



Electricity

FREE Online Physics GCSE Course

physicswithkate.com

Name _____ Date _____

TIME ALLOWED

60 minutes

TOTAL MARKS

58 COMBINED · 59 TRIPLE

YOU WILL NEED

a ruler, a pencil, a black or blue pen and a calculator

Instructions

- **Combined Science:** answer Questions 1–8. Skip Question 9.
- **Physics (triple):** answer Questions 1–7 and 9. Skip Question 8.
- Write your answers in the spaces provided, in black or blue ink.
- In calculations, show clearly how you work out your answer.

Information

- The marks for each question are shown in brackets.
- Combined Science is out of 58 marks. Physics (triple) is out of 59 marks.
- You are reminded of the need for good English and clear presentation in your answers.

Your score

Question	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Total	%
Out of	6	3	6	2	13	11	9	8	9	58 / 59	100
Your mark											

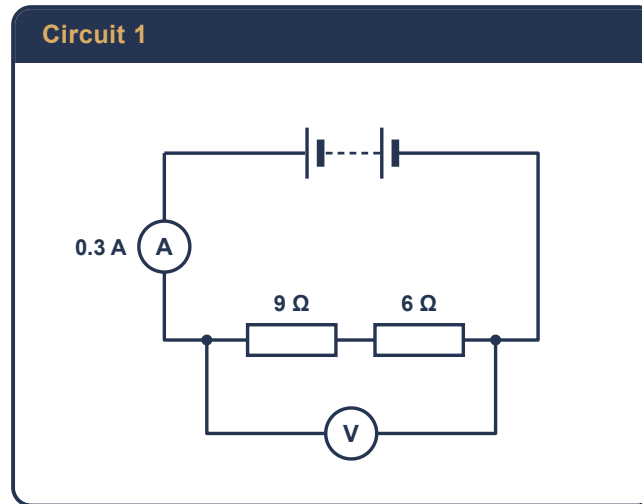
Marking your test

The full mark scheme is at the back of this booklet. Try every question first, then mark your answers in a different colour.

1 Question 1

6 marks

The diagram shows a simple circuit.



- (a) Calculate the total resistance of the two resistors in the circuit.

Total resistance = _____ Ω
(1)

- (b) Calculate the reading on the voltmeter. Show clearly how you work out your answer.

Voltmeter reading = _____ V
(2)

- (c) One of the resistors is replaced with a resistor of higher value. What happens to the reading on the ammeter?

Tick (✓) **one** box.

A It decreases.

☐

B It does not change.

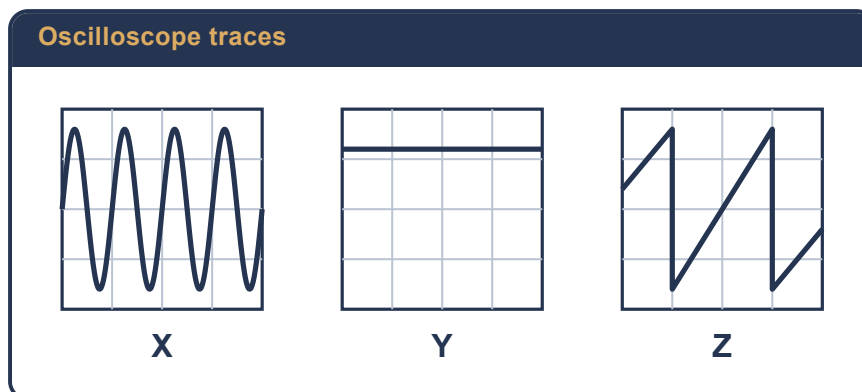
☐

C It increases.

☐

(1)

- (d) The voltmeter is replaced with an oscilloscope. Which one of the traces, **X**, **Y** or **Z**, would be seen on the oscilloscope?



Trace

Give a reason for your answer.

