Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Friday 16 June 2023

Morning (Time: 1 hour 45 minutes)

Paper reference **1PH0/2F**

Physics

PAPER 2

Foundation Tier

You must have:
Calculator, ruler, Equation Booklet (enclosed)

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.
- A list of equations is included at the end of this exam paper.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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P 7 2 5 7 4 A 0 1 4 0

Pearson

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 This question is about static electricity.

(a) Figure 1 shows a plastic comb picking up small pieces of paper.

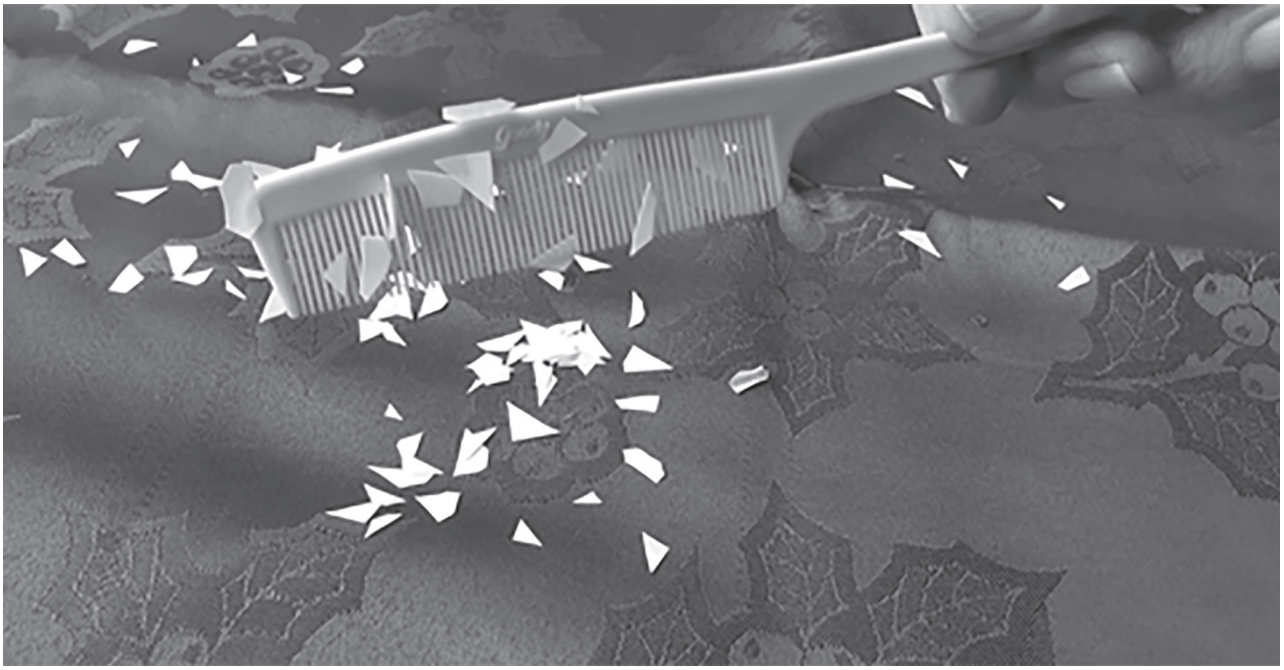

Figure 1

The comb picks up the paper because the comb has extra

(1)

☒ **A** magnetism

☒ **B** charge

☒ **C** resistance

☒ **D** weight

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(b) Figure 2 shows a person touching a charged dome.

The person's hair is standing on end.

Figure 2

(i) Explain how electric charge causes the hair to spread out, as shown in Figure 2.

(2)

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.....

.....

.....

(ii) The person lets go of the charged dome.

The charge on the person's hair is 10 μC.

The charge on the dome is 25 μC.

Calculate the percentage of charge on the hair compared with on the dome.

Use the equation

$$\text{percentage of charge on the hair} = \frac{\text{charge on hair}}{\text{charge on dome}} \times 100$$

(2)

percentage of charge on the hair = ... %

(c) Draw **one** straight line from each example of electrostatic charges in action to their descriptions.

(3)

electrostatic charges in action	**description**
charging a plastic comb	small droplets are charged so they will stick to an object
electrostatic paint spraying	build-up of charge in a cloud causes a discharge to Earth
safe fuelling of cars by earthing	prevents a dangerous build-up of charge between a flowing liquid and a pipe
lightning	produced by friction between solid surfaces

(Total for Question 1 = 8 marks)

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2 (a) Figure 3 shows the parts in an electrical circuit.

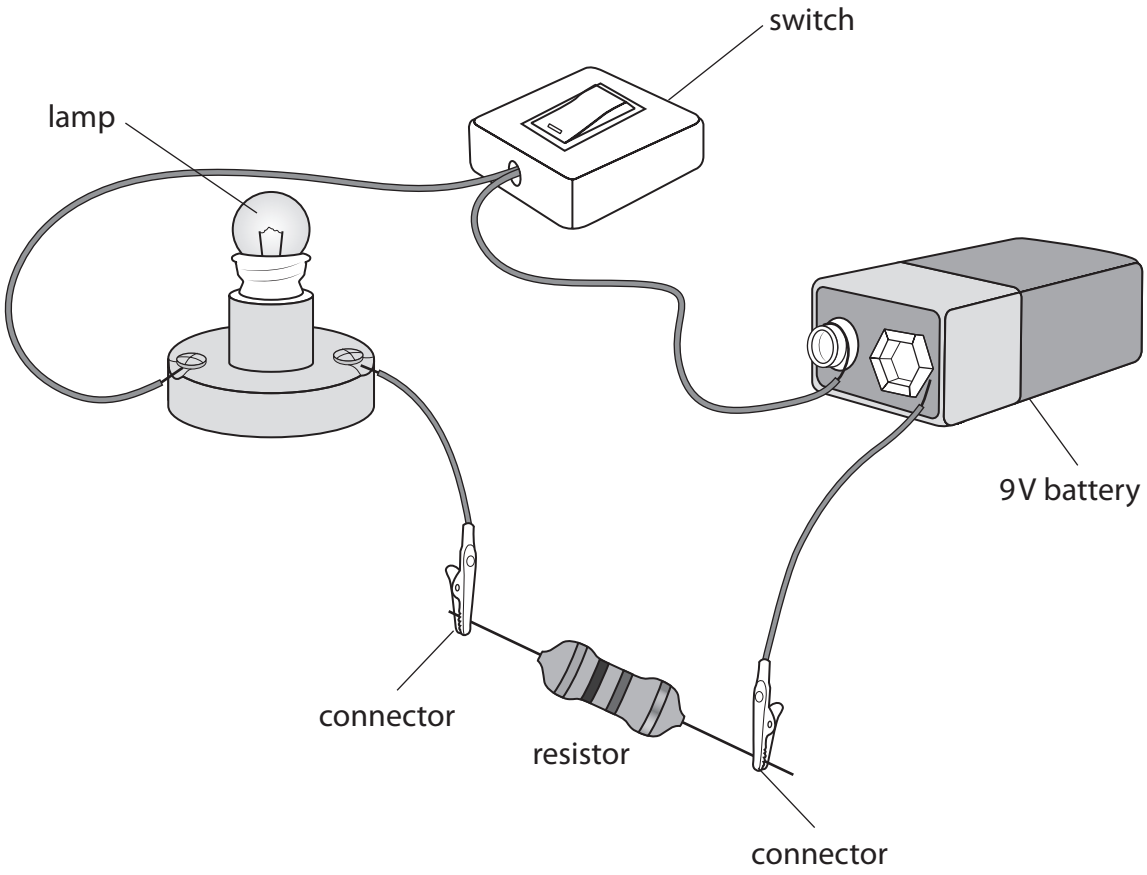


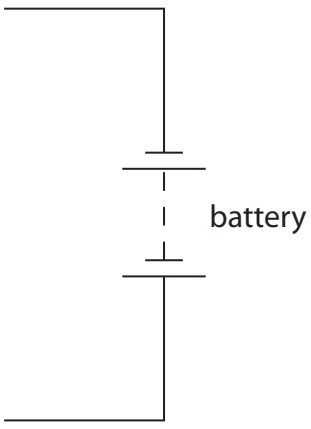
Figure 3

Draw the circuit diagram of this electrical circuit in the space provided.

The battery symbol and some of the connecting wires have been drawn for you.

(4)

circuit diagram



(b) Figure 4 shows the current flowing into and out of point P in part of a circuit.

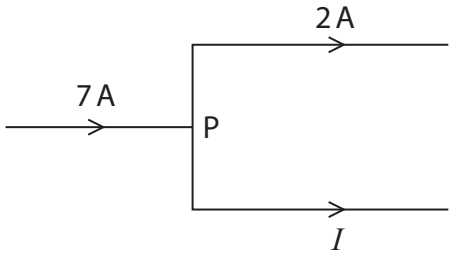


Figure 4

Which of these is the value of current I?

(1)

- ☒ **A** 2 A
- ☒ **B** 5 A
- ☒ **C** 7 A
- ☒ **D** 9 A

(c) (i) There is a current of 0.46 A in a lamp.

Calculate the total charge that flows through the lamp in 30 seconds.

Use the equation

charge = current × time in seconds

(2)

charge = ... C

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(ii) The voltage across the lamp is 6.0 V.

The current in the lamp is 0.46 A.

Calculate the energy transferred to the lamp in one minute.

Use the equation

energy transferred = current × voltage × time in seconds

(2)

energy transferred = ... J

(Total for Question 2 = 9 marks)

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3 (a) Figure 5 shows the apparatus used to investigate the melting of some crushed ice.

