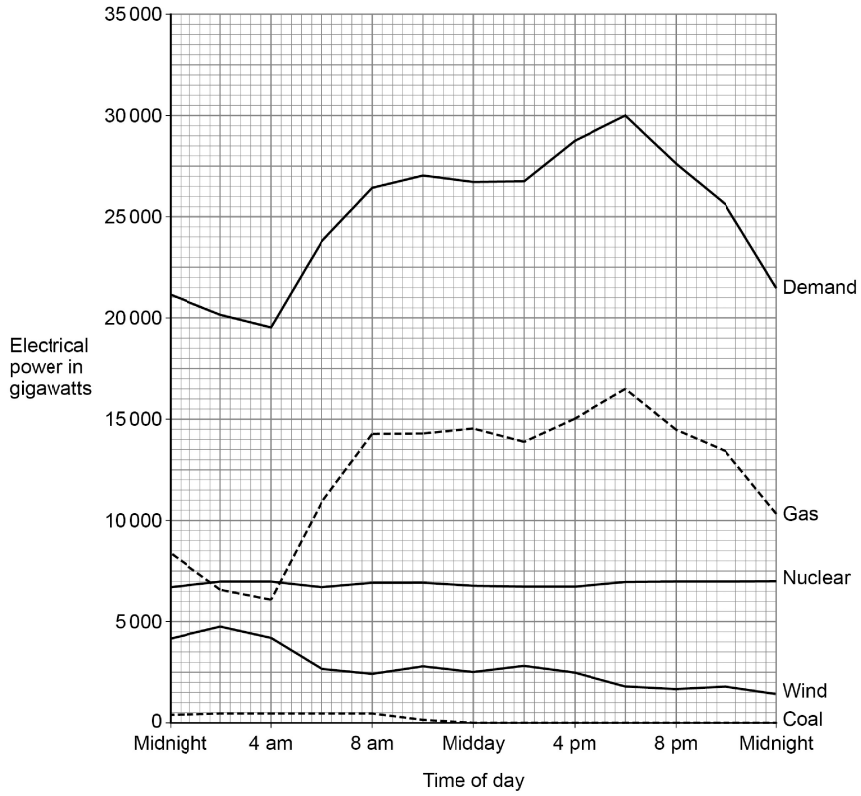
For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

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 **Figure 1** shows some of the energy resources used to meet the demand for electrical power in the UK on one day in 2020.

Figure 1



Do not write outside the box

0 1 . 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 1 . 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 1 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 1 . 3 What is this network called?

[1 mark]

0 1 . 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

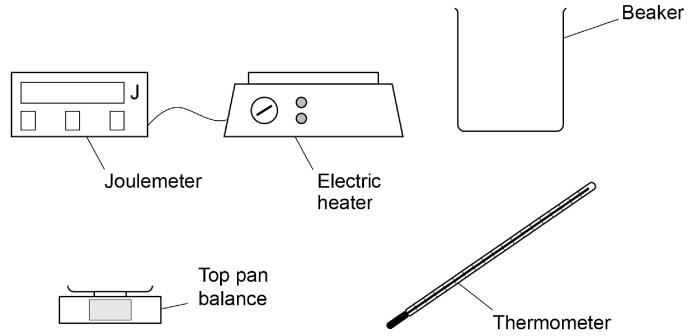
DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 2 A student made measurements to determine the specific heat capacity of vegetable oil.

Figure 2 shows the equipment used.

Figure 2



0 2 . 1 Describe how the student could use the equipment shown in **Figure 2** to determine the specific heat capacity of vegetable oil.

[6 marks]

Do not write outside the box

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

[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 **02.3** and **02.4**.

0 2 . 3 Write down the equation linking energy transferred (E), power (P) and time (t).

