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EDEXCEL GCSE PHYSICS: QUESTIONS BY TOPIC

Electricity and Circuits (10)

GCSE Physics (Higher) Topic 10

12 questions · 122 marks · Mark schemes included

Pearson Edexcel GCSE (9-1) Physics 1PH0, Higher Tier, June 2018 - June 2025

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HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.

Click any row below to jump straight to that question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

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QUESTIONS

12 questions · 122 marks · lowest tariff first



9-MARK QUESTIONS

5 questions in this booklet



- 2 (a) Figure 4 shows the results from an experiment where the potential difference (voltage) across a filament lamp was varied.

The current and voltage were measured.

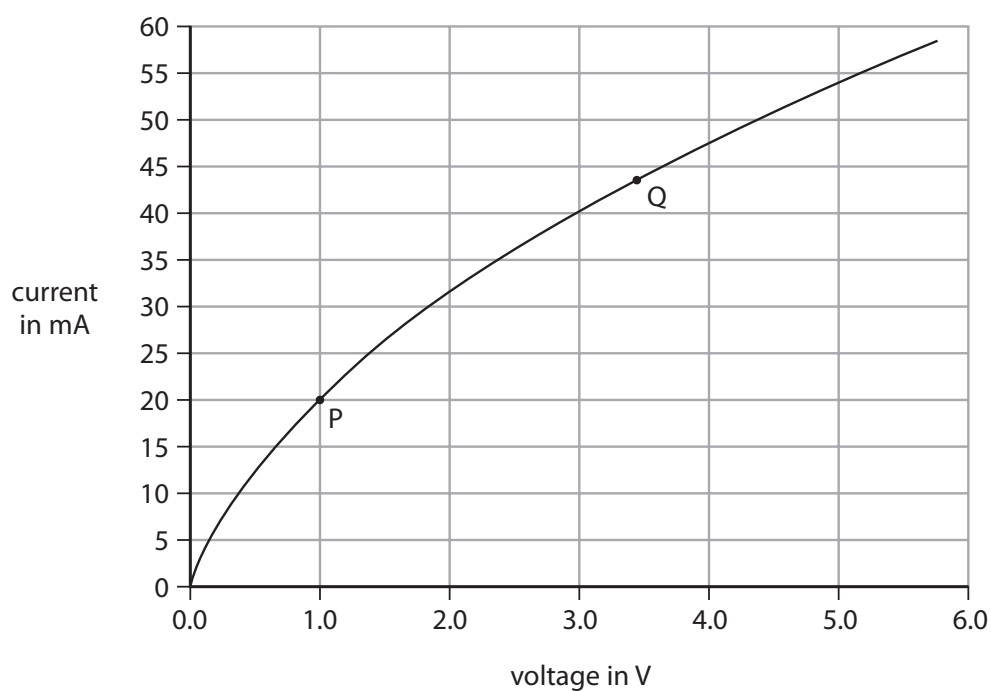


Figure 4

- (i) Describe the relationship between the current and the voltage as shown in the graph in Figure 4.

(2)

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- (ii) Use the values of the voltage and current at point P and at point Q on the graph in Figure 4 to complete the table in Figure 5.

(2)

	voltage in V	current in mA
point P		
point Q		

Figure 5

- (iii) Calculate the resistance of the filament lamp when the voltage is 4.5V and the current is 51 mA.

Use the equation

$$R = \frac{V}{I}$$

(2)

resistance = ... Ω

- (iv) Explain why the resistance of the filament lamp changes as the voltage across it increases.

(3)

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(Total for Question 2 = 9 marks)



- 2 (a) Figure 3 shows a lamp connected to a d.c. power supply.

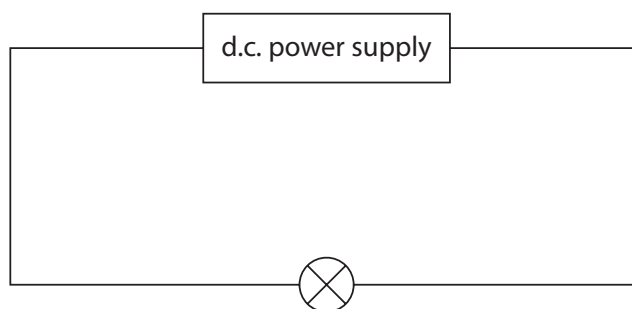


Figure 3

The power supply provides a potential difference (voltage) of 4.5 V.

The current in the lamp is 0.30 A.

- (i) Calculate the resistance of the lamp.

Use the equation

$$R = \frac{V}{I}$$

(1)

resistance = ... Ω

- (ii) Calculate the power supplied to the lamp.

(2)

power = ... W



(b) Another **identical** lamp is added to the circuit, as shown in Figure 4.

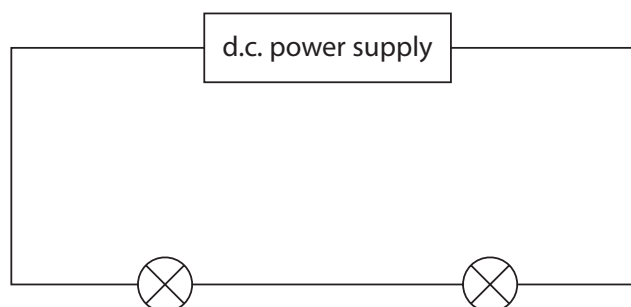


Figure 4

The power supply provides the same potential difference as it provided in the circuit in Figure 3.

State and explain the difference between the brightness of the lamp in Figure 3 and the brightness of a lamp in Figure 4.

(3)

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(c) A student is given a low voltage power supply and 1 m of resistance wire.

The student uses these and other pieces of equipment to measure the resistance of just 50 cm of the resistance wire.

Draw a diagram of the circuit that the student should use.

Your circuit diagram should identify the pieces of equipment that the student uses.

(3)

(Total for Question 2 = 9 marks)



- 2 (a) Figure 3 shows some of the apparatus that students use to determine the resistance of a piece of iron wire.

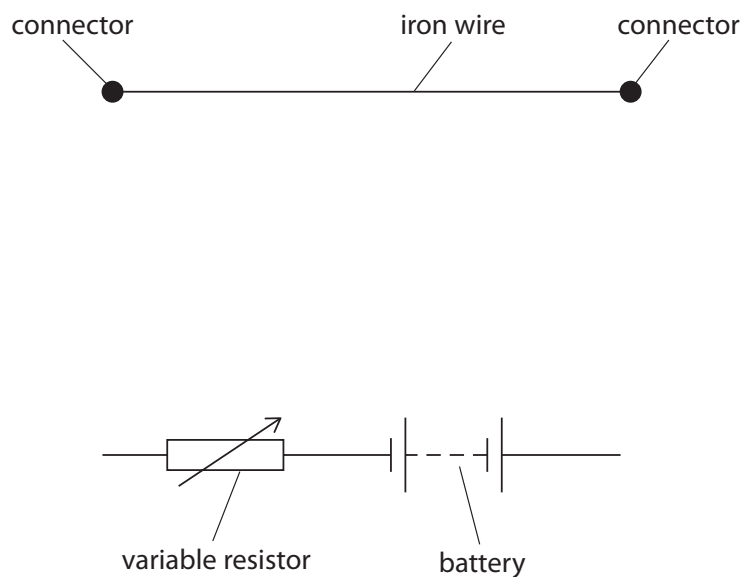


Figure 3

Add connecting wires, a voltmeter and an ammeter to complete the circuit in Figure 3 so that the students can determine the resistance of the piece of iron wire.

(2)

- (b) 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 4 shows a graph of the results.