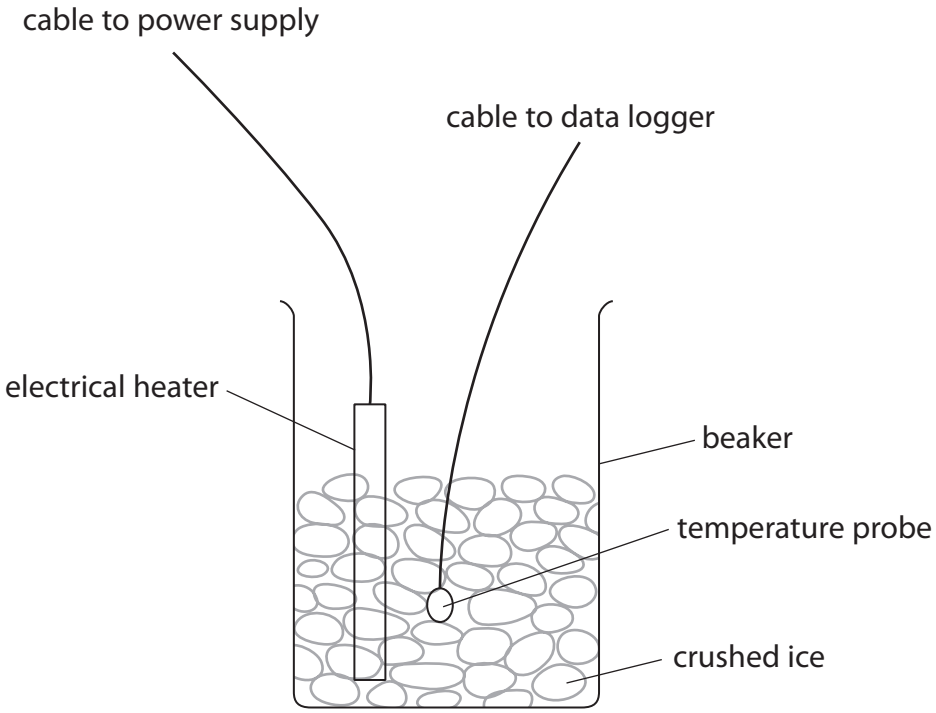

Figure 5

(i) Suggest **one** safety precaution needed when using the electrical heater.

(1)

.....

.....

(ii) Suggest **one** way of heating the crushed ice without using electricity.

(1)

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.....

(b) Figure 6 shows a graph produced from the data collected by the data logger in Figure 5.

Labels P, Q, R and S have been added.

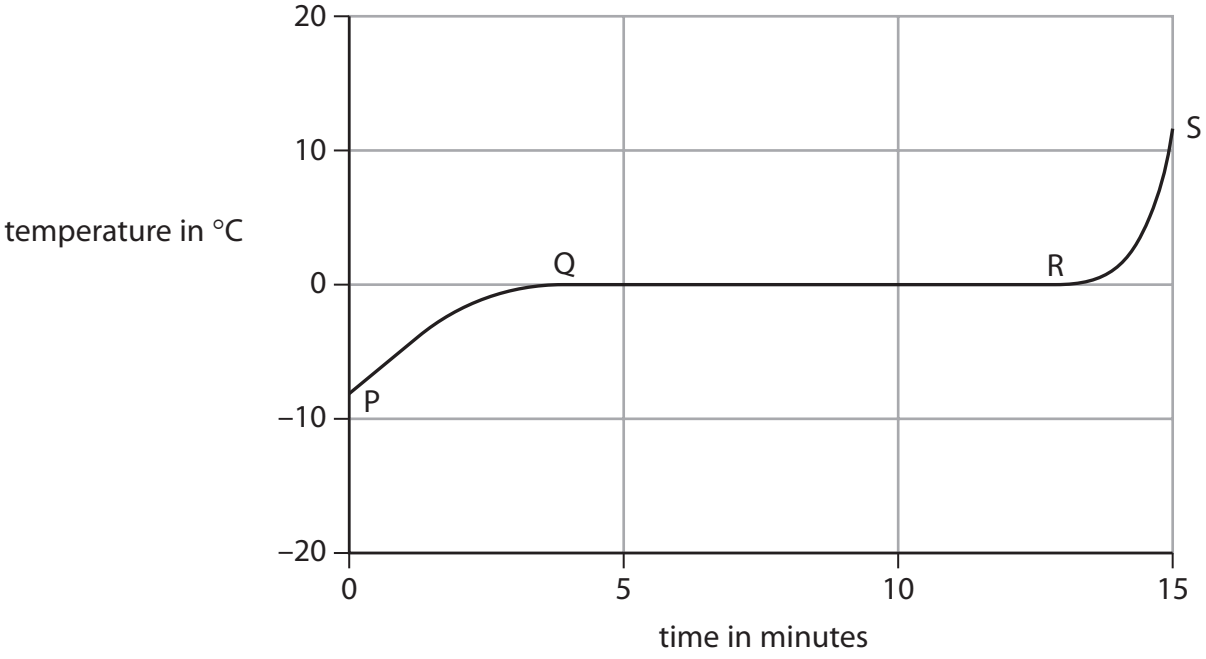

Figure 6

At the start, P, the beaker contains crushed ice at –8 °C.

Describe what happens to the crushed ice during the next 15 minutes.

You may use labels P, Q, R and S to help your answer.

(3)

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(c) Figure 7 shows bubbles of air that a diver breathes out.

The bubbles rise towards the surface.

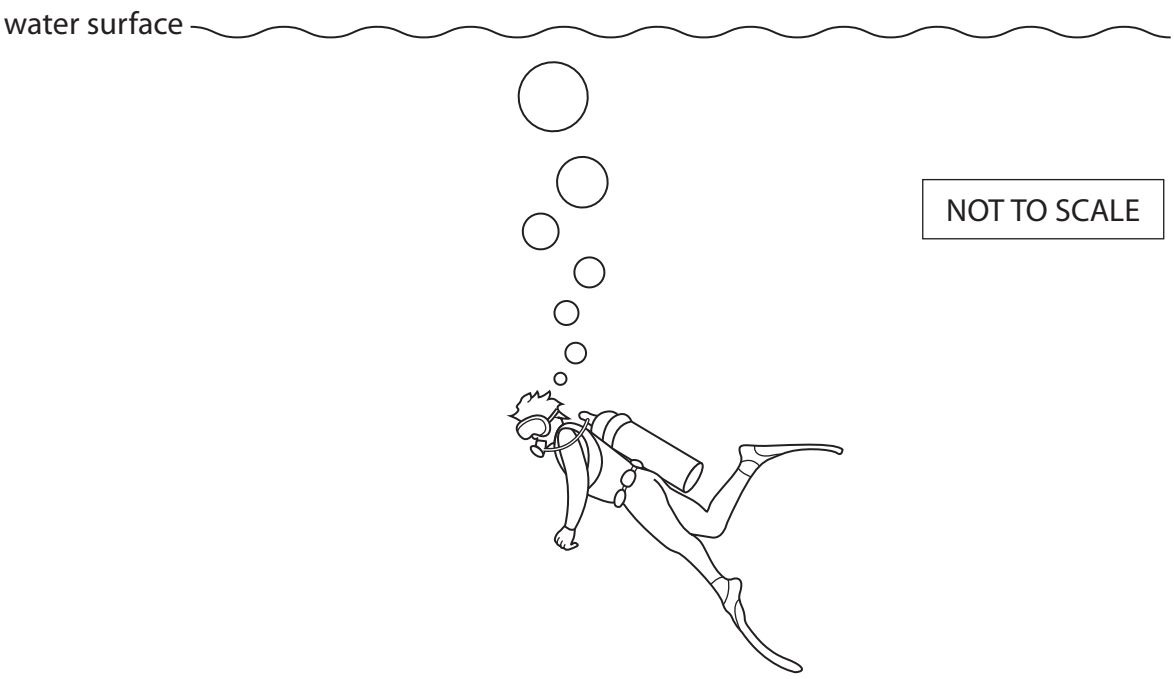

Figure 7

(i) Which row of the table is correct as one bubble rises?

(1)

		the air pressure in the bubble	the volume of the bubble
☒	**A**	decreases	decreases
☒	**B**	decreases	increases
☒	**C**	increases	decreases
☒	**D**	increases	increases

(ii) Which of these is a unit of pressure?

(1)

☒ **A** g/cm^3

☒ **B** J

☒ **C** kg/cm

☒ **D** Pa

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(iii) The diver measures air pressure in atmospheres.

A bubble has an initial volume, V_1, of 0.50 litres, at a pressure, P_1, of 3.30 atmospheres.

The bubble rises towards the surface of the water, where the pressure, P_2, is 1.07 atmospheres.

Calculate the volume, V_2, of the bubble near the surface.

Use the equation

$$V_2 = \frac{P_1 \times V_1}{P_2}$$

(2)

volume, V_2, of the bubble = ... litres

(Total for Question 3 = 9 marks)

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4 This question is about magnets and magnetism.

(a) Figure 8 shows a magnet that has picked up three paper clips.

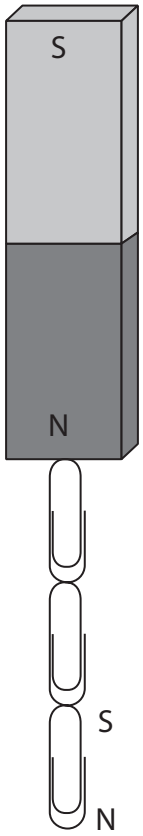

Figure 8

(i) The poles of the lowest paper clip are labelled.

Label the poles of the other two paper clips in Figure 8.