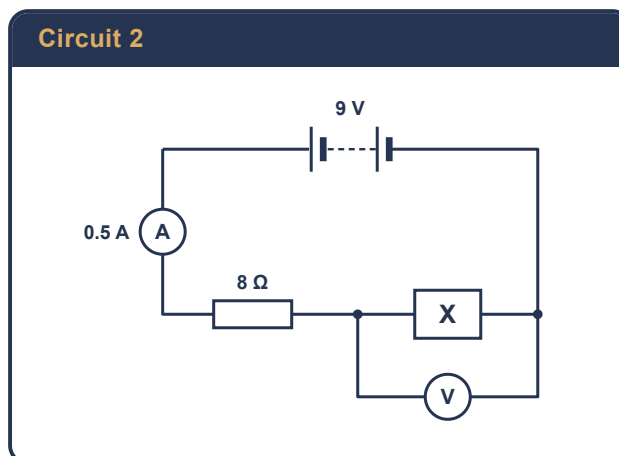
(2)

Total for this question: 6 marks

2 Question 2

3 marks

The circuit diagram below includes a component labelled **X**.



- (a) Calculate the potential difference across the $8\ \Omega$ resistor. Show clearly how you work out your answer.

Potential difference = _____ V
(2)

- (b) What is the potential difference across component **X**?

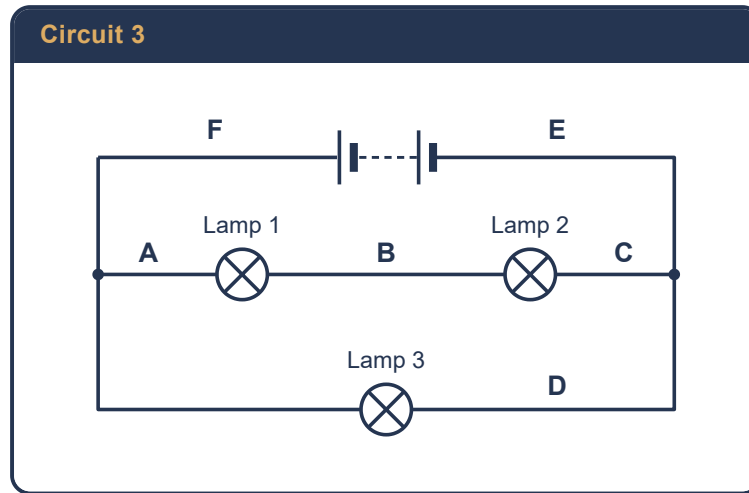
Potential difference = _____ V
(1)

Total for this question: 3 marks

3 Question 3

6 marks

The circuit contains three identical lamps.



- (a) Complete each sentence using one of the phrases in the box. Each phrase may be used once, more than once or not at all.

more than less than the same as

- (i) The current at **A** is the current at **B**.
 (ii) The current at **A** is the current at **D**.
 (iii) The current at **F** is the current at **E**.
 (iv) The current at **F** is the current at **D**.

(4)

- (b) Which lamp is the brightest?

Give a reason for your answer.

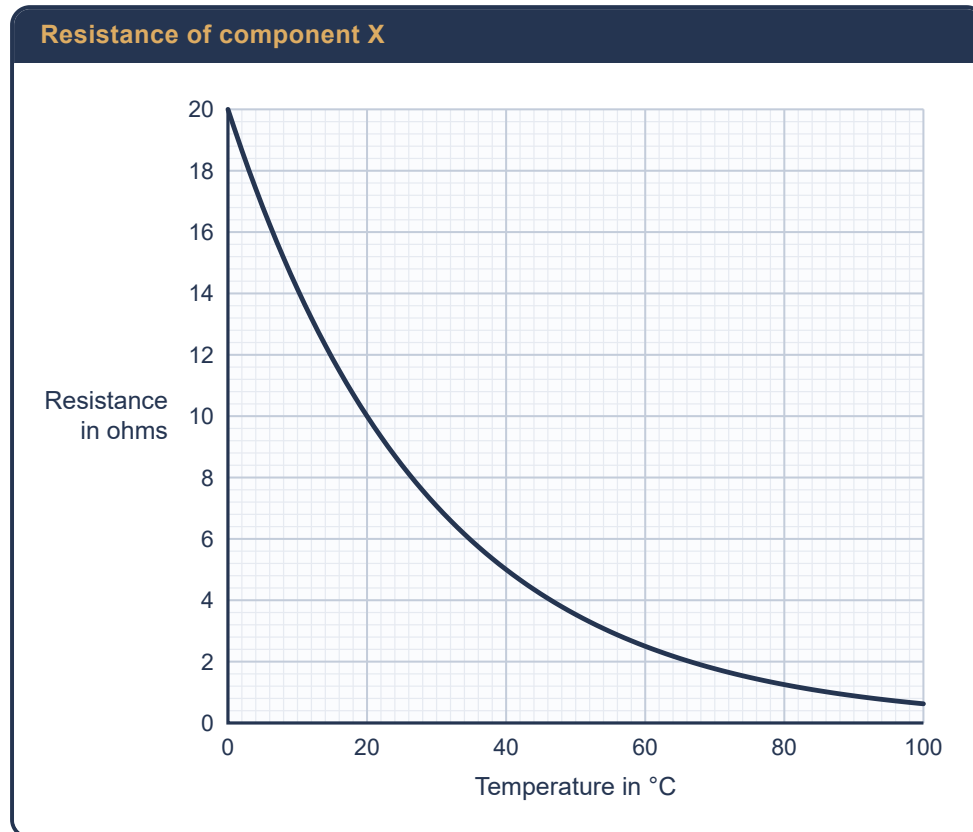
(2)