[1 mark]

0 2 . 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 2 continues on the next page

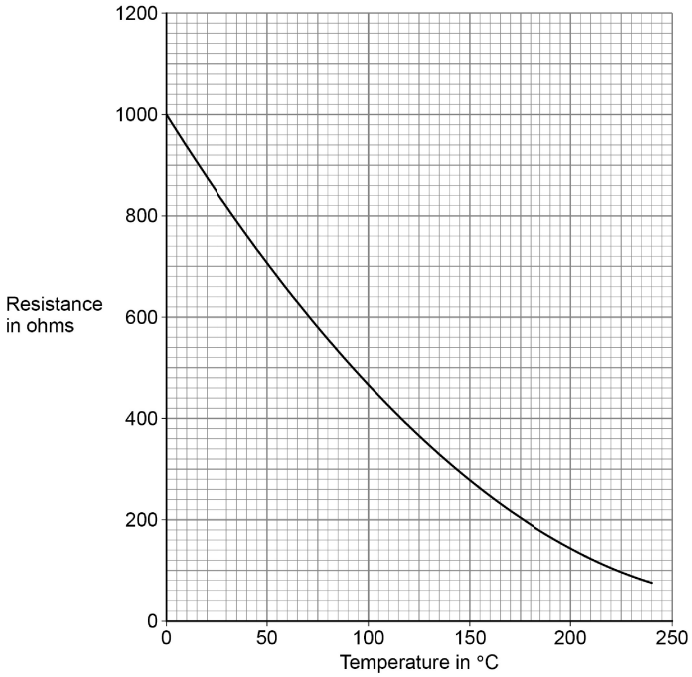
Do not write outside the box

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

Figure 3



0 2 . 5 What electrical component is used to monitor the temperature of the vegetable oil?

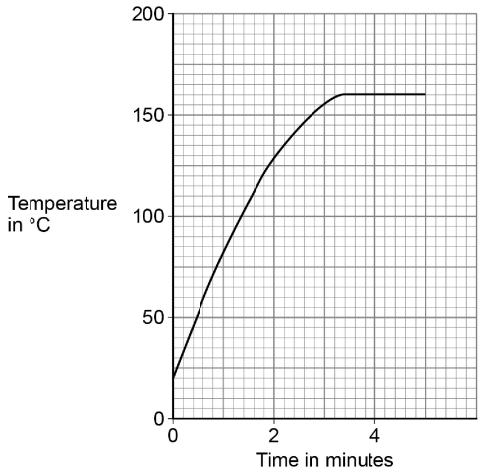
[1 mark]

Do not write outside the box

0 2 . 6 The electric heating element in the deep fryer automatically switches off when the vegetable oil reaches a certain temperature.

Figure 4 shows how the temperature of the vegetable oil changed after the deep fryer was switched on.

Figure 4



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

Use **Figure 3** and **Figure 4**.

[2 marks]

Resistance = _____ Ω

Question 2 continues on the next page

Do not write outside the box

0 2 . 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

Do not write outside the box

Turn over for the next question

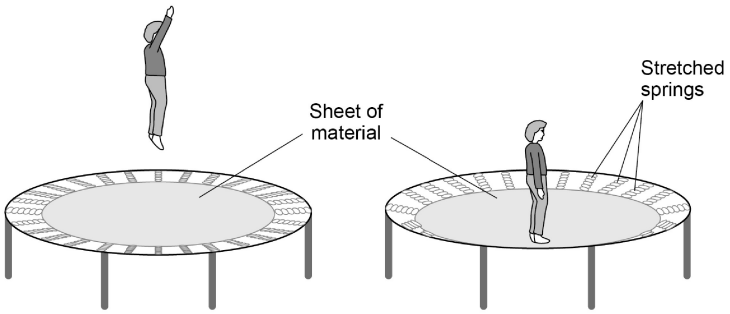
DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 3 A trampoline is made from a sheet of material held in place by stretched springs.

Figure 5 shows a child on a trampoline.

Figure 5



Do not write outside the box

0 3 . 1 Position **A** shows the child's maximum height above the trampoline.