(2)

(ii) Complete the sentence, by choosing a word from the box, to describe the type of magnetism that these paper clips have.

(1)

alternated	earthed	induced	transformed

These paper clips have ..... magnetism.

(iii) Suggest a material that these paper clips in Figure 8 could be made from.

(1)

.....

(iv) When the paper clips were pulled off the magnet they fell separately to the table.

Describe how you could test whether any of the paper clips had kept any magnetism.

(2)

(b) Figure 9 shows the magnetic field around a wire carrying a current.

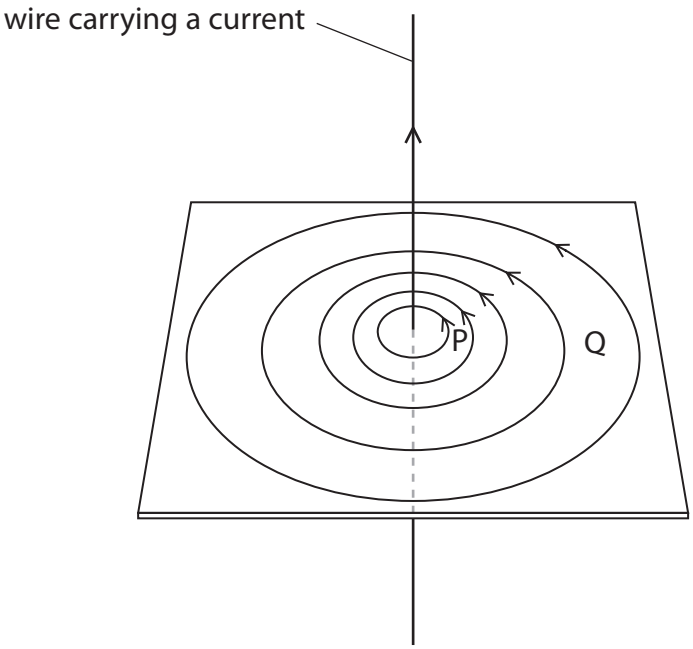

Figure 9

(i) State how you can tell from Figure 9 that the strength of the field is greater at P than at Q.

(1)

(ii) The magnetic field strength is measured at P for different values of current in the wire.

The results of this investigation are shown in Figure 10.

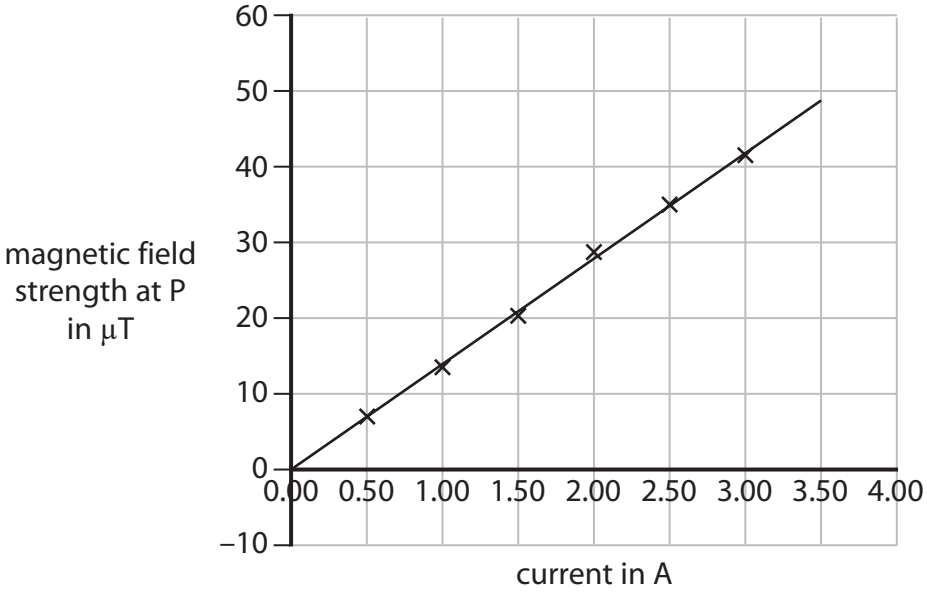

Figure 10

Describe the relationship between magnetic field strength and current.

(2)

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(Total for Question 4 = 9 marks)

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5 Figure 11 shows part of the UK National Grid system for the supply of electricity to homes.

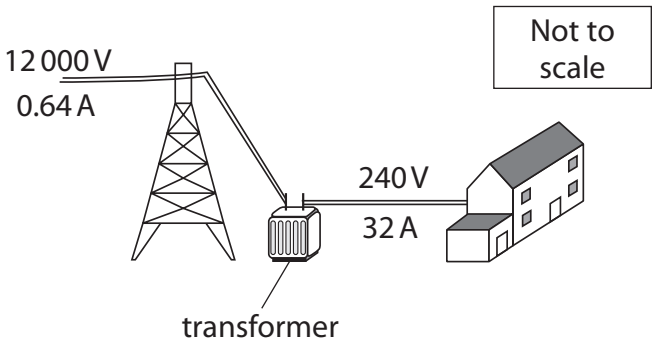

Figure 11

(a) Electricity supplied to homes has a frequency of

(1)

- ☒ **A** 0.02 Hz
- ☒ **B** 20 Hz
- ☒ **C** 50 Hz
- ☒ **D** 500 Hz

(b) Explain why the National Grid uses high voltages with small currents to transfer electricity from power stations.

(2)

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(c) Figure 12 shows details of a transformer.

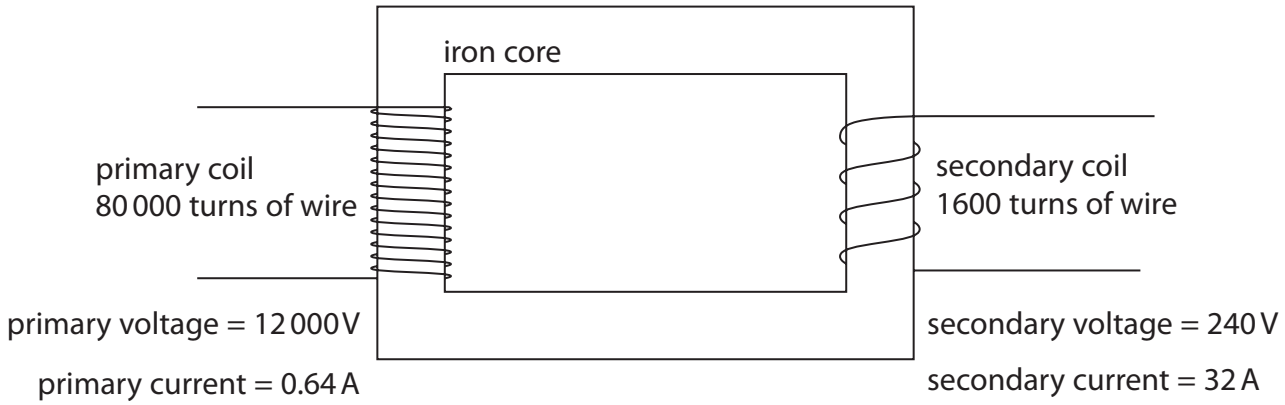

Figure 12

(i) Calculate the power in the primary coil.

Use the equation

$$P = V \times I$$

(2)

power in the primary coil = ... W

(ii) Calculate the following for the transformer in Figure 12.

$$\frac{\text{number of turns in secondary coil}}{\text{number of turns in primary coil}}$$

(2)

.....

(iii) For the transformer in Figure 12, evaluate, in its simplest form, the ratio

secondary voltage : primary voltage

(2)

..... : .....

(Total for Question 5 = 9 marks)

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6 This question is about energy transfers.

Figure 13 shows the apparatus used for investigating the transfer between gravitational potential energy and kinetic energy.

A metal ball is attached to a thread.

The ball is released from a starting position and swings on the thread.

The ball cuts a light beam at the bottom of its swing.

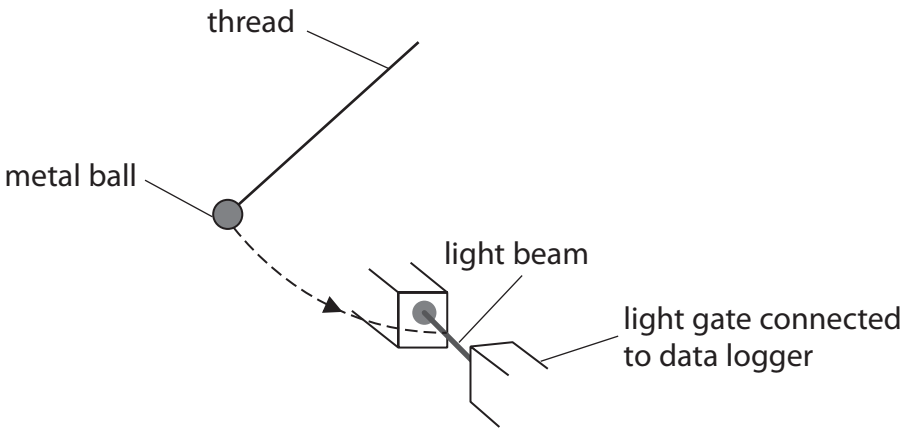

Figure 13

When the ball cuts the light beam, the speed of the ball is recorded by the data logger.

The ball was released 3 times from the same height and the speed measured each time.

The measurements of speed are given in Figure 14.

speed in m/s	1.31	1.27	1.16

Figure 14

(a) Calculate the mean speed.

(2)

mean speed = ... m/s

(b) Suggest **one** reason why the measurements of speed were repeated.

(1)

.....

.....