Total for this question: 6 marks

4 Question 4

2 marks

The graph shows how the resistance of component **X** changes with temperature.



(a) What is component **X**?

(1)

(b) Over which range of temperatures does the resistance of component **X** change the most?

Tick (✓) **one** box.

A 0 °C to 20 °C

☐

B 20 °C to 40 °C

☐

C 40 °C to 60 °C

☐

D 60 °C to 80 °C

☐

E 80 °C to 100 °C

☐

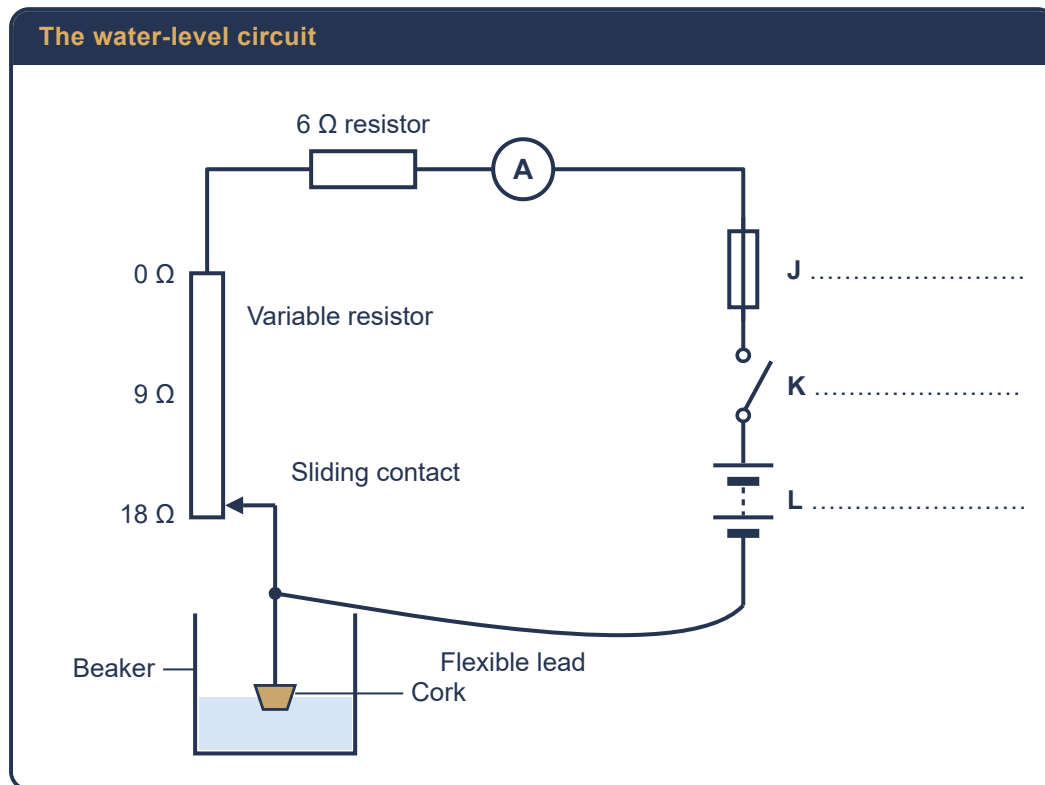
(1)

Total for this question: 2 marks

5 Question 5

13 marks

A student has designed the circuit shown in the diagram to measure the water level in a beaker. The student is going to use the ammeter to show the water level.