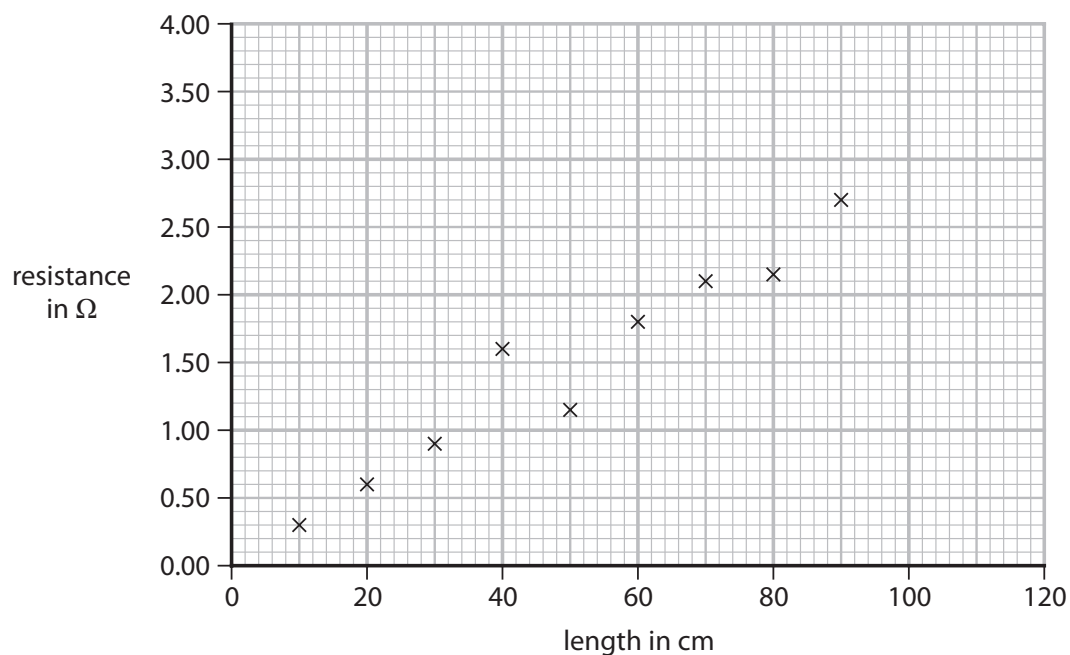


Figure 4

Draw a straight line of best fit on Figure 4.

(1)

(iii) Use Figure 4 to estimate the resistance of a 100 cm length of the iron wire.

(1)

resistance = ... Ω

(iv) The variable resistor shown in Figure 3 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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(c) 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 2 = 9 marks)



2 (a) Figure 4 is a circuit diagram.

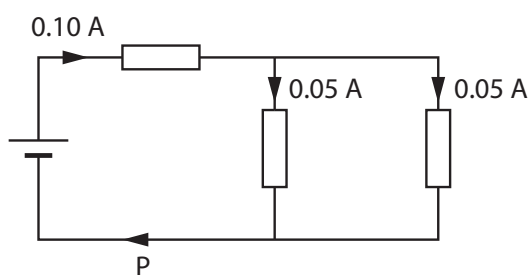


Figure 4

The current at P is

(1)

- ☐ A 0.05 A
- ☐ B 0.10 A
- ☐ C 0.15 A
- ☐ D 0.20 A

(b) Some students investigate resistors in parallel.

The students set up a circuit containing **four** identical resistors.

The circuit used is shown in Figure 5.

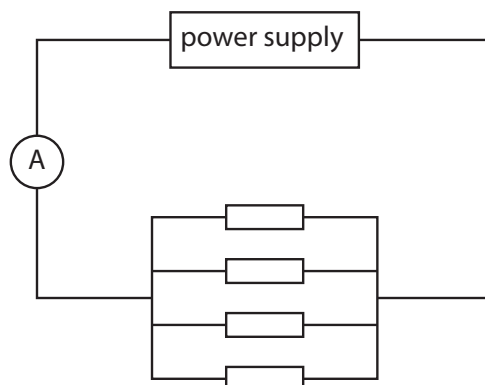


Figure 5

The students measure the current from the power supply and the voltage (p.d.) across the resistors.

- (i) On Figure 5, draw a voltmeter connected to measure the voltage (p.d.) across the resistors.

(1)

The students remove one resistor and measure the current and voltage again with only 3 resistors in the circuit.

They repeat the measurements of current and voltage with only 2 resistors in the circuit and then with only 1 resistor in the circuit.

Figure 6 is a table of their results.

number of resistors	current in mA	voltage in V
4		6.00
3	27.3	6.00
2	18.2	6.00
1	9.1	6.00

Figure 6



- (ii) Using data from the table in Figure 6, predict the current from the power supply when there are 4 resistors in the circuit.

(1)

current = ... mA

- (iii) Using data from the table in Figure 6, calculate the resistance of **only 1** resistor.

(3)

resistance = ... Ω

- (iv) Using data from the table in Figure 6, explain what happens to the **total resistance of the circuit** as the number of resistors in parallel decreases.

(3)

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(Total for Question 2 = 9 marks)



- 3 (a) State the frequency of the supply of electricity to homes in the UK (United Kingdom).

(1)

frequency = ... Hz

- (b) The mains supply to the television is 230V.

The current supplied to the television is 0.53 A.

Calculate the power input to the television.

Use the equation

$$P = I \times V$$

(2)

power = ... W

- (c) A plug connects a television to the mains supply.

- (i) The plug contains a fuse that is connected to the

(1)

- ☐ A live pin
- ☐ B negative pin
- ☐ C neutral pin
- ☐ D positive pin



(ii) A 3 A fuse is used in the plug.

Explain what happens if a fault causes the current to rise to more than 3 A.

(2)

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(iii) A fuse is a safety device.

State **one** other safety device that can be used in domestic electrical wiring.

(1)

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(d) Figure 4 shows two pieces of electrical cable side by side.

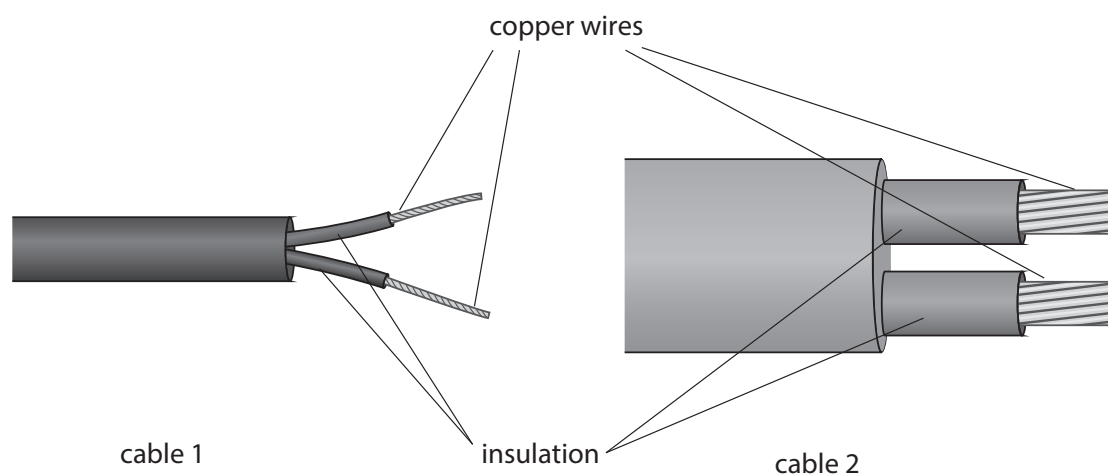


Figure 4

Cable 1 is used to supply electric current to the television.

Cable 2 is used to supply electric current to the house.

Explain why cable 2 is more suitable than cable 1 for supplying electric current to the house.