(c) The mass of the ball is 0.052 kg.

The ball falls through a vertical height (Δh) of 5.0 cm as it swings.

The gravitational field strength, g, is 10 N/kg.

Calculate the change in the gravitational potential energy of the ball.

Use the equation

$$\Delta GPE = m \times g \times \Delta h$$

(3)

change in gravitational potential energy = ... J

(d) Figure 15 shows an end-on view of the ball's swing from its starting position.

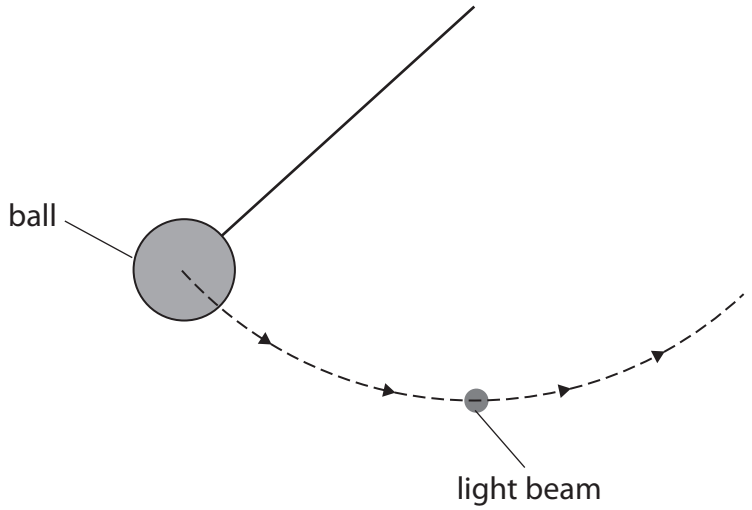

Figure 15

(i) To measure the change in vertical height, Δh, through which the ball moves, a ruler could be used.

Draw a ruler on Figure 15, placed in a position to measure the change in vertical height Δh.

(1)

(ii) Figure 16 shows a set square.

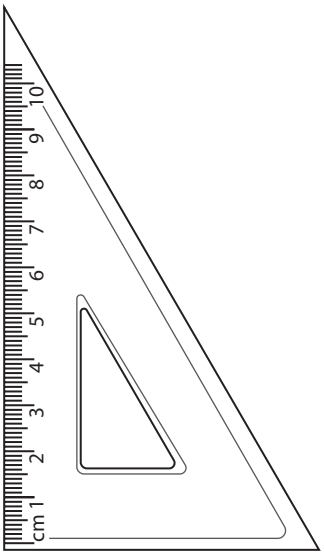

Figure 16

Describe how the measurement of the change in vertical height, Δh, could be improved using the set square.

You may add to Figure 15 or Figure 16 to help your description.

(2)

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(Total for Question 6 = 9 marks)

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7 (a) Which of these is a vector?

(1)

- ☒ **A** distance
- ☒ **B** force
- ☒ **C** mass
- ☒ **D** work done

(b) Figure 17 shows a balanced seesaw with two children on it.

The pivot is at the centre of the seesaw.

The seesaw is balanced with no children sitting on it.

Child P has a weight of 150 N.

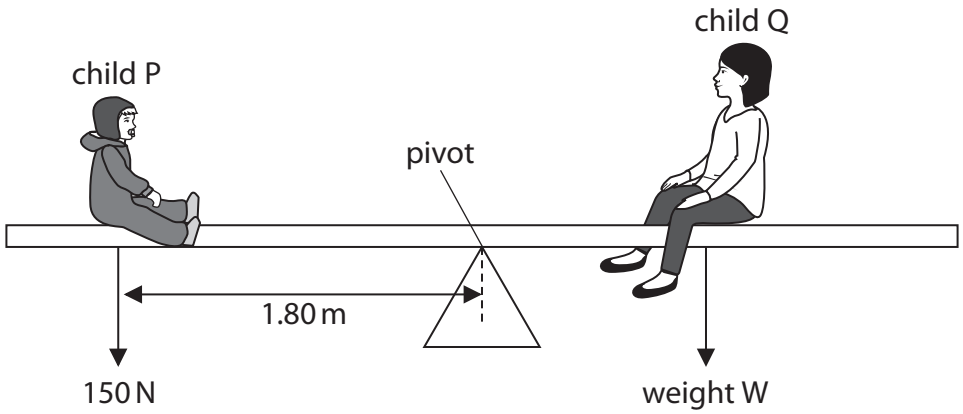

Figure 17

(i) Calculate the moment of the weight of child P about the pivot in N m.

Use the equation

moment of a force = force × distance to pivot

(2)

moment = ... N m

(ii) Figure 18 shows the same balanced seesaw, with the distance of child Q to the pivot labelled as well.

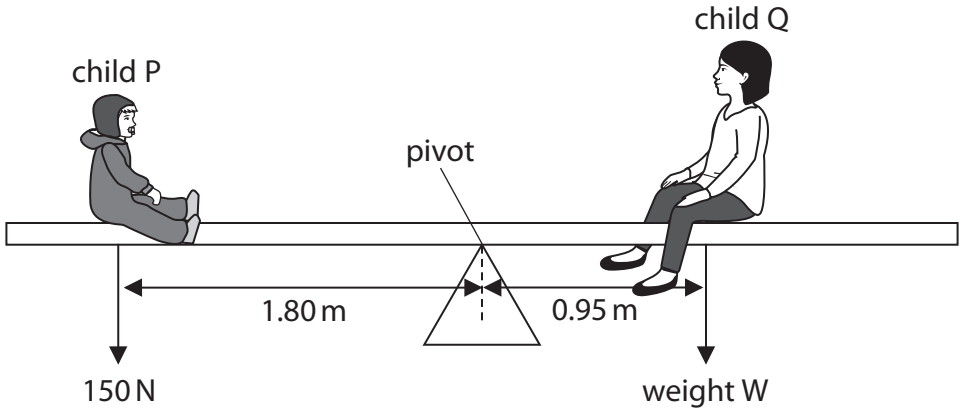

Figure 18

Calculate the value of W, the weight of child Q.

Use the idea of moments and the equation

the moment of W = the moment of the weight of child P

Give your answer to 2 significant figures.

(3)

W = ... N

*(c) Figure 19 shows a crowbar being used to lift a heavy weight.

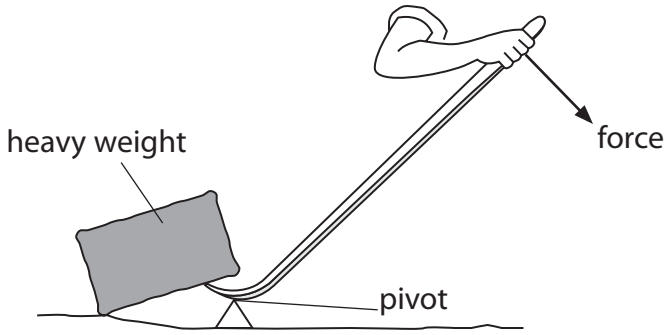

Figure 19

Explain how the crowbar enables a person to lift a heavy weight.

You should include the idea of moments in your answer.

It may help to label some distances in Figure 19 and use those distances in your explanation.

(6)

(Total for Question 7 = 12 marks)

8 (a) The voltage (potential difference) across a length of wire is 1.5 V.

A charge of 0.042 C flows through the wire.

Calculate the energy transferred.

Use the equation

$$E = Q \times V$$

(2)

E = ... J

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(b) Figure 20 shows some of the apparatus that students use to determine the resistance of a piece of iron wire.

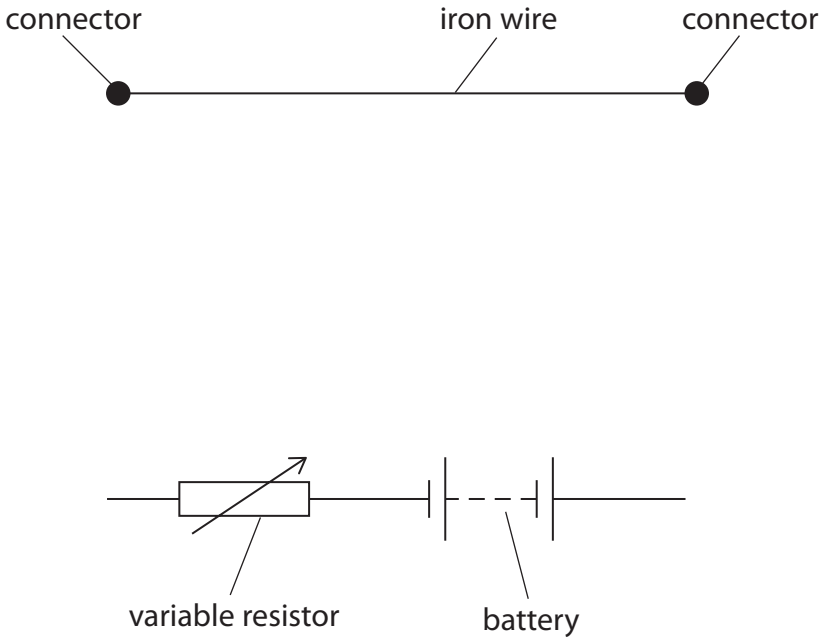

Figure 20

Add connecting wires, a voltmeter and an ammeter to complete the circuit in Figure 20 so that the students can determine the resistance of the piece of iron wire.

(2)

(c) The students extend the investigation to determine how the resistance of the iron wire changes with its length.

(i) Give the name of **one** additional piece of apparatus the students would need.

(1)

.....

(ii) Figure 21 shows a graph of the results.