Position **B** shows the lowest position reached by the child when landing on the trampoline.

Describe the changes to the stores of energy of the:

- child
- springs
- surroundings

as the child moves from position **A** to position **B**.

[4 marks]

Child _____

Springs _____

Surroundings _____

Question 3 continues on the next page

Do not write outside the box

0 3 . 2 When the child is at position **A**, each trampoline spring is stretched by 0.056 m

The elastic potential energy of each spring is 4.9 J

When the child is at position **B**, the elastic potential energy of each spring increases to 8.1 J

Calculate the extension of each spring when the child is at position **B**.

Use the Physics Equations Sheet.

[5 marks]

Extension = _____ m

0 3 . 3 As the child bounces on the trampoline the child does work.

What is the work done by the child equal to?

[1 mark]

Tick (✓) **one** box.

- The average force applied by the child ☐
- The maximum force applied by the child ☐
- The total energy store of the child ☐
- The total energy transferred by the child ☐

10

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

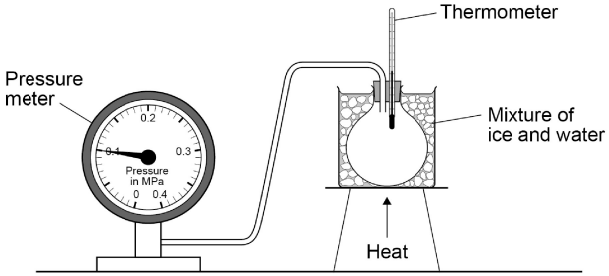
Do not write outside the box

0 4 A student investigated how the pressure of a gas depends on its temperature.

The volume of the gas did **not** change.

Figure 6 shows the equipment used.

Figure 6



0 4 . 1 Pressure is sometimes measured in units called atmospheres.

1 atmosphere is 10^5 pascals (Pa).

What is 1 atmosphere in kilopascals (kPa)?

[1 mark]

1 atmosphere = _____ kPa

Do not write outside the box

0 4 . 2 The student took four pressure readings for each temperature.

Table 1 shows the pressure readings when the temperature was 50.0 °C

Table 1

Temperature in °C	Pressure in MPa			
	1	2	3	4
50.0	0.115	0.120	0.121	0.116

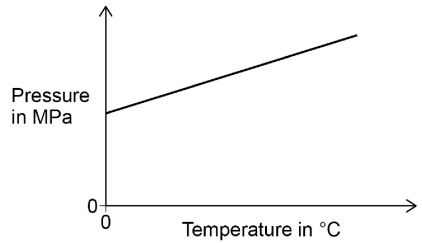
Calculate the uncertainty in the mean pressure.

[2 marks]

Uncertainty = ± _____ MPa

0 4 . 3 **Figure 7** shows a sketch graph of the results.

Figure 7



The student said that as the temperature increases the pressure increases.

Give a better description of the relationship between temperature and pressure.

[1 mark]

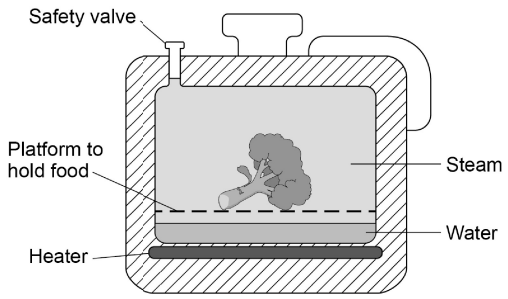
Turn over ►

Do not write outside the box

A pressure cooker is a sealed pot that uses steam to cook food.

Figure 8 shows a pressure cooker.

Figure 8



0 4 . 4 When the water in the pressure cooker starts to boil:

- the amount of steam in the pressure cooker increases
- the temperature of the steam increases above 100 °C

Explain why these changes make the pressure in the cooker increase.

[5 marks]

Do not write outside the box

0 4 . 5 If the pressure inside the pressure cooker becomes greater than 200 kPa then some of the steam is released through the safety valve.

