

4.2

Electricity

Exam-style questions

101 questions • 227 marks

Written in the style of AQA papers, including the required practicals, maths and working scientifically.

How to use this booklet

Answer on paper or in an exercise book — there is no writing space here, so the

booklet can be reused and photocopied cheaply.

Marks are shown in square brackets. Use them to judge how much to write.

Where a graph is to be plotted, a grid is provided.

Use a calculator, a ruler and a pencil for drawing.

Mark your work from the separate answer booklet.

Command words used

State, Give, Name, Write down — a short factual answer, no explanation needed

Describe — say what happens, in order, without needing a reason

Explain — give a reason; 'because', 'so' or 'therefore' should appear

Calculate — show your working and give a unit

Determine — use data given, often from a graph or table

Estimate — an approximate value from reasonable assumptions

Suggest — apply what you know to an unfamiliar situation

Compare — say how things are similar and different, in the same sentence

Evaluate — give both sides, then a conclusion

Design, Plan — set out a method others could follow

Questions are labelled beside the marks where they are Higher Tier only, Separate Physics only, or Working scientifically — the apparatus, variables, accuracy, evaluation and maths skills that carry around a third of the marks in every AQA paper.

4.2.1 Current, potential difference and resistance

1 A circuit contains a cell, a switch, a fixed resistor and an ammeter in series. A voltmeter is connected across the resistor.

- a State how an ammeter must be connected in a circuit. [1]
- b State how a voltmeter must be connected. [1]
- c Define electric current. [1]
- d Define potential difference. [1]
- e A charge of 180 C passes through the resistor in 90 s. Calculate the current. Maths skill [3]
- f The potential difference across the resistor is 6.0 V. Calculate its resistance. Maths skill [3]
- g Calculate the energy transferred by the resistor in this time. Maths skill [3]

2 A current of 0.45 A flows through a lamp for 4.0 minutes.

- a Calculate the charge that flows. Maths skill [3]
- b The lamp is connected to a 230 V supply. Calculate the energy transferred. Maths skill [2]
- c Calculate the power of the lamp. Maths skill [2]

3 Explain, in terms of the particles in a metal, why a wire gets warm when a current flows through it.

Give your answer. [3]

4.2.1 Component characteristics · Required practicals 3 and 4

4 A student investigates how the resistance of a length of resistance wire depends on its length.

Length in cm	20	40	60	80	100
Potential difference in V	0.60	1.21	1.78	2.40	3.02
Current in A	0.30	0.30	0.30	0.30	0.30

- a Calculate the resistance of the 60 cm length. Maths skill [2]
- b Describe the relationship between resistance and length shown by the data. Working scientifically [2]
- c Name the independent and the control variables in this investigation. Working scientifically [2]
- d Explain why the switch is opened between readings. Working scientifically [2]
- e One reading does not fit the pattern. Identify it and suggest a cause. Working scientifically [2]
- f Describe how the student could improve the accuracy of the length measurement. Working scientifically [2]

5 A student investigates the I–V characteristics of a filament lamp.

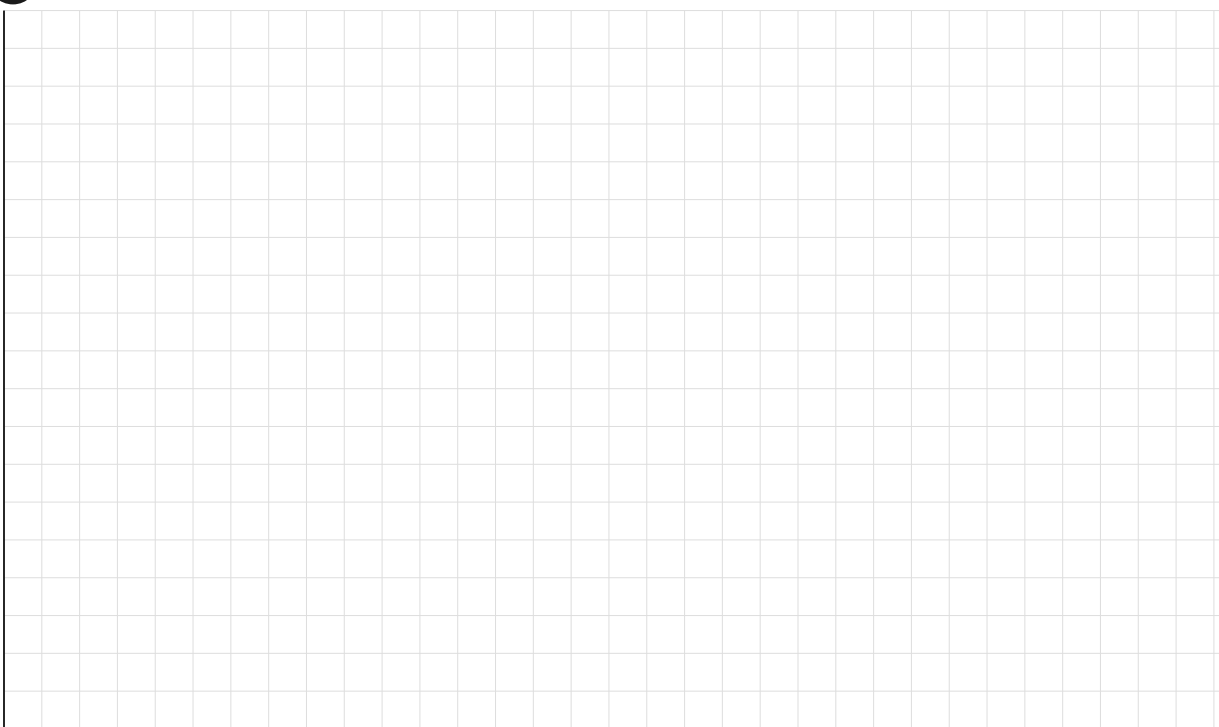
- a** Draw a labelled circuit diagram the student could use. Your diagram should include a variable resistor. Working scientifically [3]
- b** Describe the shape of the graph of current against potential difference for a filament lamp. [2]
- c** Explain the shape of this graph. [3]
- d** Describe and explain the graph obtained for a diode. [3]
- e** Explain why the connections to the supply are reversed during the investigation. Working scientifically [1]
- f** State why a protective resistor is included in series with the diode. Working scientifically [1]