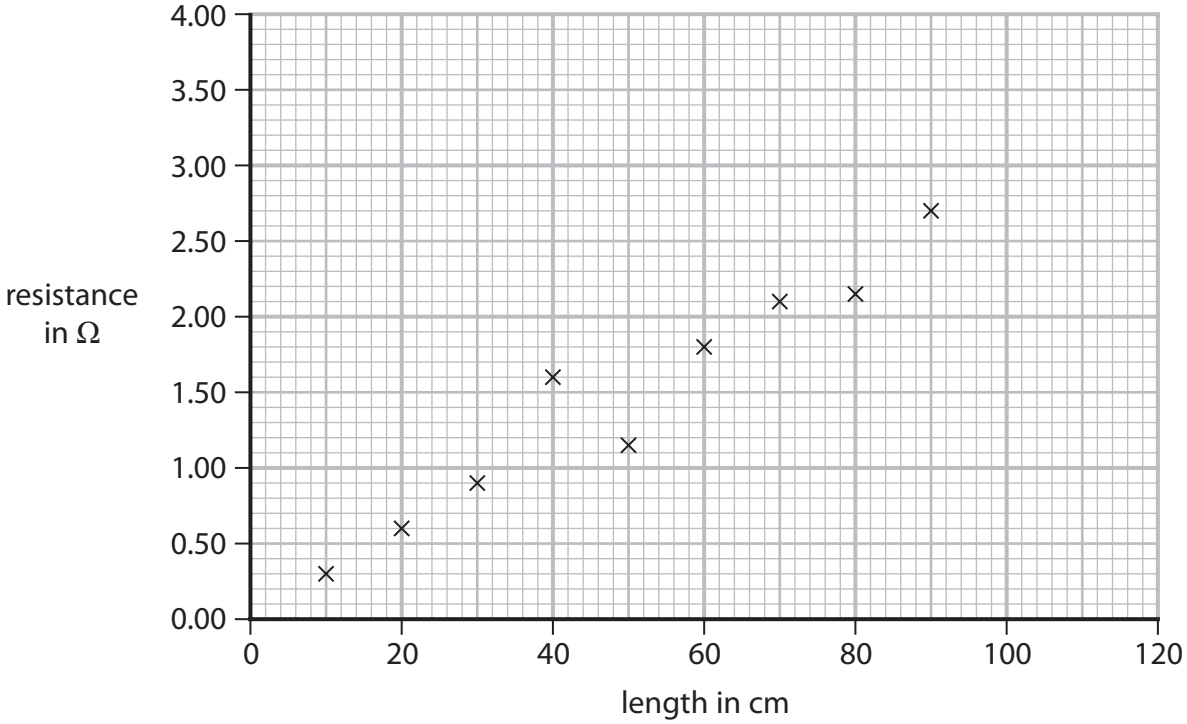

Figure 21

Draw a straight line of best fit on Figure 21.

(1)

(iii) Use Figure 21 to estimate the resistance of a 100 cm length of the iron wire.

(1)

resistance = ... Ω

(iv) The variable resistor shown in Figure 20 is used to prevent the iron wire from becoming too hot.

Explain how the variable resistor is used to prevent the iron wire from becoming too hot.

(2)

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(d) The potential difference (voltage) across another piece of wire is 1.56 *V*.

The current in the wire is 0.45 *A*.

Calculate the resistance of this piece of wire.

Use the equation

$$V = I \times R$$

(2)

resistance = ... Ω

(Total for Question 8 = 11 marks)

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9 (a) Which of these means changing state from solid directly to gas?

(1)

- ☒ **A** condensing
- ☒ **B** freezing
- ☒ **C** melting
- ☒ **D** sublimating

(b) An object has a mass of 7.22×10^{-2} kg and a volume of 2.69×10^{-5} m^3.

Calculate the density, ρ, of the object.

Use the equation

$$\rho = \frac{m}{V}$$

(3)

State the unit.

density = ... unit .....

(c) Aluminium has a melting point of 660 °C.

The absolute zero of temperature is –273 °C.

(i) Calculate the melting point of aluminium in kelvin.

(1)

melting point of aluminium = ... K

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(ii) Describe the motion of particles in liquid aluminium (above 660 °C).

(2)

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*(d) The table shows some properties of two materials used as thermal insulation.

The higher the R-value, the better the thermal insulating properties of the material.

material	R-value	fire resistance
fibreglass, made from sand	R-3.3	non-flammable
polystyrene, made from petroleum oil	R-4.0	melts at 270 °C and spreads fire very quickly

Assess which of these materials may be the more suitable to use as thermal insulation in a building.

Your answer should compare the properties of fibreglass and polystyrene given in the table.

(6)

(Total for Question 9 = 13 marks)

10 This question is about pressure.

(a) Figure 22 shows windows in an aeroplane.

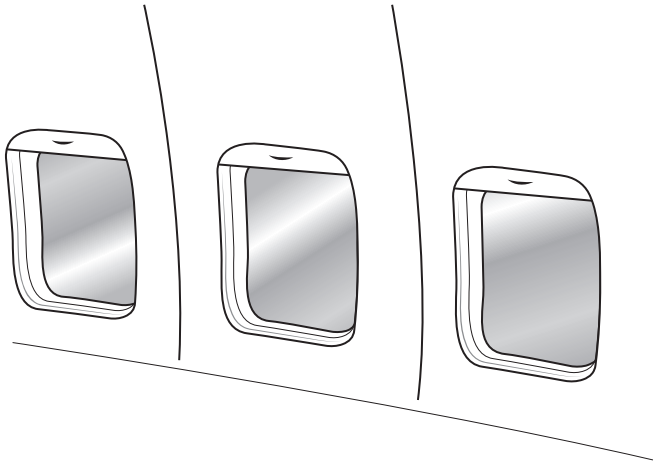

Figure 22

The aeroplane is high above the Earth's surface.

The atmospheric pressure outside the aeroplane is 23 000 Pa.

The air pressure inside the aeroplane is 80 000 Pa.

(i) Calculate the pressure difference between inside and outside of the aeroplane.

(1)

pressure difference = ... Pa

(ii) The surface area of the window is 0.094 m^2.

Calculate the size of the force on the window due to the cabin air pressure of 80 000 Pa.

Use the equation

$$P = \frac{F}{A}$$

(2)

force = ... N

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(iii) On the same aeroplane, a different window has a smaller surface area.

Explain how the force due to the air pressure inside the cabin on the small window differs from the force on the larger window.

(2)

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(iv) Figure 23 shows a cross-section through the aeroplane including one window.

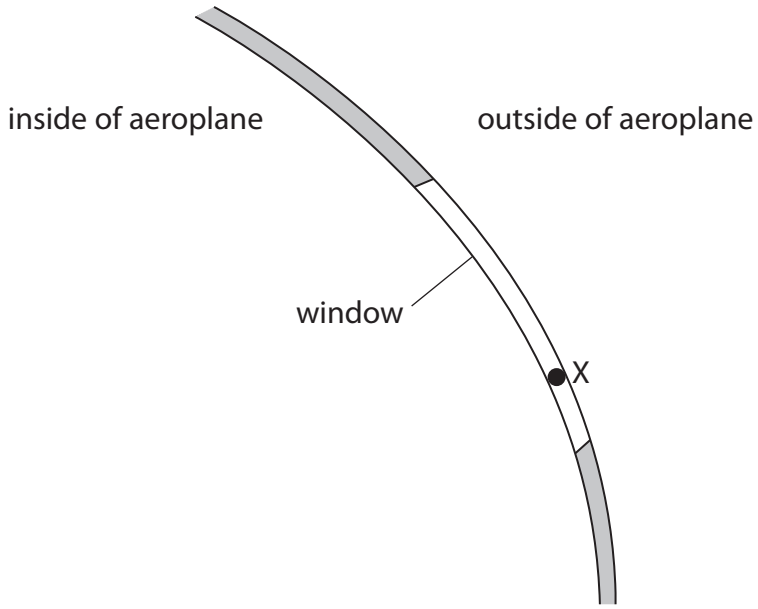

Figure 23

Draw an arrow on Figure 23 to show the direction of the resultant force due to the air pressure inside the cabin on the window at point X.

(2)

(b) Figure 24 shows the atmospheric pressure at different heights above the Earth's surface.

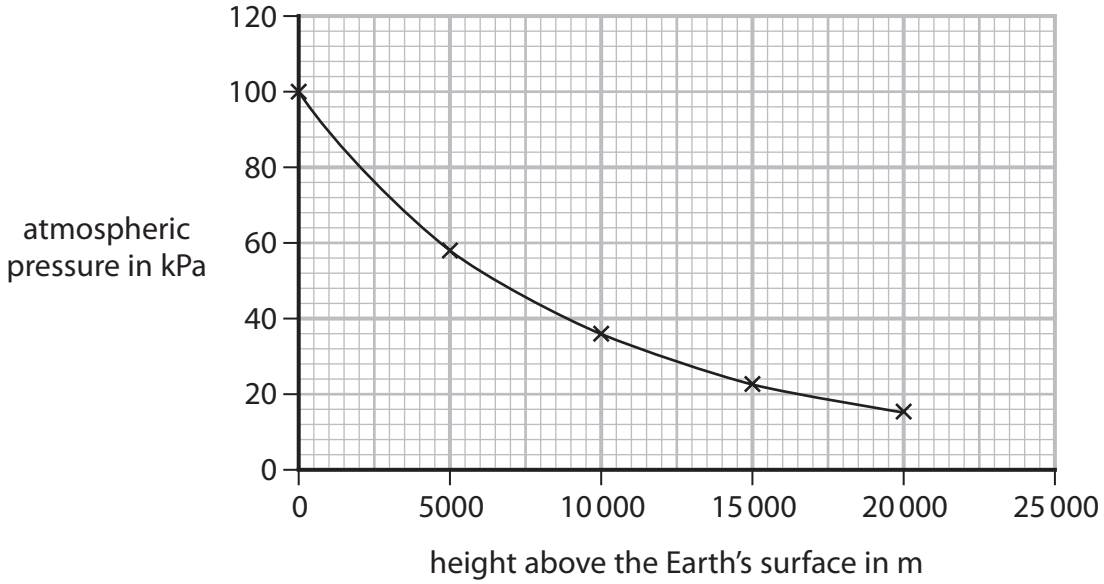

Figure 24

(i) Describe how the atmospheric pressure changes with height above the Earth's surface.