The released steam expands as it moves into the atmosphere.

Explain how a change in density of the steam is caused by a change in the arrangement of particles in the steam as it is released.

[3 marks]

12

Turn over for the next question

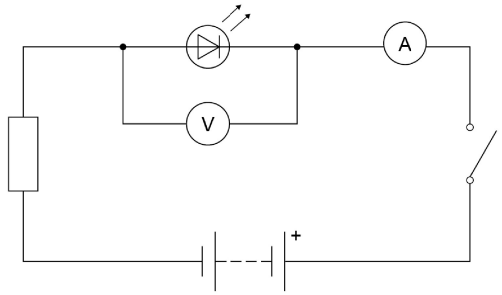
Do not write outside the box

0 5 The camera in a mobile phone uses an LED to provide light when taking a photograph.

A student investigated how the potential difference across an LED varies with the current in it.

Figure 9 shows the circuit used.

Figure 9



0 5 . 1 The student closed the switch. The voltmeter gave a reading of 5.0 V

The ammeter gave a reading of 0 mA

The LED did not emit any light.

Explain how the student should have changed the circuit to make the LED emit light.

[2 marks]

Do not write outside the box

0 5 . 2 The student changed the circuit so that the LED emitted light.

The current in the circuit was 290 mA

The power of the LED was 0.98 W

Calculate the potential difference across the LED.

Use the Physics Equations Sheet.

Give your answer to 2 significant figures.

[5 marks]

Potential difference (2 significant figures) = _____ V

Question 5 continues on the next page

Do not write outside the box

A traditional camera uses a flash unit to provide light.

Figure 10 shows a flash unit on a traditional camera.

Figure 10

0 5 . 3 The flash unit emits light from xenon gas in a fluorescent tube.

What happens when a xenon atom emits light?

[1 mark]

Tick (✓) **one** box.

- Electrons in the atom fall to a lower energy level. ☐
- Electrons in the atom move to a higher energy level. ☐
- Electrons leave the atom, causing ionisation. ☐
- Electrons transfer to the atom from the electrical circuit. ☐

Do not write outside the box

0 5 . 4 When the flash unit is used there is a mean potential difference of 200 V across the fluorescent tube.

The flash of light lasts for 2.8×10^{-4} s

1.4 J of energy is transferred.

Calculate the mean current.

Use the Physics Equations Sheet.

[6 marks]

Mean current = _____ A

14

Turn over for the next question

Do not write outside the box

0 6 A smoke detector contains a source of alpha radiation in a plastic case.

0 6 . 1 A source of beta radiation in a smoke detector would be more hazardous than a source of alpha radiation.

Explain why.

[2 marks]

0 6 . 2 Actinium (Ac) is one source of alpha radiation.

An actinium (Ac) nucleus emits an alpha particle (α) and turns into a francium (Fr) nucleus.

This can be represented as:

$$^{A}_{Z}Ac \longrightarrow {}^{223}_{87}Fr + \alpha$$

Determine the values of **A** and **Z**.

[2 marks]

A = _____

Z = _____

Do not write outside the box

0 6 . 3 A teacher wanted to find out what nuclear radiation is emitted from a source.

The teacher placed different barriers between the source and a detector.

The teacher recorded the count for 30 seconds after each barrier was put in place.

Table 2 shows the results.

Table 2

Barrier	Thickness in millimetres	Count after 30 seconds
None		985
Paper	0.1	149
Aluminium	5.0	0
Lead	20.0	0

Explain what nuclear radiation was emitted by the source.