- (a) Use words from the box to label the three components, **J**, **K** and **L**, on the diagram.

battery cell fuse lamp resistor switch

(3)

- (b) The resistance of the variable resistor changes as the cork moves up and down inside the beaker. This changes the electric current in the circuit.

- (i) What is meant by the term *electric current*?

(1)

- (ii) A voltmeter was mistakenly added to the circuit in series. The reading on the ammeter was zero. Suggest why.

(1)

- (c) The table gives the variable resistor value and the ammeter reading for different water levels. The table is not complete.

Water level	Variable resistor value in ohms	Ammeter reading in amps
Full	0	2.0
Half full	9	0.8
Empty	18	

Calculate the reading on the ammeter when the beaker is empty. Assume the ammeter, battery, fuse and wires have zero resistance.

Ammeter reading = _____ A
(3)

- (d) A second student copied the design using a 2 A fuse, but forgot to include the $6\ \Omega$ resistor. What will happen to the fuse in this circuit as the water reaches the top of the beaker? Explain your answer.

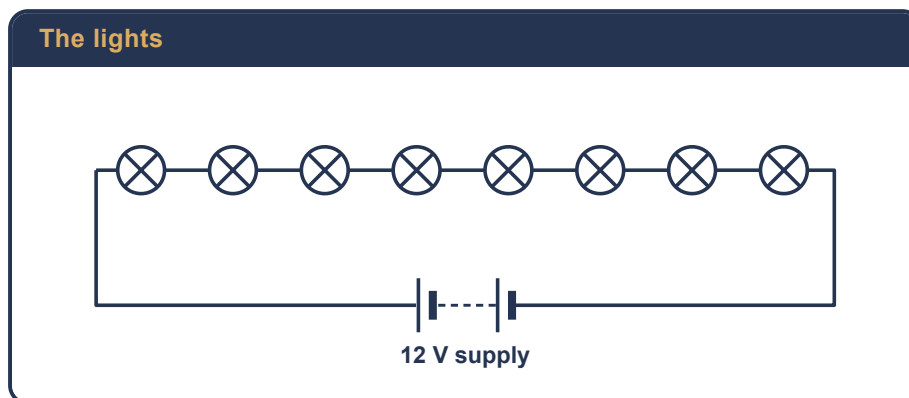
(5)

Total for this question: 13 marks

6 Question 6

11 marks

A set of decorative lights has eight identical filament lamps connected in series to a 12 V supply.



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

Potential difference = _____ V
(1)

- (b) The power of each lamp is 0.75 W. Calculate the resistance of each lamp.

Resistance = _____ Ω
(4)

- (c) A student wants to investigate how the resistance of a single filament lamp changes with the potential difference across it.

Describe a method the student could use. Include a circuit diagram in your answer.

(6)

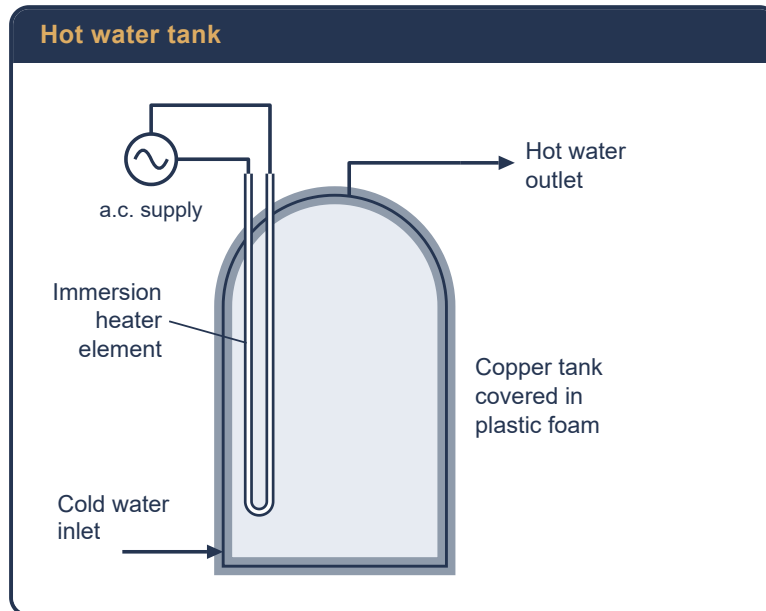
Total for this question: 11 marks

7 Question 7

9 marks

The diagram shows an electric immersion heater in a hot water tank.