(2)

(Total for Question 3 = 9 marks)

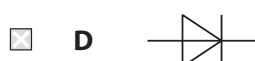
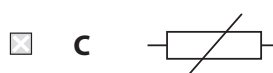
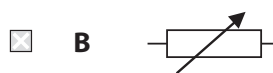
10-MARK QUESTIONS

1 question in this booklet



8 (a) Which of these shows the correct circuit symbol for a thermistor?

(1)



(b) A student investigates how the resistance of a thermistor varies with temperature.

Figure 16 shows a graph of the results of this investigation.

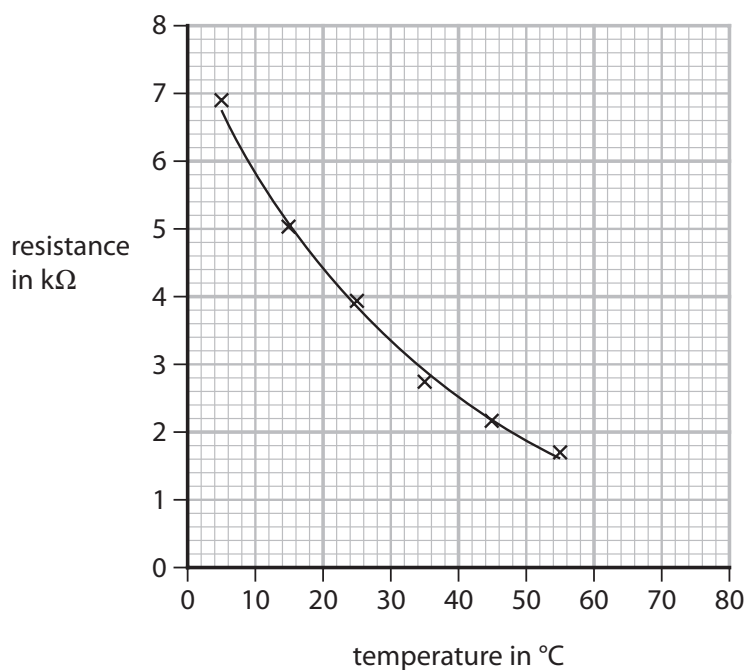


Figure 16

(i) Describe how the resistance of this thermistor varies with temperature.

(2)

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(ii) Draw the tangent to the curve at a temperature of 30 °C, to find the rate of change of resistance with temperature at 30 °C.

State the unit.

(3)

rate of change of resistance with temperature at 30 °C = ... unit



(c) Figure 17 shows the apparatus used for this investigation.

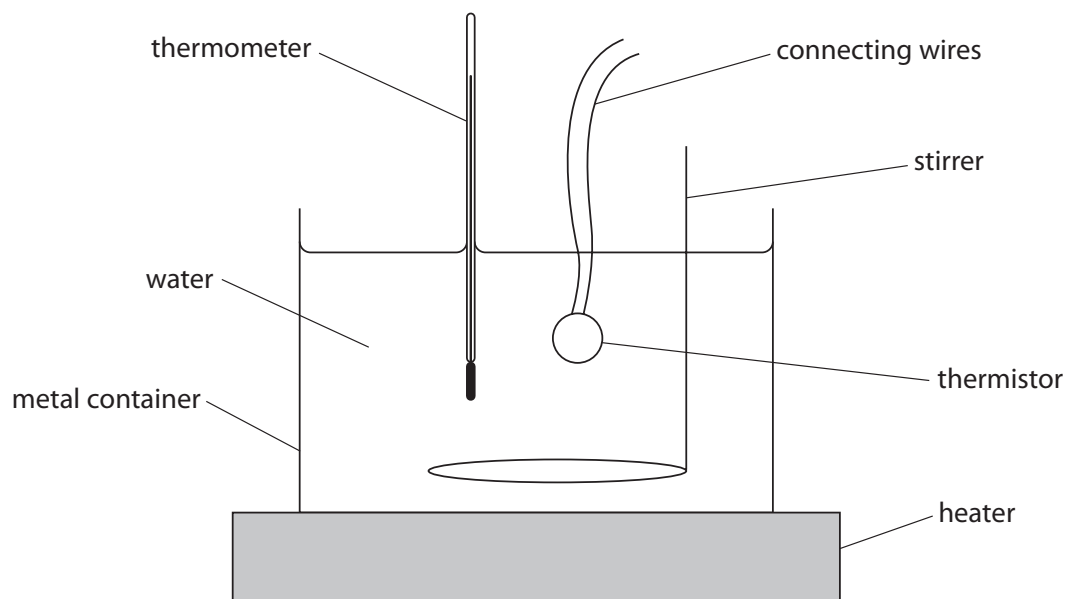


Figure 17

- (i) Explain **one** improvement in measurement that the student could make in the investigation.

(2)

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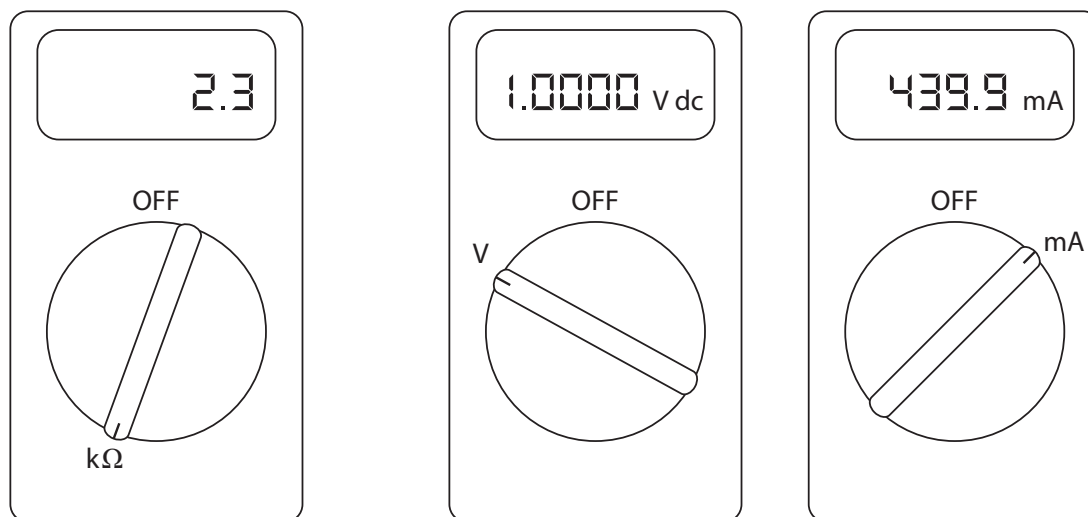
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In this investigation, the resistance can be measured in two ways.

Method 1 – use an ohmmeter.

Method 2 – use an ammeter and a voltmeter.



Method 1

using an ohmmeter

Method 2

using an ammeter and voltmeter

Figure 18

(ii) Explain why method 2 gives more precise results than method 1.

(2)

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(Total for Question 8 = 10 marks)

11-MARK QUESTIONS

5 questions in this booklet



8 (a) A resistor is connected to a power supply.

The potential difference across the resistor is 6.0V.

(i) Which of these corresponds to a potential difference of 6.0V?

(1)

- ☐ **A** 6.0 joules per ohm
- ☐ **B** 6.0 amps per coulomb
- ☐ **C** 6.0 joules per coulomb
- ☐ **D** 6.0 amps per ohm

(ii) The resistor remains connected for a period of time.

The current in the resistor is 200 mA.

A total charge of 42 C flows through the resistor.

Calculate, in minutes, the time taken for this amount of charge to flow through the resistor.

(3)

time = ... minutes

(iii) Calculate the total energy transferred by the 6.0V power supply when a charge of 42 C flows through the resistor.

(2)

energy = ... J



- (b) The resistor becomes warm while there is a current in it.