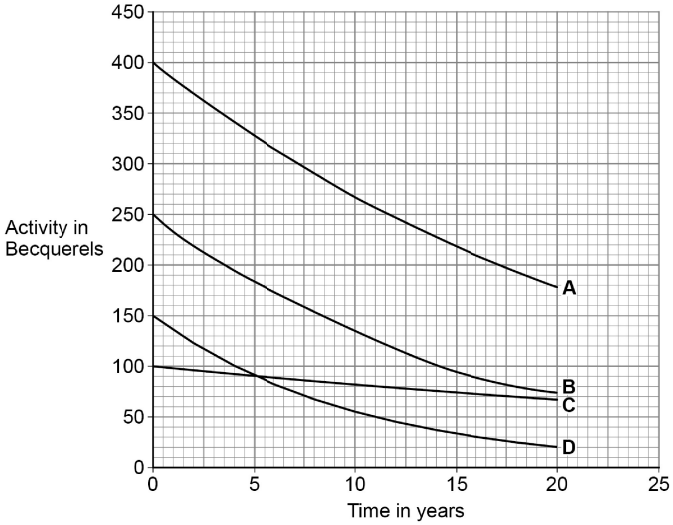
[4 marks]

Question 6 continues on the next page

Do not write outside the box

0 6 . 4 **Figure 11** shows how the activity of four different radioactive isotopes, **A**, **B**, **C** and **D**, changes over time.

Figure 11



Write the isotopes **A**, **B**, **C** and **D** in order of increasing stability of their nuclei.

Explain your answer.

[3 marks]

Least stable **Most stable**

Explanation _____

END OF QUESTIONS

Do not write outside the box

11

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

Do not write outside the box

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

Do not write outside the box

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

Do not write outside the box

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

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

AQA

GCSE
COMBINED SCIENCE: TRILOGY
8464/P/1H

Physics Paper 1H

Mark scheme

June 2022

Version: 1.0 Final Mark Scheme

226G8464P1H/MS

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	16 500(GW) **and** 30 000 (GW) read from graph		1	AO3 6.1.3
	percentage = $\frac{16500}{30000}$ (×100%)	allow a correct substitution using a value of 15300 or 18000 for gas	1	
	percentage = 55 (%)	allow an answer consistent with a value of 15300 or 18000 for gas	1	

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

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	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 1		8

Question 2

Question	Answers	Mark	AO / Spec. Ref.
02.1	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 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.
02.2	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.
02.3	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.
02.4	$50 = \frac{4750}{t}$ **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.
02.5	thermistor		1	AO1 6.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	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.
02.7	the water will recover its original properties if the steam is cooled		1	AO1 6.3.1.2

Total Question 2		**15**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1		ignore descriptions of energy transfers before the child reaches position A		AO1 6.1.1.1 6.1.2.1
	Child			
	gravitational potential energy decreases		1	
	kinetic energy increases **and** then decreases (to zero)		1	
	Springs			
	elastic potential energy increases	ignore references to kinetic energy of the springs	1	
	Surroundings			
	internal / thermal store of energy increases	allow energy is dissipated allow (average) kinetic energy of the particles increases	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	**At position A** $4.9 = 0.5 \times k \times 0.056^2$		1	AO2 6.1.1.2
	$k = \frac{2 \times 4.9}{0.056^2} = 3125$ (N/m)		1	
	At position B $8.1 = 0.5 \times 3125 \times e^2$	allow a correct substitution of an incorrectly calculated value of k using 0.056 m **and** 4.9 J	1	
	$e = \sqrt{\left(\frac{2 \times 8.1}{3125}\right)}$	allow $e^2 = 0.005184$ allow a correct re-arrangement using an incorrectly calculated value of k	1	
	$e = 0.072$ (m)	allow an answer consistent with their calculated value of k	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	the total energy transferred by the child		1	AO1 6.1.1.4