The information label on the immersion heater says: **230 V, 10 A**.



- (a) Write down the equation that links power, current and potential difference.

_____ (1)

- (b) Calculate the power of the heater. Show clearly how you work out your answer and give the unit.

Power = _____ (2)

- (c) There are three wires in the cable to the immersion heater. Two of the wires are connected to the immersion heater. The third wire is connected to the copper tank.

Explain the purpose of this third wire and of the fuse in the circuit.

(3)

- (d) Write down the equation that links potential difference, current and resistance.

_____ (1)

- (e) Calculate the resistance of the heater. Show clearly how you work out your answer and give the unit.

Resistance = _____ (2)

Total for this question: 9 marks

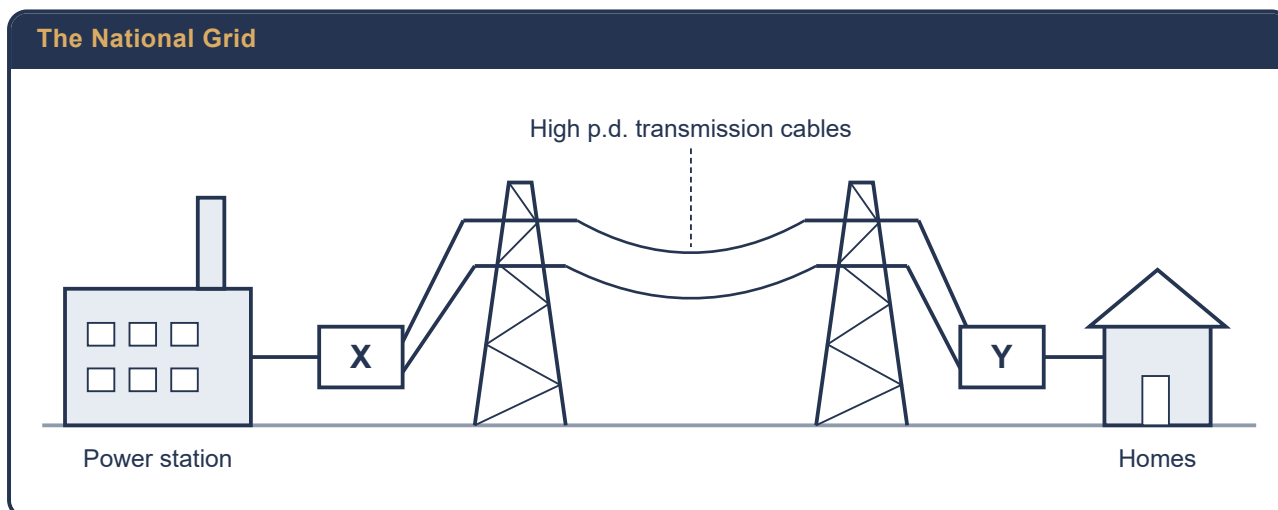
8 Question 8

Combined Science only

8 marks

Combined Science only. Physics (triple) students: skip this question. You meet the National Grid in the Magnetism and Electromagnetism topic.

The diagram shows part of the National Grid.



- (a) Name the type of transformer at **X** and at **Y**.

X

Y

(2)

(b) Transformer **X** changes the potential difference and the current.

(i) What does transformer **X** do to the potential difference?

Tick (✓) **one** box.

A decreases it

☐

B does not change
it

☐

C increases it

☐

(1)

(ii) What does transformer **X** do to the current?

Tick (✓) **one** box.

A decreases it

☐

B does not change
it

☐

C increases it

☐

(1)

(c) Explain why the National Grid transmits electricity at a very high potential difference.

(3)

(d) Suggest why transformer **Y** is needed before the electricity reaches homes.