Explain why the resistor becomes warm.

(2)

- (c) Figure 16 shows a cardboard tube with a wire coming out from each end.



Figure 16

There are two 10 ohm resistors inside the cardboard tube.

A potential difference of 6.0V is connected between P and Q.

There is a current of 1.2 A in the wires.

Deduce how the resistors have been arranged inside the cardboard tube.

(3)

(Total for Question 8 = 11 marks)

- 10** (a) Figure 18 shows identical filament lamps connected together to a 12V power supply.

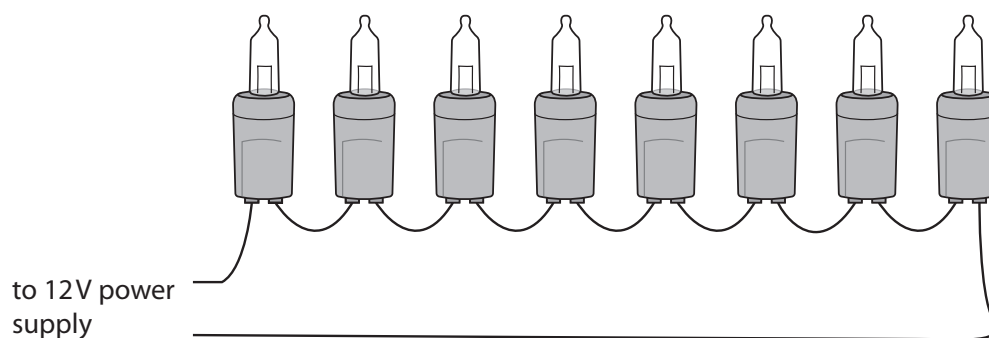


Figure 18

- (i) Calculate the potential difference across each lamp.

(1)

potential difference = ... V

- (ii) The power output of each lamp is 0.75 W

Calculate the resistance of each lamp.

(4)

resistance = ... Ω

*(b) Explain, with the aid of a circuit diagram, the method a student could use to investigate how the resistance of a single lamp changes with the potential difference across the lamp.

(6)

(Total for Question 10 = 11 marks)



- 8 A technician investigates different electrical devices that are used in a car.

The technician connects a device to the 12V car battery.

The technician measures the current in the circuit and the potential difference (voltage) across the device.

Figure 17 shows the car battery and the device that is being tested.



Figure 17

- (a) (i) Draw on Figure 17 to show how the circuit should be completed so that the current in the circuit and voltage across the device can be measured.

(2)

- (ii) The technician tests a headlamp.

The current in the headlamp is 4.8 A when connected to the 12V battery.

Calculate the power supplied to the headlamp.

(2)

power = ... W

(iii) The technician tests an interior light.

The current in the interior light is 600 mA when connected to the 12 V battery.

Calculate the energy transferred to the interior light in 7 minutes.

Use an equation selected from the list of equations at the end of the paper.

(2)

energy transferred = ... J

(b) The technician connects four devices to the car battery.

Each device is connected to its own switch and its own fuse.

Figure 18 shows how the four devices, fuses and switches are connected.

The current in each device is shown next to the device.

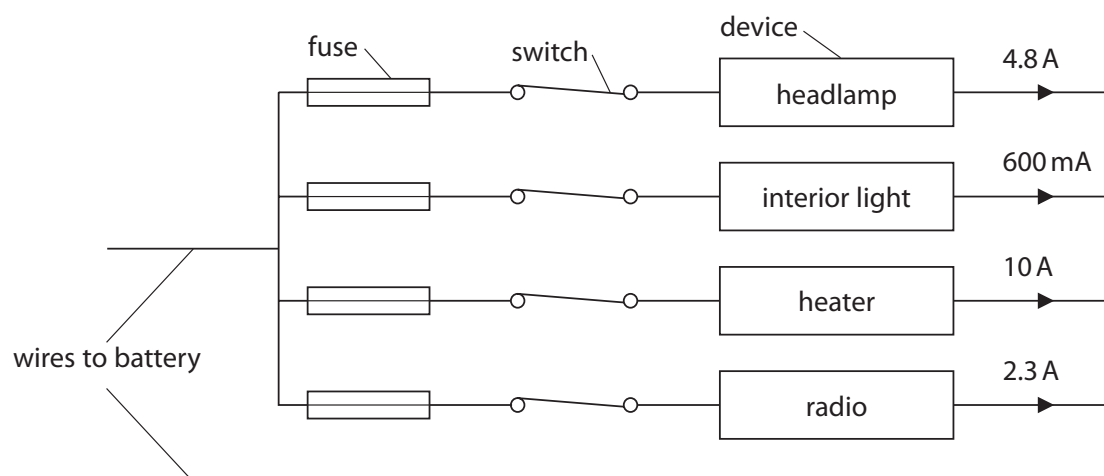


Figure 18

- (i) Calculate the current in the wires to the battery when all the devices are switched on.

(1)

current = ... A

- (ii) State how the overall resistance of the circuit changes when any one of the devices is switched off.

(1)

- (iii) There is a current of 2.3 A in the radio when the radio is working correctly.

Which of these should the technician choose to protect the radio circuit?

(1)

- ☐ **A** 2 A fuse
- ☐ **B** 5 A fuse
- ☐ **C** 10 A fuse
- ☐ **D** 13 A fuse

- (iv) Explain why the wires to the battery in a car are thicker than the wires that connect each device to its switch and its fuse.

(2)

(Total for Question 8 = 11 marks)



- 8** (a) A student investigates how current varies with potential difference across a filament lamp.

The student uses a power supply, a variable resistor, the filament lamp and two meters.

Part of the circuit diagram is shown in Figure 19.

Complete the circuit diagram needed for this investigation.

(3)



Figure 19

- (b) Another student repeats the investigation in part (a) using a data logger.

The data logger records observations using sensors instead of meters. The sensors are connected to a computer to collect and display the observations.

The data logger collects 555 pairs of data in 2 minutes.

The results are shown in Figure 20.

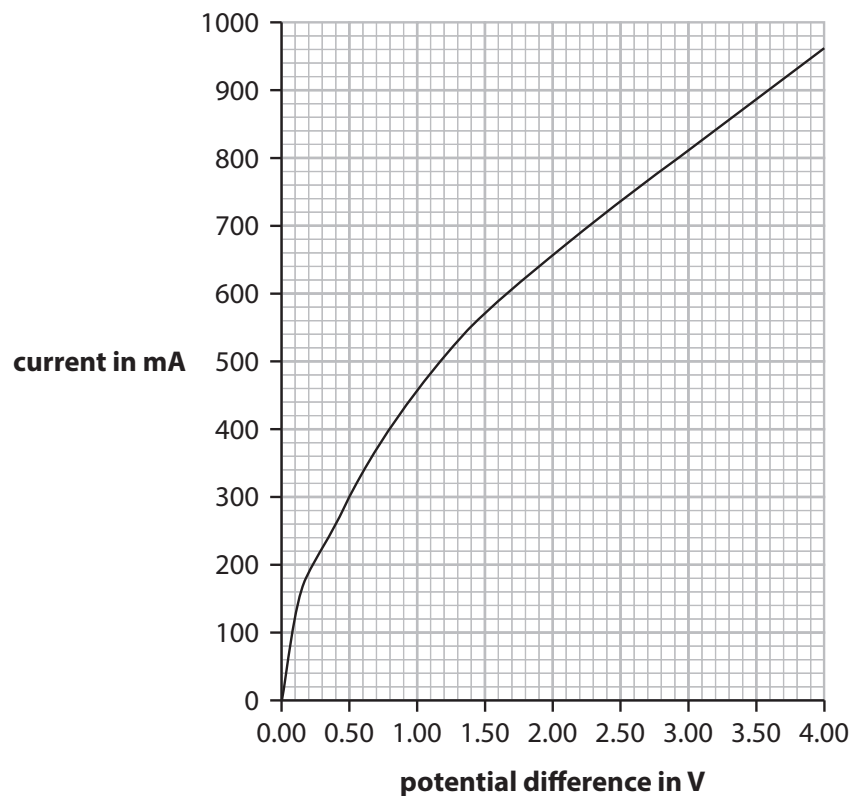


Figure 20

- (i) Suggest **one** advantage of using a data logger instead of meters in this investigation.