Total Question 3		**10**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	100 (kPa)	allow 10^2 (kPa)	1	AO2 6.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	range = 0.006 (MPa) uncertainty = ± 0.003 (MPa)	allow mean = 0.118 an answer of uncertainty = 0.118 (MPa) scores **0** marks	1 1	AO2 6.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	the relationship is linear	allow the relationship obeys $y = mx + c$ allow the gradient (of the graph) is constant do **not** accept (directly) proportional	1	AO2 6.3.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4		particles refers to particles in the steam throughout		AO2 6.3.3.1
	(as the amount of steam increases) the number of particles increases		1	
	and (as the temperature increases) particles move faster	allow (as the temperature increases) the (average) kinetic energy of the particles increases	1	
	particles collide with the wall of the cooker		1	
		if MP3 is not awarded no subsequent marks may be awarded		
	these collisions are more frequent		1	
	and each collision exerts more force		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	the particles spread out	do **not** allow particles expand	1	AO1 6.3.1.1
	so the steam / gas takes up a greater <u>volume</u>	allow there is less gas in the same <u>volume</u>	1	
	and $\text{density} = \frac{\text{mass}}{\text{volume}}$ so the density decreases	do **not** allow density of particles decreases	1	

Total Question 4		**12**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	reverse the connections to the LED / battery	allow reverse the potential difference across the LED / diode	1	AO3 6.2.1.4
	because an LED / diode only allows current through in one direction	allow because an LED / diode has a large resistance in the reverse direction	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	290 mA = 0.29 A		1	AO2 6.2.4.1
	$0.98 = V \times 0.29$ **or** $R = \frac{0.98}{0.29^2}$	allow a correct substitution of an incorrectly / not converted current allow R = 11.652… ignore $0.98 = (0.29)^2 \times R$	1	
	$V = \frac{0.98}{0.29}$	allow $V = 11.65 \times 0.29$	1	
	V = 3.379…	allow a correct rearrangement using an incorrectly / not converted current	1	
	V = 3.4 (V)	allow a correct calculation using an incorrectly / not converted current allow a correctly rounded answer to 2 sig figs consistent with their calculated value of V using numbers from the question	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	electrons in the atom fall to a lower energy level		1	AO1 6.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	$1.4 = Q \times 200$		1	AO2 6.2.4.2
	$Q = \frac{1.4}{200}$		1	6.2.1.2
	$Q = 0.0070$ (C)		1	
	$0.0070 = I \times 2.8 \times 10^{-4}$	allow a correct substitution of their calculated value of Q	1	
	$I = \frac{0.0070}{2.8 \times 10^{-4}}$	allow a correct re-arrangement using their value of Q	1	
	$I = 25$ (A)	allow an answer consistent with their value of Q	1	
	OR			
	$1.4 = P \times 2.8 \times 10^{-4}$ (1)			
	$P = \frac{1.4}{2.8 \times 10^{-4}}$ (1)			
	$P = 5000$ (W) (1)			
	$5000 = 200 \times I$ (1)	allow a correct substitution of their calculated value of P		
	$I = \frac{5000}{200}$ (1)	allow a correct re-arrangement using their value of P		
	$I = 25$ (A) (1)	allow an answer consistent with their value of P		

Total Question 5		14

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	beta radiation is more penetrating (than alpha radiation)	allow beta radiation can pass through the case (but alpha radiation cannot) allow beta radiation can travel further (in air than alpha radiation) do **not** allow beta radiation is more ionising	1	AO1 6.4.2.1 6.4.2.4
	so beta radiation could irradiate people passing near the smoke detector	allow beta radiation can pass through skin	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	A = 227		1	AO1
	Z = 89		1	AO2 6.4.2.2 6.4.2.1 6.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	(some) radiation is stopped by paper		1	AO3 6.4.2.1
	so the source emits alpha radiation	MP2 dependent on MP1	1	
	and (some) radiation passes through paper but is stopped by aluminium		1	
	so the source emits beta radiation (but does not emit gamma)	MP4 dependent on MP3	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	D B A C	all four letters must be in the correct order explanation only scores if correct order given	1	AO3 6.4.2.1 6.4.2.3
	explanation			
	a substance with a longer half-life has more stable nuclei	allow the more stable a nucleus, the less likely it is to decay (in a given time)	1	
	so answers are in order of increasing half-life		1	

Total Question 6		11