(1)

Total for this question: 8 marks

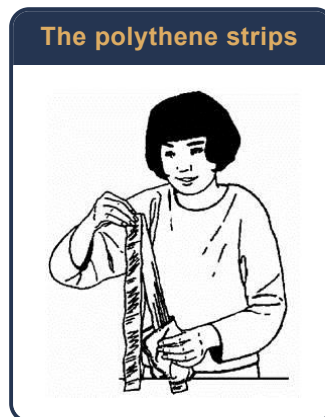
9 Question 9

Physics (triple) only

9 marks

Physics (triple) only. Combined Science students: skip this question.

A student did an experiment with two strips of polythene. She held the strips together at one end. She rubbed down one strip with a dry cloth. Then she rubbed down the other strip with the dry cloth. Still holding the top ends together, she held up the strips.



(a) What movement would you expect to see?

_____ (1)

(b) Why do the strips move in this way?

_____ (2)

(c) Complete the **four** spaces in the passage.

Each strip has a negative charge. The cloth is left with a _____ charge. This is because particles called _____ have been transferred from the _____ to the _____.

(4)

(d) The student tried the experiment using two strips of aluminium. The strips did not move. Complete each sentence.

(i) Materials, such as aluminium, that electricity passes through easily are called _____.

_____ (1)

(ii) Materials, such as polythene, that electricity does **not** pass through easily are called

.....

(1)

Total for this question: 9 marks

END OF TEST

Now mark your answers using the mark scheme that follows.

MARK SCHEME

Electricity · Topic Test

[1] in the Mark column means one mark for that line.

accept / allow notes (gold) are other answers that also score.

reject / do not accept notes (red) are answers that do not.

1 Question 1 — mark scheme

6 marks

PART	ANSWER	MARK
(a)	15 (Ω)	1
(b)	4.5 (V) allow 1 mark for correct substitution, i.e. 0.3×15 (or $0.3 \times \text{their (a)}$), provided no subsequent step is shown allow their (a) $\times 0.3$ correctly calculated for 2 marks	2
(c)	it decreases	1
(d)	Y the reason only scores if Y is chosen	1
	a battery / cell gives a direct (d.c.) potential difference / current or it is the only trace showing a constant potential difference accept: X and Z are alternating (a.c.) accept voltage for potential difference "it is not changing" on its own is insufficient	1

Total: 6 marks

2 Question 2 — mark scheme

3 marks

PART	ANSWER	MARK
(a)	$V = I \times R = 0.5 \times 8$	1
	$= 4 \text{ (V)}$	1
(b)	5 (V) allow 9 – their (a) (error carried forward) negative values are not allowed	1

Total: 3 marks

3 Question 3 — mark scheme

6 marks

PART	ANSWER	MARK
(a)(i)	the same as	1
(a)(ii)	less than	1
(a)(iii)	the same as	1
(a)(iv)	more than	1
(b)	lamp 3 <i>accept D</i>	1
	there is more current (twice the current) in this part of the circuit or the resistance of this branch is less <i>accept: it is on its own, so it does not share the potential difference / energy with another lamp</i> <i>do not accept "sharing current" or "only one lamp to go through"</i>	1

Total: 6 marks

4 Question 4 — mark scheme

2 marks

PART	ANSWER	MARK
(a)	thermistor	1
(b)	0 °C to 20 °C	1

Total: 2 marks

5 Question 5 — mark scheme

13 marks

PART	ANSWER	MARK
(a)	J fuse	1
	K switch	1
	L battery <i>do not accept cell: L has two cells</i>	1
(b)(i)	the number of charges passing a point per second <i>allow rate of flow of charge</i>	1
(b)(ii)	a voltmeter has a very high resistance	1

(c)	total resistance = $18 + 6 = 24 \Omega$ the battery p.d. is 12 V: $2.0 \text{ A} \times 6 \Omega$ from the "Full" row	1
	$I = 12 \div 24$	1
	$= 0.5 \text{ (A)}$ correct answer with or without working gains 3 marks an answer of 0.67 ($12 \div 18$, leaving out the 6Ω resistor) gains 2 marks $12 \div 18$ alone gains 1 mark	1
(d)	the fuse melts do not accept blows	1
	breaks the circuit / circuit is broken / current stops	1
	because without the 6Ω resistor, as the water reaches the top of the beaker, the total resistance approaches 0Ω	1
	so the current rises above the 2 A fuse rating	1
	and the heating effect in the fuse increases	1