6 The table shows readings taken for an ohmic conductor at constant temperature.

Potential difference in V	1.0	2.0	3.0	4.0	5.0
Current in A	0.08	0.16	0.24	0.32	0.40

- a** Plot a graph of current against potential difference on the grid provided. Working scientifically [4]
- b** Determine the gradient of your line. Maths skill [2]
- c** Use the gradient to determine the resistance of the conductor. Maths skill [2]
- d** Explain how the graph shows that the conductor is ohmic. [2]
- e** A student misreads the current as 0.8 A rather than 0.08 A. Explain the effect on the calculated resistance. Working scientifically [2]

7 Use the grid to plot the data from the previous question.



No answer is required here — the grid is for your graph.

[0]

- 8** A thermistor and a light-dependent resistor are both connected in turn to a 6.0 V supply.
- a Describe how the resistance of a thermistor changes with temperature. [1]
 - b Describe how the resistance of an LDR changes with light intensity. [1]
 - c At 20 °C the thermistor has a resistance of 1200 Ω . Calculate the current through it. Maths skill [3]
 - d Describe one practical use of a thermistor and one of an LDR. [2]
 - e Suggest how a thermistor could be used to switch on a fan when a room becomes too warm. [3]

4.2.2 Series and parallel circuits

- 9** A 4.0 Ω resistor and a 6.0 Ω resistor are connected in series across a 12 V battery.
- a Calculate the total resistance. Maths skill [1]
 - b Calculate the current in the circuit. Maths skill [3]
 - c Calculate the potential difference across the 6.0 Ω resistor. Maths skill [2]
 - d State the potential difference across the 4.0 Ω resistor, and explain how you know. [2]
 - e A third resistor is added in series. State and explain the effect on the current. [2]
- 10** Two 12 Ω resistors are connected in parallel across a 6.0 V supply.
- a Calculate the current through one resistor. Maths skill [3]
 - b Calculate the total current drawn from the supply. Maths skill [1]
 - c Calculate the total resistance of the combination. Maths skill [2]
 - d Explain why adding a resistor in parallel decreases the total resistance of a circuit. [3]
 - e Compare the brightness of two identical lamps connected in series with two connected in parallel across the same supply. [3]
- 11** A string of decorative lights contains 20 identical lamps connected in series across a 230 V supply.
- a Calculate the potential difference across each lamp. Maths skill [2]
 - b One lamp fails and the circuit breaks. Explain why all the lamps go out. [2]
 - c Suggest one advantage and one disadvantage of wiring the lights in parallel instead. [2]

4.2.3 and 4.2.4 Domestic electricity, power and energy transfers

- 12** A three-pin plug contains a live wire, a neutral wire and an earth wire, and a fuse.
- a Give the colours of the live, neutral and earth wires. [3]
 - b State the potential difference and frequency of the UK mains supply. [2]
 - c Explain the difference between direct and alternating potential difference. [2]
 - d Explain how the earth wire and the fuse together protect the user of an appliance with a metal case. [4]
 - e Explain why the fuse is always placed in the live wire. [2]
 - f Explain why a plastic-cased hairdryer does not need an earth wire. [2]

13

An electric shower is rated at 9.2 kW and operates from the 230 V mains.

- a Calculate the current drawn by the shower. Maths skill [3]
- b Explain why the shower must be wired with thicker cable than a table lamp. [2]
- c The shower is used for 8.0 minutes. Calculate the energy transferred, in joules. Maths skill [3]
- d Calculate the cost of this shower if electricity costs 28p per kWh. Maths skill [3]

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A resistor of resistance 25 Ω carries a current of 0.80 A.

- a Calculate the power dissipated in the resistor. Maths skill [3]
- b Calculate the energy transferred in 5.0 minutes. Maths skill [2]
- c Explain why electrical energy is transmitted across the National Grid at very high potential difference. [4]

15

The table gives the power ratings of four household appliances.