(1)

- (ii) Describe how current varies with potential difference in the graph in Figure 20.

(2)

- (iii) Use data from the graph in Figure 20 to show how the resistance changes with potential difference for the filament lamp.

(2)

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- (c) Which of these equations is correct?

(1)

- ☐ **A** $\text{time} = \frac{\text{charge}}{\text{current}}$
- ☐ **B** $\text{time} = \text{charge} \times \text{current}$
- ☐ **C** $\text{time} = \frac{\text{power}}{\text{energy}}$
- ☐ **D** $\text{time} = \text{power} \times \text{energy}$

- (d) The unit of work is the joule.

Starting with the meaning of work, we may obtain an equivalent unit of work as Nm.

Using $\text{work} = F \times d$

unit of work = unit of force $\times$ unit of distance = Nm

The unit of potential difference is the volt.

Explain how, starting with the meaning of potential difference, we may obtain an equivalent unit of potential difference.

(2)

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(Total for Question 8 = 11 marks)



10 (a) A student connects a resistor across the terminals of a 9V battery.

There is a current of 6 mA in the resistor.

(i) Calculate the resistance of the resistor.

(2)

resistance = ... Ω

(ii) Describe how an additional component could be used to vary the current in the resistor.

(2)

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(b) A voltmeter has four different scales.

Which one of these scales would be most suitable to measure a voltage of 0.85 V?

(1)

- ☐ **A** 0 to 20 mV
- ☐ **B** 0 to 200 mV
- ☐ **C** 0 to 2 V
- ☐ **D** 0 to 20 V



*(c) The table in Figure 23 gives some information about **series** and **parallel** circuits.

series and parallel circuits
A battery can be connected to two equal value resistors in series . The same battery can be connected to the same two equal value resistors in parallel .
The current from the battery when the resistors are in series is different from the current from the battery when the resistors are in parallel .
The potential difference across each resistor when the resistors are in series will be different from the potential difference across each resistor when the resistors are in parallel .

Figure 23

Describe how a student can use ammeters and voltmeters to investigate the information given in Figure 23.

Your answer should include

- circuit diagrams showing how the currents and voltages can be measured
- a comparison of the results that would be expected

(6)

Space for circuit diagrams

Answer lines for this question are on page 37.



(Total for Question 10 = 11 marks)



12-MARK QUESTIONS

1 question in this booklet



- 8 (a) A student investigates resistors connected in parallel using a number of resistors. Each resistor has the same resistance.

Figure 19 shows a circuit diagram with one resistor, R.

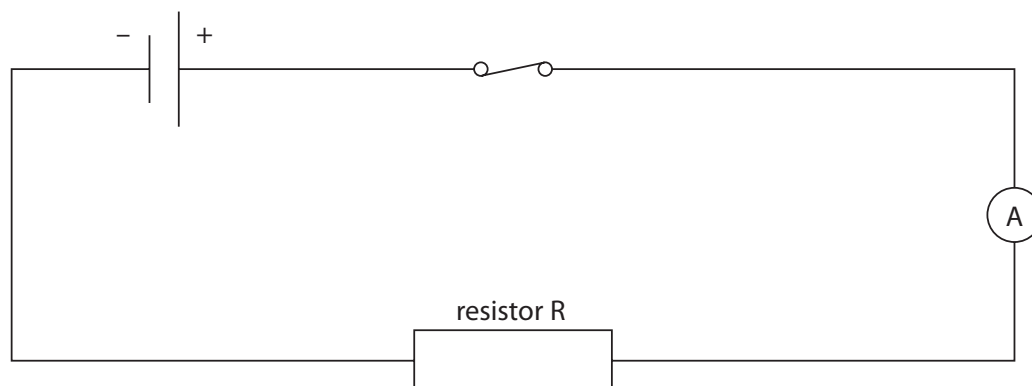


Figure 19

- (i) Add to Figure 19:

- a voltmeter to find the potential difference across resistor R
- another resistor in parallel with resistor R.

(2)

- (ii) State the measurements that the student must take to find the overall resistance of the resistors in parallel.

(2)

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- (iii) The student investigates how the overall resistance of the circuit changes when additional resistors are added in parallel to R.

Each resistor has the same resistance.

Figure 20 shows the results of the student's investigation.

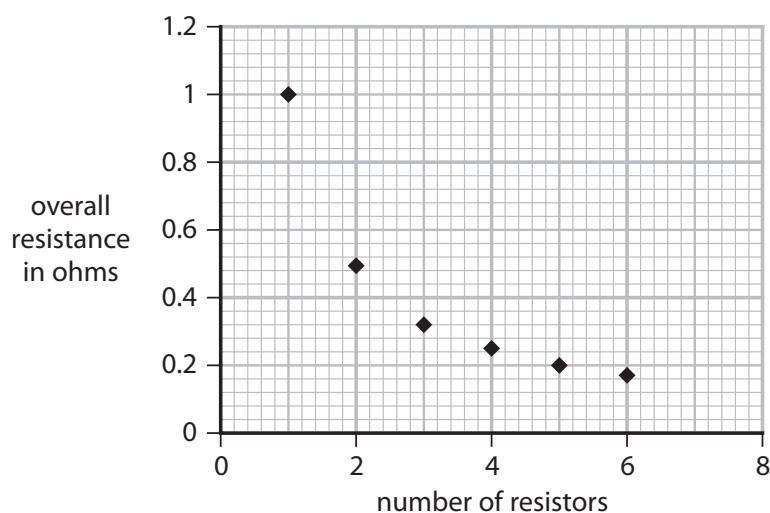


Figure 20

State the resistance of a single resistor.

(1)

resistance = ... Ω

- (iv) Comment on the relationship between the overall resistance of the circuit and the number of resistors in parallel.

Use information from Figure 20 to support your answer.

(3)

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(b) A different circuit is then set up with two resistors as shown in Figure 21.



Figure 21

(i) Calculate the potential difference across the 15 Ω resistor.

(2)

potential difference = ... V

(ii) Calculate the total power dissipated when there is a current of 0.20 A in the two resistors.