Total: 13 marks

6

Question 6 — mark scheme

11 marks

PART	ANSWER	MARK
(a)	1.5 (V) accept $12 \div 8$	1
(b)	$P = I \times V$: $0.75 = I \times 1.5$ allow error carried forward from (a) for every mark	1
	$I = 0.75 \div 1.5 = 0.5 \text{ (A)}$	1
	$R = V \div I = 1.5 \div 0.5$	1
	$R = 3.0 \text{ (}\Omega\text{)}$ allow other approaches, e.g. $P = V^2 \div R$, so $R = 1.5^2 \div 0.75$ full marks for the correct answer without working	1
(c)	Use a 'best-fit' approach to the levels.	
0	No relevant content.	0
L1	Some relevant content, e.g. a partly correct circuit or a few relevant steps. The method would not give valid results.	1–2
L2	A correct circuit or a clear method, with some steps missing or out of order.	3–4

- L3** A correct circuit **and** a clear, logical method that would give valid results, including how the resistance is found.

5–6

Indicative content**Circuit diagram**

- power supply (or battery)
- filament lamp
- ammeter in series with the lamp
- voltmeter in parallel with the lamp
- variable resistor (or a variable power supply) to change the potential difference

Method

- measure the current through the lamp with the ammeter
- measure the potential difference across the lamp with the voltmeter
- change the potential difference using the variable resistor and take a range of readings
- calculate the resistance for each pair of readings using $R = V \div I$
- repeat the readings (and take a mean), or reverse the supply
- plot a graph of resistance against potential difference and compare

Model answer

- Connect the filament lamp in series with an ammeter, a variable resistor and a power supply. Connect a voltmeter in parallel across the lamp.
- Switch on and record the current from the ammeter and the potential difference from the voltmeter.
- Adjust the variable resistor to change the potential difference, and record at least six pairs of readings over a wide range.
- Calculate the resistance for each pair of readings using $R = V \div I$.
- Repeat the readings and calculate a mean for each potential difference.
- Plot a graph of resistance against potential difference: the resistance increases as the potential difference increases, because the filament gets hotter.

Total: 11 marks

7

Question 7 — mark scheme

9 marks

PART	ANSWER	MARK
(a)	$P = I \times V$ <i>accept power = current × potential difference, in words or symbols</i> <i>accept power = volts × amps</i> <i>do not accept C for current</i>	1
(b)	$(P = 230 \times 10 =) 2300$ <i>accept 2.3 with kW</i>	1

W or J/s

1

accept kW if the number is 2.3

(c) any **three** from:

3

- the third wire is the earth wire
- if a fault makes the (metal) tank live, a large current flows through the earth wire
- this makes the fuse melt (blow), which breaks the circuit / stops the current
- the fuse is in the live wire
- this prevents an electric shock / prevents damage to the heater or a fire

(d) $V = I \times R$

1

accept potential difference = current $\times$ resistance, in words or symbols

(e) $(230 = 10 \times R) R = 23$

1

ohms or Ω

1

Total: 9 marks

8 Question 8 — mark scheme

Combined Science only

8 marks

PART	ANSWER	MARK
(a)	X step-up (transformer)	1
	Y step-down (transformer)	1
(b)(i)	increases it	1
(b)(ii)	decreases it	1
(c)	the current (in the cables) is lower	1
	so less energy is wasted / transferred to the thermal store of the cables and the surroundings	1
	accept: the cables do not get as hot	
	do not accept "electricity is lost" or "no energy is lost"	
	so the transmission (energy transfer) is more efficient	1
(d)	to reduce the potential difference to a (safer) level for use in homes (230 V)	1
	accept: the high p.d. would be dangerous in homes	

Total: 8 marks

9

Question 9 — mark scheme

Physics (triple) only

9 marks

PART	ANSWER	MARK
(a)	(the bottom ends) move apart or repel	1
(b)	they have the same charge <i>accept both have a negative charge</i> <i>do not accept both have a positive charge</i>	1
	like charges repel <i>"opposite charges attract" on its own is not enough</i>	1
(c)	positive	1
	electrons	1
	cloth	1
	polythene <i>accept strips</i>	1
(d)(i)	conductors <i>accept metals</i>	1
(d)(ii)	insulators <i>accept non-conductors</i> <i>do not accept poor conductors or non-metals</i>	1

Total: 9 marks

END OF MARK SCHEME