Use data from Figure 24 to support your answer.

(3)

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.....

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(ii) Suggest **one** reason why the atmospheric pressure changes with height above the Earth's surface.

(1)

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(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

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Equations

(final velocity)^2 – (initial velocity)^2 = 2 × acceleration × distance $v^2 - u^2 = 2 \times a \times x$
energy transferred = current × potential difference × time $E = I \times V \times t$
potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil $V_p \times I_p = V_s \times I_s$
change in thermal energy = mass × specific heat capacity × change in temperature $\Delta Q = m \times c \times \Delta\theta$
thermal energy for a change of state = mass × specific latent heat $Q = m \times L$
to calculate pressure or volume for gases of fixed mass at constant temperature $P_1 V_1 = P_2 V_2$
energy transferred in stretching = 0.5 × spring constant × (extension)^2 $E = ½ \times k \times x^2$

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Mark Scheme (Results)

Summer 2023

Pearson Edexcel GCSE
In Physics (1PH0)
Paper 2F

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Mark schemes have been developed so that the rubrics of each mark scheme reflects the characteristics of the skills within the AO being targeted and the requirements of the command word. So for example the command word 'Explain' requires an identification of a point and then reasoning/justification of the point.
Explain questions can be asked across all AOs. The distinction comes whether the identification is via a judgment made to reach a conclusion, or, making a point through application of knowledge to reason/justify the point made through application of understanding. It is the combination and linkage of the marking points that is needed to gain full marks.
When marking questions with a 'describe' or 'explain' command word, the detailed marking guidance below should be consulted to ensure consistency of marking.

Assessment Objective		**Command Word**	
Strand	**Element**	**Describe**	**Explain**
AO1		An answer that combines the marking points to provide a logical description	An explanation that links identification of a point with reasoning/justification(s) as required
AO2		An answer that combines the marking points to provide a logical description, showing application of knowledge and understanding	An explanation that links identification of a point (by applying knowledge) with reasoning/justification (application of understanding)
AO3	1a and 1b	An answer that combines points of interpretation/evaluation to provide a logical description	
AO3	2a and 2b		An explanation that combines identification via a judgment to reach a conclusion via justification/reasoning
AO3	3a	An answer that combines the marking points to provide a logical description of the plan/method/experiment	
AO3	3b		An explanation that combines identifying an improvement of the experimental procedure with a linked justification/reasoning

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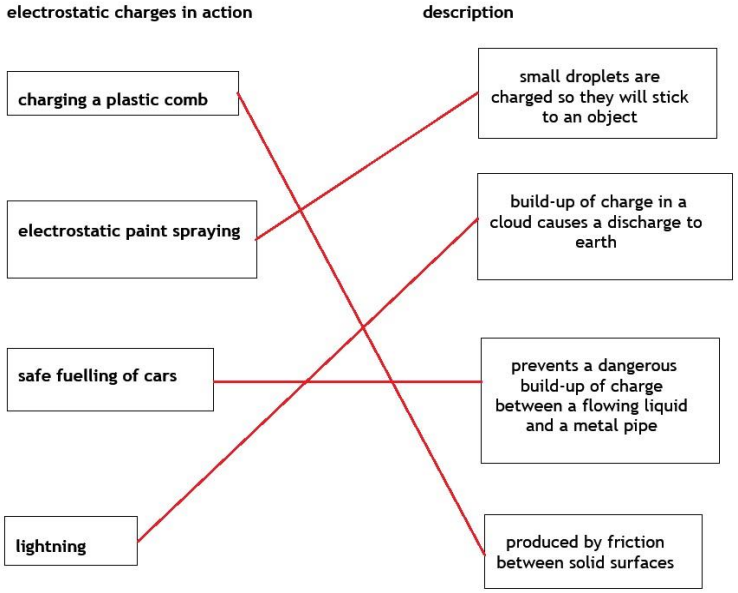
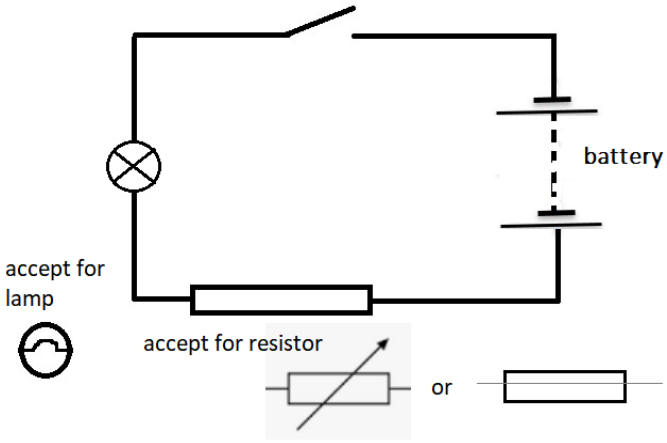
Question number	Answer	Additional guidance	Mark
1 (a)	B charge A, C and D are incorrect force or property associations		(**1**) AO1

Question number	Answer	Additional guidance	Mark
1(b) (i)	explanation linking like/same charges (on strands of hair) (1) (like charges) repel (1)	positives / protons negatives / electrons if no other mark allow one mark for charge / 'it' / electron(s) moves OR current (in body, to or from dome) ignore 'static'	(**2**) AO1

Question number	Answer	Additional guidance	Mark
1 (b) (ii)	substitution (1) (%) = $\frac{10}{25}$ (x 100) evaluation (1) (%) = 40 (%)	accept 0.4 accept 10 and 25 written next to numerator and denominator of the stated equation award full marks for the correct answer without working	(**2**) AO2

Question number	Answer	Additional guidance	Mark
1 (c)		1 mark for one line correct 2 marks for two or three lines correct 3 marks for four lines correct. if more than one line is drawn from or to a box, do not credit any of those lines	(**3**) AO3

Total for Q1 = 8 marks

Question number	Answer	Additional guidance	Mark
2(a)	 lamp symbol (1) switch symbol (1) open or closed resistor symbol (1) complete series circuit, with any circuit symbol(s) connected to the battery (1)	ignore any additional symbols ignore cells / batteries	**(4)** AO1

Question number	Answer	Additional guidance	Mark
2 (b)	**B** 5 A A, C and D are incorrect repetitions or addition		(**1**) AO1

Question number	Answer	Additional guidance	Mark
2 (c) (i)	substitution (1) (charge) = 0.46 x 30 evaluation (1) (charge) = 14 (C)	any number that rounds to 14 e.g. 13.8 award full marks for the correct answer without working	(**2**) AO2

Question number	Answer	Additional guidance	Mark
2 (c) (ii)	substitution (1) (energy transferred) = 0.46 x 6.0 x 60 evaluation (1) (energy transferred) = 170 (J)	 allow (energy transferred) = 0.46 x 6.0 x 1 or (energy transferred) = 0.46 x 6.0 x 30 any number that rounds to 170 e.g. 165.6 or 166 allow answers that round to 2.8 or 83 e.g. 2.76 or 82.8 for 1 mark only award full marks for the correct answer without working	(**2**) AO2

Total for Q2 = 9 marks

Question number	Answer	Additional guidance	Mark
3 (a) i	any one from do not touch heater (when it is switched on) (1) do not use mains (voltage) (1) use gloves/cloth to handle beaker/heater (after water is heated) (1)	 accept only switch on when in beaker/water 'use gloves' must be qualified with a purpose in using them e.g. use gloves to prevent burns	(**1**) AO1

Question number	Answer	Additional guidance	Mark
3 (a) ii	any one from bunsen (burner) (1) putting out in the sunlight (1) water bath (1)	 gas (heating) solar accept use hands (to warm)	(**1**) AO1

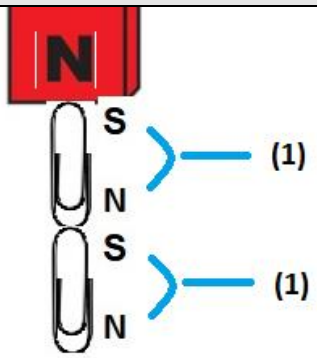
Question number	Answer	Additional guidance	Mark
3 (b)	A description to include any three from from P to Q temperature (of ice) increases (1) from Q to R temperature (of ice and water mixture) stays constant (at 0°C) (1) from R to S temperature (of water) increases (1) any reference to melting / melts (1) melting from Q to R (1) PQ (contents are) solid (1) QR (contents are) {solid + liquid} / {ice + water} (1) RS (contents are) liquid / water (1)	accept time interval references as equivalent to PQ, QR and RS intervals take PQ as from -8/-9°C to Q take RS as from R to to 11/12 °C accept solid/ice turns to liquid/water temperature stays constant when melting if no other mark scored, allow one mark for correct description of temperature changes without references to PQRS or time	(**3**) AO3

Question number	Answer	Mark
3 (c) i	B decreases increases A is wrong because the volume of the bubble does not decrease C and D are wrong because the air pressure in the bubble does not increase	(**1**) AO1