Use the equation

$$P = I^2 \times R$$

(2)

power produced W

(Total for Question 8 = 12 marks)



MARK SCHEMES

official Pearson Edexcel mark schemes



Question number	Answer	Additional guidance	Mark
8(c)(iii)(F) 2(aiii)(H)	substitution (1) $(R = \frac{4.5}{51 \times 10^{-3}})$ evaluation (1) 88.(2) (Ω)	0.088(2) or 8.8(2) or 0.88(2) or 0.09 seen scores 1 mark 0.088(2) k Ω or 0.09 k Ω scores 2 marks award full marks for correct answer without working	(2) AO2

Question number	Answer	Additional guidance	Mark
8(c)(iv)(F) 2(aiv)(H)	an explanation linking any three of: identification of resistance increasing (1) heating (of the filament) (1) because of more collisions (1) of electrons (with ions / atoms / other electrons) (1)	temperature increases	(3) AO1

Total 9 marks

Question number	Answer	Additional guidance	Mark
9(a)(F) 3(a)(H)	descriptions to include any two of particles / atoms in solid close(r) together (1) particles / atoms in solid (vibrate) in fixed positions but particles in liquid move (freely) (1) particles in a solid in regular arrangement but particles in liquid are randomly arranged (1) particles in a liquid have more (kinetic) energy (than in a solid) (1)	reverse argument difference asked for so must compare for subsequent marking points allow answers in terms of forces between particles	(2) AO1

Question number	Answer	Additional guidance	Mark
9(b)(F) 3(b)(H)	volume substitution (1) $1.5 \times 1.0 \times 0.2(0) (= 0.3)$ substitution in equation (1) $\text{mass} = 2100 \times (0.3(0))$ evaluation (1) $= 630 \text{ (kg)}$	ecf from calculated value of volume for this mark only award 2 marks for $6.3 \times$ any other power of 10 5670 gains 1 mark from use of $1.5+1.0+0.2=2.7$ award full marks for correct answer without working	(3) AO2

Question number	Answer	Additional guidance	Mark
9(c)(F) 3(C)(H)	statements to include any two from use cladding / (extra) insulation (1) use double thicknesses of the concrete (1) use silver / reflective / white (paint) (1) plant trees around (wind break) (1) use double glazed windows (1) (properly) close window(s)/door	create cavity draft exclusion	(2) AO1

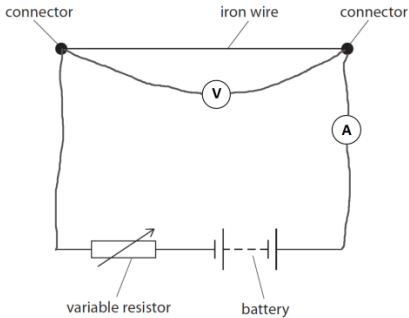
Question number	Answer	Additional guidance	Mark
2 (a)(i)	Substitution and evaluation (1) 15 (Ω)		(1) AO2.1

Question number	Answer	Additional guidance	Mark
2 (a)(ii)	select / recall (1) (power =) $V \times I$ or (power =) $I^2 \times R$ or (power =) $\frac{V^2}{R}$ substitution and evaluation (1) (power =) 1.4 (W)	(power =) 4.5×0.3 $0.3^2 \times 15$ $\frac{4.5^2}{15}$ allow 1.3(5) (W) award full marks for the correct answer without working	(2) AO2.1

Question number	Answer	Additional guidance	Mark
2 (b)	an explanation linking any three from: lamp in second circuit is dimmer (than lamp in first circuit) (1) current in second circuit is less (than in first circuit) (1) potential difference / voltage across each lamp (in second circuit is) less / shared (1) idea that power of each lamp (in second circuit) is less / shared (1) the (total) resistance of the second circuit is more (than in first circuit) (1)	accept reverse arguments throughout	(3) AO1.1

Question number	Answer	Additional guidance	Mark
2 (c)	a diagram of a circuit including all of the following: power supply / cell(s) / battery identifiable resistance wire an ammeter a voltmeter (1) plus any two from ammeter in series (1) voltmeter in parallel (1) indication of tapping off / using 50cm of resistance wire (1)	accept symbols accept ohmmeter with resistance wire only ignore lamp(s) / additional resistors allow ohmmeter (across wire) instead of ammeter and voltmeter for 1 mark e.g. (crocodile) clips	(3) AO2.2

Total 9 marks

Question number	Answer	Additional guidance	Mark
2 (a)	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:  connector iron wire connector variable resistor battery	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
2 (b) (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) AO1

Question number	Answer	Additional guidance	Mark
2 (b) (ii)	(ii) Figure 4 shows a graph of the results.	accept any straight line within the shaded range judge by eye. ignore extrapolation for this marking point	(1) AO2

Question number	Answer	Additional guidance	Mark
2 (b)(iii)	any number between 2.7 and 3.3 inclusive	allow ecf from (ii) $\pm 0.1 \Omega$	(1) AO2

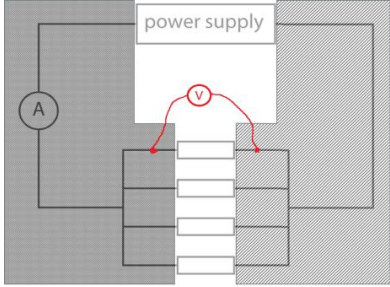
Question number	Answer	Additional guidance	Mark
2 (b) (iv)	explanation linking any two from: (variable) resistor increases the resistance (of the circuit) (1) (therefore) keeps the current constant / small(er) (1) because current increases temperature of the (iron) wire (1)	accept flow of electrons / charge for current in this context 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) AO2

Question number	Answer	Additional guidance	Mark
2 (c)	substitution (1) $1.56 = 0.45 \times R$ rearrangement and evaluation (1) $(R =) 3.5 \text{ (ohms)}$	alternative method rearrangement (1) $(R =) \frac{V}{I}$ or $(R =) \frac{1.56}{0.45}$ (substitution and) evaluation (1) $(R =) 3.5 \text{ (ohms)}$ 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 9 marks (H paper)

Question number	Answer	Mark
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Question Number	Answer	Mark
2(a)	The only correct answer is B <i>A, C and D are not correct because they do not add up to the current entering the junction AND they do not equal the current coming from the battery</i>	(1) AO1.1

	Answer	Additional guidance	Mark
2(b)(i)	voltmeter in parallel with resistors (1)	 one voltmeter connection in each shaded region	(1) A)1.2

	Answer	Additional guidance	Mark
2(b)(ii)	36(.4) (mA) (1)	allow 36 to 37 inclusive may be seen in table in Figure 6	(1) AO3.2

	Answer	Additional guidance	Mark
2(b)(iii)	substitution into $V = IR$ (1) $6(.00) = 9.1 (\times 10^{-3}) \times R$	allow substitution and rearrangement in either order accept 18.2/2 or 27.3/3 or (36 to 37)/4 in place of 9.1 allow substitution of correct values into a	(3) AO2.1

	rearrangement (1) $(R =) \frac{6(.00)}{9.1 (\times 10^{-3})}$ evaluation (1) 660 (Ω)	visible, incorrectly rearranged algebraic equation for this mark only $(R =) \frac{V}{I}$ allow values that round to 660 e.g. 659.3 award full marks for the correct answer without working. value rounding to 660 to any other power of 10 scores 2 marks	
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	Answer	Additional guidance	Mark
2(b)(iv)	an explanation linking: (total) resistance increases (1) (because) current decreases (1) (and) voltage stays the same (1)	fewer paths for the current resistance calculations supporting increasing resistance	(3) AO3.2

Question 2 total 9 marks

	Answer	Additional guidance	Mark
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Question Number	Answer	Additional guidance	Mark
3(a)	50(Hz) (1)		(1) AO1.1

Question Number	Answer	Additional guidance	Mark
3(b)	substitution (1) (P=) 0.53×230 evaluation (1) 120 (W)	accept values that round down to 120 to 2s.f. e.g. 121.9 or 122 award full marks for the correct answer without working	(2) AO2.1

Question Number	Answer	Additional guidance	Mark
3(c)(i)	A live pin B is incorrect because the mains plug has no negative pin C is incorrect because the neutral pin is at 0 V D is incorrect because the mains plug has no positive pin		(1) AO1.1

Question Number	Answer	Additional guidance	Mark
3(c)(ii)	An explanation linking the fuse melts (1) (so) stops / switches off current (1)	allow fuse blows / breaks circuit is broken allow switches off {charge flow / circuit / TV / appliance / supply / electricity / voltage / power / energy}	(2) AO2.2

Question Number	Answer	Additional guidance	Mark
3(c)(iii)	any one from circuit breaker (1) earth (wire/pin) (1) surge protector (1) cable clamp (inside plug) (1) insulation / armouring (1) socket protector/cover (1)	accept RCD / ELCB / RCCB / GFCI / MCB allow ground accept SPD accept rubber coating accept plug cover ignore switch / fuse / fuse box	(1) A01.1