Appliance	Power in W	Time used per day
Fridge	150	24 hours
Television	90	4 hours
Kettle	2200	12 minutes
Oven	2500	45 minutes

- a Calculate the energy transferred by the television each day, in kWh. Maths skill [2]
- b Determine which appliance transfers the most energy per day. Show your working. Maths skill [3]
- c Suggest why the fridge uses the most energy despite having the lowest power rating. [2]
- d Suggest two ways the household could reduce the energy it uses. [2]

4.2.5 Static electricity

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A polythene rod is rubbed with a dry cloth and becomes negatively charged.

- a Explain how the rod becomes negatively charged. Separate Physics only [3]
- b The rod is held near small pieces of paper, which jump up to it. Explain why. Separate Physics only [2]
- c Define an electric field. Separate Physics only [1]
- d Describe the electric field around an isolated negatively charged sphere. Separate Physics only [2]
- e Explain why a spark may jump when a charged object is brought close to an earthed conductor. Separate Physics · HT only [3]

Working scientifically

- 17** A student investigates how the resistance of a thermistor changes with temperature using a water bath, a thermometer, an ammeter and a voltmeter.
- a Name the independent, dependent and one control variable. Working scientifically [3]
 - b Explain why the student stirs the water before taking each reading. Working scientifically [2]
 - c Identify one hazard and give a precaution. Working scientifically [2]
 - d The student takes readings at 10 °C intervals from 20 °C to 80 °C. Explain why this is better than taking only two readings. Working scientifically [2]
 - e The ammeter has a resolution of 0.01 A and the readings are around 0.03 A. Explain the problem this causes. Working scientifically [3]
- 18** Two students measure the resistance of the same resistor. Student A records 47 Ω , 48 Ω and 47 Ω . Student B records 44 Ω , 52 Ω and 46 Ω . The true value is 47 Ω .
- a State which student's results are more precise, and explain why. Working scientifically [2]
 - b State which student's results are more accurate, and explain why. Working scientifically [2]
 - c Calculate the mean of student B's results. Maths skill [1]
 - d Suggest one cause of the spread in student B's readings. Working scientifically [1]
 - e Explain why repeating a measurement does not remove a systematic error. Working scientifically [2]
- 19** A manufacturer claims that its energy-saving lamp 'uses 80% less electricity than a filament lamp for the same brightness'. A consumer group tests the claim.
- a Describe how the group could test the claim fairly. Working scientifically [3]
 - b The group finds the saving is 72%. Suggest why this differs from the manufacturer's claim. Working scientifically [2]
 - c Explain why the group's findings are more trustworthy if they are peer reviewed before publication. Working scientifically [2]
- 20** A circuit is set up with a battery of unknown potential difference, a 15 Ω resistor and a lamp in series. The current is 0.40 A and the potential difference across the lamp is 3.0 V.
- a Calculate the potential difference across the resistor. Maths skill [2]
 - b Determine the potential difference of the battery. Maths skill [1]
 - c Calculate the resistance of the lamp at this current. Maths skill [2]
 - d The lamp is replaced by one of higher resistance. State and explain the effect on the current. [2]
 - e Calculate the total energy transferred by the circuit in 2.0 minutes. Maths skill [3]
- 21** A student uses a joulemeter to measure the energy transferred by a 12 V motor lifting a load.
- a The joulemeter reads 480 J and the motor runs for 40 s. Calculate the power input. Maths skill [2]
 - b Calculate the current drawn by the motor. Maths skill [2]
 - c The motor lifts a load of 15 N through 1.6 m. Calculate the useful work done. Maths skill [2]
 - d Calculate the efficiency of the motor. Maths skill [2]
 - e Suggest two reasons why the efficiency is low. [2]

22

A student tests three resistors using the same supply and records the readings below.

Resistor	Potential difference in V	Current in A
X	6.0	0.50
Y	6.0	0.20
Z	6.0	1.20

- a Calculate the resistance of each resistor. Maths skill [3]
- b Identify the resistor that dissipates the most power, and justify your answer with a calculation. Maths skill [3]
- c Predict the total resistance if X and Y are connected in series. Maths skill [1]
- d Predict whether the total resistance of X and Z in parallel is more or less than $5.0\ \Omega$, and explain. [2]

23

Explain why connecting an ammeter in parallel with a component, instead of in series, can damage the circuit.

Give your answer.

Working scientifically [2]

24

A technician must choose a fuse for a 1150 W appliance used on the 230 V mains. Fuses available are rated 3 A, 5 A and 13 A.

- a Calculate the normal operating current. Maths skill [2]
- b State which fuse should be chosen, and explain why. [2]

Extended response

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An electrician is called to a house where a metal-cased washing machine has given someone a small electric shock.

Explain how the live, neutral and earth wires, together with the fuse, should work to make the appliance safe, and suggest what may have gone wrong. [6]

26

A student is given two circuits containing identical lamps and an identical battery: one with the lamps in series and one with the lamps in parallel.

Compare the two circuits in terms of current, potential difference, total resistance and the brightness of the lamps. Explain your answers. [6]