Question number	Answer	Additional guidance	Mark
3 (c) ii	**D** Pa A , B and C are wrong because they are all wrong units for pressure		(**1**) AO1

Question number	Answer	Additional guidance	Mark
3 (c) iii	substitution (1) (V_2 =) $\frac{0.5 \times 3.3}{1.07}$ evaluation (1) (volume of the bubble =) 1.5	 any number that rounds to 1.5 (m/s) accept 1.54 award full marks for the correct answer without working	(**2**) AO2

Total for Q3 = 9 marks

Question number	Answer	Additional guidance	Mark
4 (a) (i)		both poles needed for each mark (either side of paper clip, right or left) allow just S at the top of the pair and N at the bottom of the pair for 1 mark ignore the third paper clip after these two (given in question)	(**2**) AO1

Question number	Answer	Additional guidance	Mark
4 (a) (ii)	induced (1)		(**1**) AO1

Question number	Answer	Additional guidance	Mark
4 (a) (iii)	iron / steel / nickel / cobalt (1)	ignore 'metal' do not allow any other named metal	(**1**) AO1

Question number	Answer	Additional guidance	Mark
4(a) (iv)	description including **two** from use a (plotting) compass (1) (plotting compass) shows a change in direction / needle moves OR bring the paper clips together (1) seeing if they attract / repel (1) OR use of iron filings (around the paperclips) (1) see a pattern (1)	 sees repulsion / repelling bring the paper clips near to a magnetic material ignore 'magnet' for this marking point do not accept 'attracts to a magnet' accept for two marks bring a magnet close to a paper clip to test for repulsion	(**2**) AO1

Question number	Answer	Additional guidance	Mark
4 (b) (i)	(magnetic field) {lines / circles / pattern} closer (together at P) (1)	(magnetic field) lines more concentrated (at P) (magnetic field) lines further apart / less concentrated at Q ignore idea that P is closer (to the wire than Q)	(**1**) AO1

Question number	Answer	Additional guidance	Mark
4 (b) (ii)	a description to include as current increases magnetic field strength increases (1) linear/ increases in even steps / doubling idea / proportional (1)	allow positive correlation 'directly proportional' scores 2 marks	(**2**) AO3

Total for Q4 = 9 marks

Question number	Answer	Mark
5 (a)	**C** 50 Hz A, B and D are all distracting numbers not matching the frequency of the mains	(**1**) AO1

Question number	Answer	Additional guidance	Mark
5(b)	explanation linking any two from: (smaller currents) reduce heating effect (in cables) (1) less energy / power wasted (in cables) (1) increases efficiency (1)	accept thermal energy for heat energy allow will not get (as) hot / heat loss is reduced allow 2 marks for 'reduce(s) heat energy loss'	(2) AO1

Question number	Answer	Additional guidance	Mark
5 (c) (i)	substitution (1) (power =) 12000 x 0.64 evaluation (1) R = 7700 (W)	 allow (power =) 240 x 32 any answer that rounds to 7700 (W) e.g. 7680 (W) award full marks for the correct answer without working	(**2**) AO3

Question number	Answer	Additional guidance	Mark
5(c) (ii)	substitution (1) ($\frac{\text{number of turns in secondary coil}}{\text{number of turns in primary coil}}$ =) $\frac{1600}{80000}$ or $\frac{1}{50}$ evaluation (1) 0.02(0)	0.02(0) to any other power of 10 scores 1 mark award full marks for correct answer without working accept for 1 mark (seen anywhere) $\frac{50}{1}$, $\frac{80000}{1600}$, 50 **or** (from counting turns) $\frac{4}{15}$, 0.27	(2) AO2

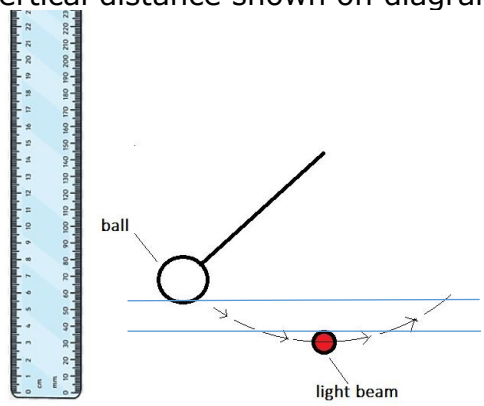
Question number	Answer	Additional guidance	Mark
5(c) (iii)	(ratio =) 240 : 12000 (1) 1 : 50 (1)	0.02 : 1 award full marks for correct answer without working	(**2**) AO2

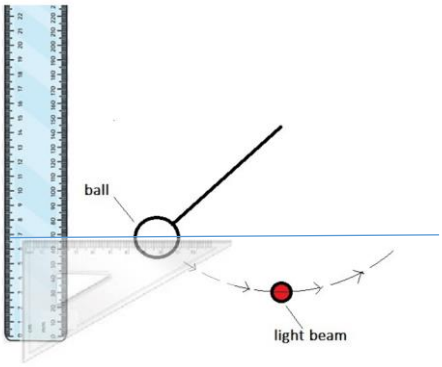
Total for Q5 = 9 marks

Question number	Answer	Additional guidance	Mark
6 (a)	substitution (1) (mean speed) = $\frac{1.31 + 1.27 + 1.16}{3}$ evaluation (1) speed = 1.25 (m/s)	 $\frac{3.74}{3}$ any number that rounds to 1.25 (m/s) e.g. 1.247 accept 1.2 or 1.3 allow 1.24 award full marks for the correct answer without working	(**2**) AO2

Question number	Answer	Additional guidance	Mark
6 (b)	any one idea from • identifying anomalous results (1) • improve reliability (1) • uncertainty in starting point (1)	ignore accuracy check if results are precise allow more precise	(**1**) AO1

Question number	Answer	Additional guidance	Mark
6 (c)	substitutions (2) $(\Delta GPE = m \times g \times \Delta h)$ = 0.052 x 10 x (0.0)5 (1) converts 5 cm to 0.05 m (1) evaluation (1) = 0.026 (J)	0.05 seen award full marks for the correct answer without working 0.026 to any other power of ten scores 2 marks	(**3**) AO2

Question number	Answer	Additional guidance	Mark
6 (d) i	ruler / line / rectangle shown vertically, must include minimum vertical distance shown on diagram (1) 	judge by eye accept any vertical line covering the minimum vertical distance	(**1**) AO3

Question number	Answer	Additional guidance	Mark
6 (d) ii	description to include set square placed against ruler (to measure vertical position) (1) (one edge of set square placed at) right angles / perpendicular / 90° (to ruler) (1) (set square used to) make ruler vertical (1)	accept reasonable alternatives on a diagram or explained in writing accept one edge of the set square shown as vertical in diagram full marks may be awarded from additions to Figure 15 or 16 e.g.  allow 2 marks for any horizontal line (set square use) on the diagram drawn through / touching a vertical ruler if no other mark scored allow 1 mark for improving accuracy	(**2**) AO3

Total for Q6 = 9 marks

Question number	Answer	Mark
7 (a)	B force A, C and D are all scalars; B is the only vector	(**1**) AO1

Question number	Answer	Additional guidance	Mark
7 (b) (i)	substitution (1) moment of force = 150 x 1.8 evaluation (1) moment of force = 270 (N m)	 award full marks for the correct answer without working	(**2**) AO2

Question number	Answer	Additional guidance	Mark
7 (b) (ii)	substitution (1) W x 0.95 = 270 rearrangement and evaluation (1) W =($\frac{270}{0.95}$)= 280 (N) any answer to 2 sf (1)	ecf from (i) any number that rounds to 280 (N) e.g. 284.2 (N) award 2 marks to here for the correct answer without working	(**3**) AO2

Question number	Indicative content	Mark
***7(c)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • benefit → easier with a lever (AO2) • crowbar easier to lift/move (AO2) • (applied force) is less (AO1) • distance to pivot from (applied) force is (considerably) bigger than distance of load/weight to pivot (AO2) • labelled distances in figure xx (AO2) • force (applied) x x = load x y i.e. principle of moments used (AO1) • relevant mention of clockwise and anticlockwise moments (AO1) • specific application to crowbar (AO2)	**(6)** AO1, AO2

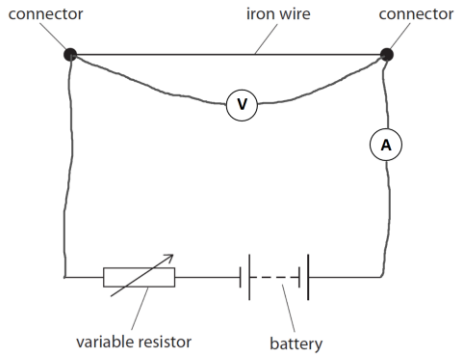
AO targeting 3 marks AO1 strand 1 and 3 marks AO2 strand 1

Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)
Level 3	5-6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)