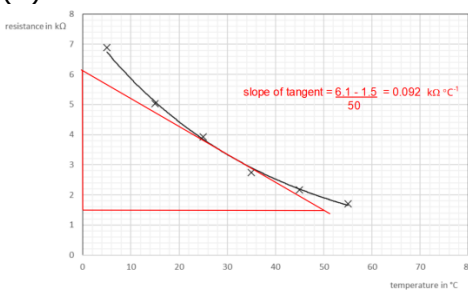
Question number	Answer	Additional guidance	Mark
3(d)	an explanation that links any two attributes of cable 2 compared with cable 1 from (wires have a) greater (cross-sectional) area (1) lower resistance (1) (safely carry a) higher current (1)	accept reverse arguments (wires are) thicker/ wider / heavier / larger less likely to overheat if no other marks scored allow 1 mark for less likely to be damaged due to more insulation OWTTE	(2) A03

Total for Question 3 = 9 marks



Question number	Answer	Mark
8 (a)	☒ c  Only this is the correct symbol for a thermistor	(1) AO1.1

Question number	Answer	Additional guidance	Mark
8 (b) (i)	A description to include as temperature increases resistance decreases (1) non-linear / decreasing gradient (1)	ORA allow exponential / inversely proportional in this context curve gets less steep as temperature increases ignore negative correlation unqualified quoted values are insufficient	(2) AO3.1

Question number	Answer	Additional guidance	Mark
8(b) (ii)	uses a right-angled triangle to calculate slope with a line of grazing incidence at $\theta = 30^\circ \text{C}$ (1)  evaluation (1) (-) 0.092 ($\text{k}\Omega / ^\circ \text{C}$) unit (1) $\text{k}\Omega / ^\circ \text{C}$ or $\text{k}\Omega ^\circ \text{C}^{-1}$	tangent seen and used, drawn between $\theta = 25$ and 35°C accept for 2 marks either between 0.087 and 0.097 ($\text{k}\Omega / ^\circ \text{C}$) or between 87 and 97 ($\Omega / ^\circ \text{C}$) kohm/K or kohm K^{-1}	(3) AO3.2

Question number	Answer	Additional guidance	Mark
8 (c) (i)	explanation linking a suitable improvement (1) with a matching reason (1)	for example place thermometer close(r) to the thermistor stirring digital thermometer thermometer measures same temperature as thermistor to get uniform temperature (for stirring) thermometer with better resolution or scale	(2) AO3.3

Question number	Answer	Additional guidance	Mark
8 (c) (ii)	an explanation including: method 2 has measurements to more significant figures / more decimal places (than method 1) (1) so the calculated answer can have more s.f.'s / d.p.'s (1)	may be shown via a calculation accept an alternative argument in terms of consistency in final calculated answer ignore restating stem of question – e.g. so more precise ignore more accurate	(2) AO3.2

TOTAL 10 marks

Question Number:	Answer	Mark
8(a)(i)	C 6.0 joules per coulomb The only correct answer is C <i>A is not correct because 1 volt is 1 joule per coulomb</i> <i>B is not correct because 1 volt is 1 joule per coulomb</i> <i>D is not correct because 1 volt is 1 joule per coulomb</i>	(1) AO 1 1

Question Number:	Answer	Additional Guidance	Mark
8(a)(ii)	recall and substitution (1) $42 = \frac{200 \times t}{(1000)}$ rearrangement (1) $t = \frac{42 (\times 1000)}{200 (\times 60)}$ evaluation (1) (t =) 3.5 (minutes)	accept substitution and rearrangement in either order 2.1 to any power of 10 or 3.5 to any power of 10 scores 2 marks 3 minutes 30 seconds award full marks for correct answer without working	(3) AO 1 1 AO 2 1

Question Number:	Answer	Additional Guidance	Mark
8(a)(iii)	recall and substitution (1) (E =) 42 x 6.0 evaluation (1) (energy =) 250 (J)	(using E = VIt) (E =) 6.0 x 200 (x 10⁻³) x 2.10 (x 10²) accept 252 (J) award full marks for correct answer without working	(2) AO 1 1 AO 2 1

Question Number:	Answer	Additional Guidance	Mark
8(b)	an explanation linking: collisions between electrons and lattice (1) lattice {vibrates / moves} more (1)	throughout accept atoms / ions for lattice accept charges / charged particles for electrons allow collision between electrons in this context KE of lattice increases KE of electrons decreases	(2) AO 1 1

Question Number:	Answer	Additional Guidance	Mark
8(c)	an explanation linking: relevant calculation (1) $R \text{ (between P and Q)} = \frac{6}{1.2} = 5\Omega$ reasoning / interpretation of result (1) this is less than {a single resistor / two resistors in series} conclusion (1) resistors must be connected <u>in parallel</u>	allow alternative arguments such as if resistors had been in series, then... $I = \frac{6}{20} = 0.3A$ $V \text{ (between P and Q)} = 1.2 \times 10 = 12V$ current is more (than 0.3A) total p.d. is less than 12 V	(3) AO 3 2a AO 3 2b

(Total for Question 8 = 11 marks)



Question Number:	Answer	Additional Guidance	Mark
10(a)(i)	1.5 (V)	accept $\frac{12}{8}$ or $\frac{3}{2}$ or $1\frac{1}{2}$	(1) AO 3 1b

Question Number:	Answer	Additional Guidance	Mark
10(a)(ii)	recall and substitution (1) $0.75 = I \times 1.5$ rearrangement (1) $(I =) \frac{0.75}{1.5} (= 0.5)$ recall, substitution and rearrangement (1) $R = \frac{1.5}{0.5}$ evaluation (1) $(R =) 3.0 (\Omega)$	allow ecf from a(i) for all marking points substitution and rearrangement in either order allow ecf of current from MP2 for this mark point only allow other approaches such as $P = \frac{V^2}{R}$ scores 1 mark $0.75 = \frac{1.5^2}{R}$ scores 2 marks $R = \frac{(1.5)^2}{0.75}$ scores 3 marks award full marks for correct answer without working	(4) AO 2 1

Question Number	Answer	Mark
*10(b)	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. AO1(6 marks) Circuit diagram including • power supply • ammeter • voltmeter • filament lamp • means of varying potential difference Description of method • measure current with ammeter • measure potential difference with voltmeter • vary the potential difference • calculate the resistance • repeat and compare	(6) AO 1 2

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• An explanation that demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) • Presents an explanation that is not logically ordered and with significant gaps. (AO1)
Level 2	3-4	• An explanation that demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) • Presents an explanation of the procedure that has a structure, which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5-6	• An explanation that demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure, which is clear, coherent and logical. (AO1)

(Total for Question 10 = 11 marks)



Question number	Answer	Additional guidance	Mark
8 (a) (i)	voltmeter connected in parallel with device (1) ammeter connected in series with device (1)	voltmeter connected in parallel with battery may be in top or bottom of circuit and could be inside or outside the voltmeter connections	(2) AO1

Question number	Answer	Additional guidance	Mark
8 (a) (ii)	recall and substitution (1) (power =) 12×4.8 evaluation (1) (power =) 58 (W)	voltmeter connected in parallel with battery allow values that round to 58 e.g. 57.6 award full marks for the correct answer without working	(2) AO2

Question number	Answer	Additional guidance	Mark
8 (a) (iii)	substitution (1) (power =) $12 \times 600 / 1000 \times 7 \times 60$ evaluation (1) (energy =) 3000 (J)	allow values that round to 3000 e.g 3024 allow 1 mark for any other values of 3(.024) to any power of ten. if no other marks scored then award 1 mark for answers of 50,400 or 50.4 (substitution mark) award full marks for the correct answer without working.	(2) AO2

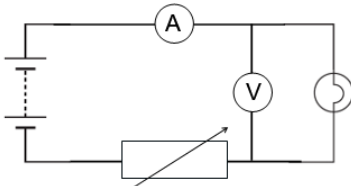
Question number	Answer	Additional guidance	Mark
8 (b) (i)	17.7 (A)		(1) AO1

Question number	Answer	Additional guidance	Mark
8 (b) (ii)	(The resistance) increases		(1) AO1

Question number	Answer	Additional guidance	Mark
8 (b) (iii)	B 5 A fuse A is incorrect because it has a smaller value than the expected current C and D are incorrect because they have a much higher value than the expected current		(1) AO1

Question number	Answer	Additional guidance	Mark
8 (b) (iv)	An explanation linking two of thick(er) wires have low(er) resistance (1) less thermal energy transferred (in the wires)(1) less potential difference / voltage (drop) across the wires (1)	allow reverse argument allow so wires do not get hot allow less voltage is lost more current can be carried	(2) AO1

Total for question 8 = 11 marks

Question number	Answer	Additional guidance	Mark
8 (a)	a complete circuit diagram with a correct symbol for a variable resistor added in series with a lamp (1) ammeter connected in series with a lamp (1) voltmeter added in parallel with a lamp (1)	allow inclusion of this lamp symbol in series with the power supply  allow potential divider or potentiometer alternative allow ammeter and voltmeter symbols to be shown in square boxes example: 	(3) AO1.2

Question number	Answer	Additional guidance	Mark
8 (b) i	any one suggestion from (collect data in a) short time (1) simultaneous measurement (of current and voltage) (1) gives an immediately accessible graph to analyse / think about (1) greater number of / more data pairs collected (1) improves reliability (1)	allow saves time allow it is fast ignore 'accuracy' ignore 'precision'	(1) AO2.2

Question number	Answer	Additional guidance	Mark
8 (b) ii	a description to include as potential difference increases current increases (1) non-linear (1)	curve / changes gradient / changes steepness	(2) AO3.2

Question number	Answer	Additional guidance	Mark
8 (b) iii	an explanation linking any attempt at calculating resistance using data from the graph and $R=V/I$ (1) with a second pair of values used to give another value for resistance showing that resistance increases as p.d. increases (1)	alternative as potential difference increases resistance increases with shown by gradient of graph decreasing as p.d. increases	(2) AO1.2

Question Number	Answer	Mark
8(c)	The only correct answer is A time = $\frac{\text{charge}}{\text{current}}$ <i>B, C and D are incorrect expressions not yielding time as the subject of an equation e.g. B would be 'Coulomb Amps', not recognisable as a physical quantity. Similar arguments for C and D</i>	(1) AO1.1

Question Number	Answer	Additional Guidance	Mark
8(d)	an explanation linking (potential difference) is energy (transferred) per unit charge (passed) (1) so units of p.d. = J/C or Nm/C (1)	allow $\text{pd} = \frac{\text{energy}}{\text{charge}}$	(2) AO1.1

Question 8 total 11 marks



Question number	Answer	Additional guidance	Mark
10(ai)	selection and substitution (1) $(R =) \frac{9}{6} \times 10^{-3}$ evaluation (1) (resistance =) 1500 (Ω)	1.5 k(Ω) allow 1500 to any other power of ten for 1 mark award full marks for correct answer without working.	(2) AO2

Question number	Answer	Additional guidance	Mark
10(aii)	(connect a variable) resistor (1) in series (with the resistor) (1)	accept thermistor/ light dependent resistor/ LDR/ lamp / battery / cell / LED / diode between battery and resistor	(2) AO1

Question number	Answer	Additional guidance	Mark
10(b)	C is correct because 0.85 is less than 2V A is incorrect because 0.85 V is greater than 20 mv B is incorrect because 0.85 V is greater than 200 mv D is incorrect because 0.85 V would show a (very) small reading on the scale.		(1) AO1

Question number	Indicative content	Mark
*10(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. Description (may be inferred from circuit diagram(s)) • Connect ammeter in series with resistor(s) • Connect voltmeter across / in parallel with resistor(s) • Move meters to new positions. Circuit diagram(s) (accept any recognisable symbol) • Two resistors in series with a battery • Two resistors in parallel with a battery • An ammeter in series with the resistor(s) and battery • A voltmeter in parallel with the resistor(s) Expected results (allow reverse arguments) • Current (from battery) greater in parallel circuit than in series circuit • Pd across resistor(s) less in series circuit than in parallel circuit • Pd across resistor(s) in parallel circuit same as pd across battery • Pd across battery shared between resistors in series • Current (from battery) shared between resistors in parallel • Current same throughout whole of series circuit	(6) AO1

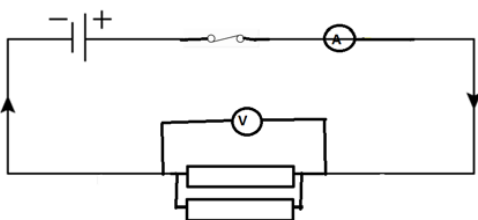
Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	- Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) - Presents a description which is not logically ordered and with significant gaps. (AO1)
Level 2	3-4	- Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) - Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5-6	- Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) - Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)

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	<u>Additional guidance</u> description of that would allow at least two measurements or an expected result of those measurements	<u>Possible candidate responses</u> any two correctly connected meters (may be in different circuits) or resistors in a series and a parallel circuit or current in parallel circuit shared between resistors or Pd of supply shared between resistors in series
Level 2	3–4	<u>Additional guidance</u> descriptions of obtaining two measurements with an expected results of those measurements for at least one circuit or expected results of those comparisons between circuits without description of obtaining measurements	<u>Possible candidate responses</u> a series and a parallel circuit with a correctly connected meter with current in parallel circuit shared between resistors but pd across them is same as supply or (total) current more in parallel than in series circuit and pd across each resistor in series less than in parallel without creditworthy circuit diagram or description of obtaining measurements
Level 3	5–6	<u>Additional guidance</u> descriptions of obtaining comparable measurements with expected results of those comparisons between circuits	<u>Possible candidate responses</u> a series and a parallel circuit with at least one correctly connected ammeter and voltmeter with (total) current more in parallel than in series circuit and pd across each resistor in series less than in parallel

Total for Question 10 = 11 marks

Total for Paper = 100 marks



Question number	Answer	Additional guidance	Mark
8(a)(i)	 voltmeter in parallel across resistor (1) second resistor in parallel (1)		(2)

Question number	Answer	Additional guidance	Mark
8(a)(ii)	potential difference/ voltage (drop across resistors in parallel) (1) current (in the circuit) (1)	voltmeter reading ammeter reading	(2)

Question number	Answer	Additional guidance	Mark
8(a)(iii)	1 (Ω)	one (ohm)	(1)

Question number	Answer	Additional guidance	Mark
8(a)(iv)	Comments to include: the (overall) resistance decreases as the number of resistors (in parallel) increases (1) the relationship is non-linear (1) any two relevant values from the graph (1)	decreases at a decreasing rate the relationship is inversely proportional scores first 2 marks	(3)

Question number	Answer	Additional guidance	Mark
8(b) (i)	recall and substitution (1) $V = 0.20 \times 15$ evaluation (1) 3 (V)	7(V) gains 1 mark (use of $15 + 20$) award full marks for the correct answer without working	(2)

Question number	Answer	Additional guidance	Mark
8(b) (ii)	addition and substitution (1) $(P=) 0.20^2 \times 35$ evaluation (1) 1.4 (W)	award full marks for the correct answer without working	(2)

Total mark for question 8 = 12 marks