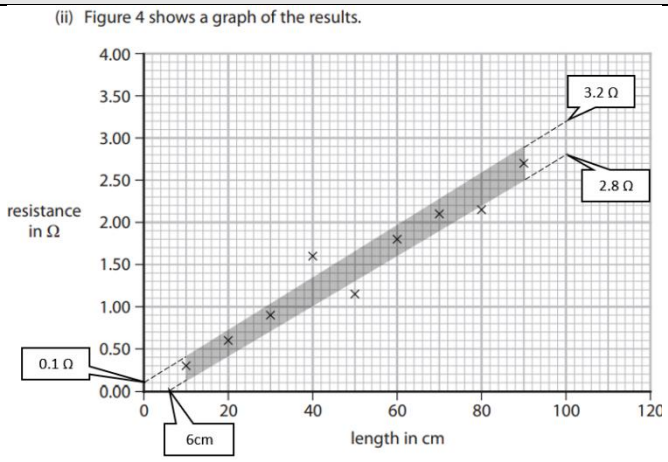
Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance elements of physics understanding with some linking to scientific ideas/practical application two isolated statements	Possible candidate responses easier to lift big distance to pivot you can apply your weight onto the crowbar
Level 2	3–4	Additional guidance mostly relevant physics understanding with application of scientific ideas makes some link between force and distance OR some reference to moments	Possible candidate responses less force needed as there is a bigger distance to pivot OR because of moments you need less force
Level 3	5–6	Additional guidance accurate and relevant physics understanding with detailed application of scientific ideas Some reference to crowbar. makes links between force and distance AND refers to moments	Possible candidate responses If moment of weight = moment of crowbar, then the further away you are, you need less force to move the weight the bigger the distance to the pivot, the less force you need to provide the same moment

Total for Q7 = 12 marks

Question number	Answer	Additional guidance	Mark
8 (a)	substitution (1) (E =) 0.042 x 1.5 evaluation (1) (E =) 0.063 (J) (1)	 6.3×10^{-2} award 2 marks for the correct answer without working accept 0.063 to any other power of 10 for 1 mark	(**2**) AO2

Question number	Answer	Additional guidance	Mark
8(b)	voltmeter connected in parallel with the iron wire / any part of the iron wire (1) ammeter connected in series with the iron wire (1) example:  	accept any recognisable symbols. accept symbol drawn over connecting wire do not credit the same type of meter shown in contradictory positions	(**2**) AO1

Question number	Answer	Additional guidance	Mark
8 (c) (i)	one from (1) metre rule / metre stick / ruler / (measuring) tape / crocodile clip / other clip / wire cutters / pliers / sliding contact jockey / more (iron) wire	 accept scissors ignore additional electrical devices such as ohmmeter / multimeter	(**1**) AO3

Question number	Answer	Additional guidance	Mark
8(c)(ii)	(ii) Figure 4 shows a graph of the results.  	accept any straight line within the shaded range shown judge by eye. ignore extrapolation	(**1**) AO2

Question number	Answer	Additional guidance	Mark
8 (c)(iii)	any number between 2.7 and 3.3 inclusive	allow ecf from (ii) ±0.1 Ω	(**1**) AO2

Question number	Answer	Additional guidance	Mark
8 (c) (iv)	explanation linking any **two** from: (variable) resistor increases the resistance (of the circuit) (1) (therefore) keeps the current constant / small(er) (1) because **current** increases temperature of the (iron) wire (1)	accept flow of electrons / charge for current reduces current / limits the current ignore slows the current / charge accept current heats up (iron) wire accept for two marks: adjust variable resistor to keep current constant / small	(**2**) AO1

Question number	Answer	Additional guidance	Mark
8 (d)	substitution (1) 1.56 = 0.45 x R rearrangement and evaluation (1) (R =) 3.5 (ohms)	alternative method rearrangement (1) (R =) $\frac{V}{I}$ **or** (R=) $\frac{1.56}{0.45}$ (substitution and) evaluation (1) (R =) 3.5 (ohms) allow values that round to 3.5 e.g. 3.46(666) 3.47 etc award full marks for the correct answer without working	(**2**) AO2

Total 11 marks

Question number	Answer	Mark
9 (a)	☒ D sublimating A is incorrect because it describes a change of state from gas to liquid. B is incorrect because it describes a change of state from liquid to solid C is incorrect because it describes a change of state from solid to liquid	(**1**) AO1

Question number	Answer	Additional guidance	Mark
9 (b)	substitution (1) $(r) = \frac{7.22(\times 10^{-2})}{2.69(\times 10^{-5})}$ evaluation (1) (ρ =) 2680 unit (1) kg / m^3	 2.68 to any power of ten seen allow any value that rounds to 2680; e.g. 2684 accept 2700 allow values in standard form e.g. 2.68 x 10^3 kg m^{-3} allow for three marks: 2.68 to any power of ten **with** a consistent unit, e.g. 2680 kg/m^3 2680 g/dm^3 2.68 g/cm^3 2.68 kg/dm^3 0.00268 kg/cm^3 2 680 000 g/m^3 allow for two marks: • 2680 with no or incorrect unit • 2.68 to any other power of 10 **with** an inconsistent unit of density • correct substitution **with** an inconsistent unit of density allow for one mark: • 2680 to any other power of ten with no or incorrect unit • appropriate unit of density with no or an incorrect value	(**3**) AO2

Question number	Answer	Additional guidance	Mark
9 (c) (i)	933 (K) (1)	do not accept -933	(**1**) AO2

Question number	Answer	Additional guidance	Mark
9 (c)(ii)	A description to include any **two** from: (motion is) random (1) various {speeds / velocities / kinetic energies} (1) bump into each other / collide (1) fast(er than solid) (1)	 move freely / move in any direction / move around different speeds range of speeds slide over / past each other / touch each other / in contact with each other more kinetic energy (than in solid) ignore bulk properties of liquids e.g. take shape of container. ignore vibrate "random speeds" on its own scores 1 mark	(**2**) AO1

Question number	Indicative content	Mark
***9(d)**	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Fibre glass • has lower R-value • similar R-value (to polystyrene) • derived from sand so plentiful / cheap • non-flammable • dangerous to install • concludes / uses other arguments to say that it is a suitable or unsuitable material Polystyrene • high(est) R-value so suitable on that score • (but) involves petroleum / oil extraction so (could be) environmentally damaging • melting / flammable / fire hazard / release of toxic fumes • concludes / uses other arguments to say that it is a suitable or unsuitable material	**(6)** AO2, AO3

AO targeting: 3 marks AO2 strand 1 and 3 marks AO3 strand 1a and 1b

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1–2	• Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3) • The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2)
Level 2	3–4	• Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (AO3) • The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2)
Level 3	5–6	• Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3) • The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)

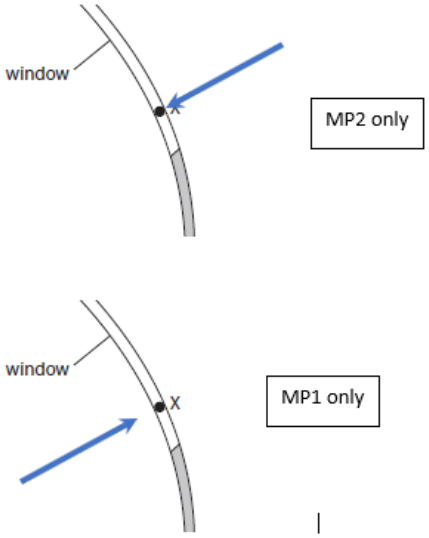
Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance at least two pieces of information from the table used OR one piece of information on the table and makes a simple choice	Possible candidate responses R is 4.0 for polystyrene + fibreglass is not flammable OR we should use fibreglass
Level 2	3–4	Additional guidance compares at least two properties OR compares one property and gives a conclusion about suitability uses information from the two materials used AND makes some comparison(s) / concludes logically about suitability	Possible candidate responses fibreglass has a lower R-value and is not flammable, but polystyrene is OR fibreglass is not flammable, but polystyrene is, so fibreglass better
Level 3	5–6	Additional guidance compares at least two properties AND gives a conclusion (both materials involved, allow one to be discussed in greater detail than the other) WITH logical connections between elements argued from the table.	Possible candidate responses fibreglass and polystyrene have similar R-values. Fibreglass is not flammable, but polystyrene is, so fibreglass is better

Total for Q9 = 13 marks

Question number	Answer	Additional guidance	Mark
10 (a) (i)	(80 000 – 23 000) 57 000 (Pa) (1)	 -57 000 (Pa)	(**1**) AO2

Question number	Answer	Additional guidance	Mark
10 (a) (ii)	substitution (1) 80 000 = $\frac{F}{0.094}$ rearrangement and evaluation (1) (F=) 7500 (N)	alternative method re-arrangement (1) (F =) P x A **or** (F=) 80 000 x 0.094 (substitution and) evaluation (1) accept 7520 (N), award full marks for correct answer without working. allow 1 mark max for substitution using pressure of 57 000 **or** an answer that rounds to 5400 e.g. 5358 (calculated net force)	(**2**) AO2

Question number	Answer	Additional guidance	Mark
10 (a) (iii)	force is less (on small window) (1) pressure is the same (1)	force is greater on large window	(**2**) AO1

Question number	Answer	Additional guidance	Mark
10 (a) (iv)	arrow pointing towards outside of aeroplane (1) arrow is normal to surface at X (judge by eye) (1) Examples:  	may be inside or outside of aeroplane. need not touch X do not award if two or more conflicting arrows drawn must touch X or dot at X independent marks	(**2**) AO1

Question number	Answer	Additional guidance	Mark
10 (b) (i)	increase in height results in decrease in pressure (1) non-linear relationship (1) use of numerical data (1) at least two different pressure and height values from the graph	pressure decreases with height accept inversely proportional in this context accept negative correlation double the height does not result in half the pressure pressure not does change evenly description of graph e.g. curved / not straight calculation of change in pressure e.g. 5000m to 10000 m pressure went down by 22	(**3**) AO3

Question number	Answer	Additional guidance	Mark
10 (b) (ii)	any **one** from air becomes less dense (1) smaller weight (of air) above (1) lower temperature (1)	accept oxygen / atmosphere for air air gets thinner / (air) particles further apart / fewer particles / less particles less air above / smaller height of air above ignore change in value of g with height	(**1**) AO1

Total 11 marks