

Electricity

Mark Scheme

Level	Pre U
Subject	Physics
Exam Board	Cambridge International Examinations
Topic	Electricity
Booklet	Mark Scheme

Time Allowed: 56 minutes

Score: /46

Percentage: /100

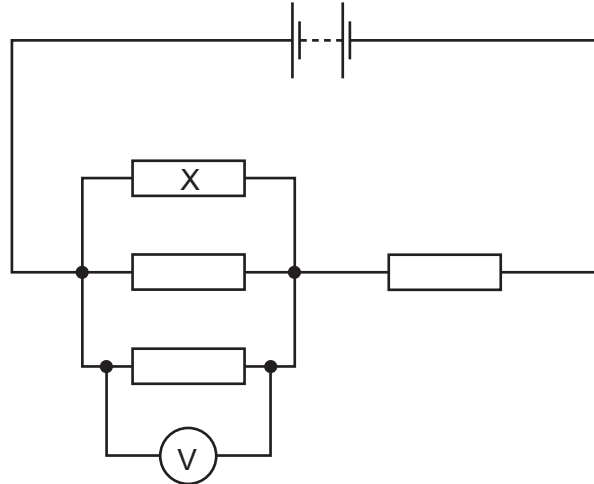
Grade Boundaries:

- 1 A metal wire of length L and uniform cross-sectional area A has a resistance of $80.0\ \Omega$. The wire is stretched and L increases by 0.5% . The volume of the wire remains constant.

What is the resistance of the stretched wire?

- A** $76.0\ \Omega$ **B** $80.4\ \Omega$ **C** $80.8\ \Omega$ **D** $84.0\ \Omega$

- 2 Four identical resistors are connected in a circuit as shown.



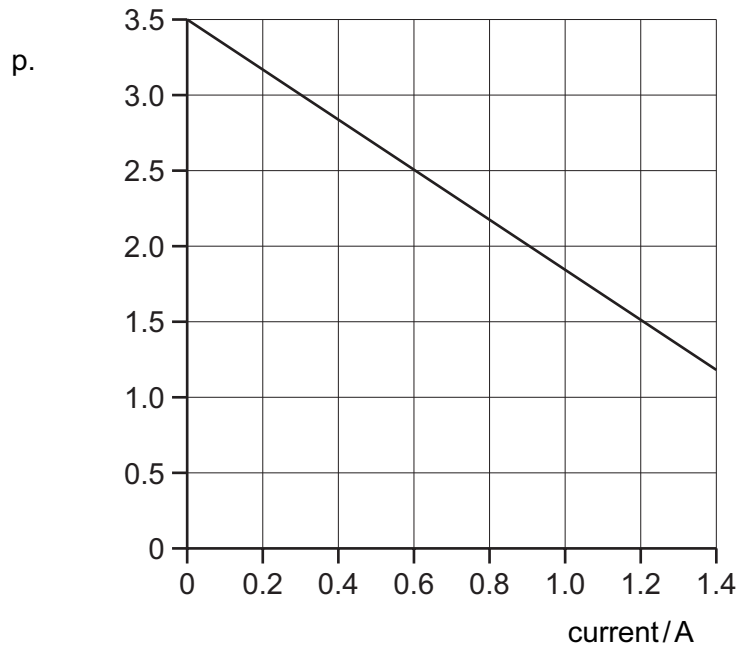
The voltmeter reads $6.0\ \text{V}$. The battery has negligible internal resistance.

What is the potential difference across resistor X and the emf of the battery?

	potential difference across X /V	emf of battery /V
A	2.0	6.0
B	6.0	6.0
C	6.0	12.0
D	6.0	24.0

Space for working

- 3 The diagram shows how the potential difference (p.d.) across a battery varies with the current that it supplies.

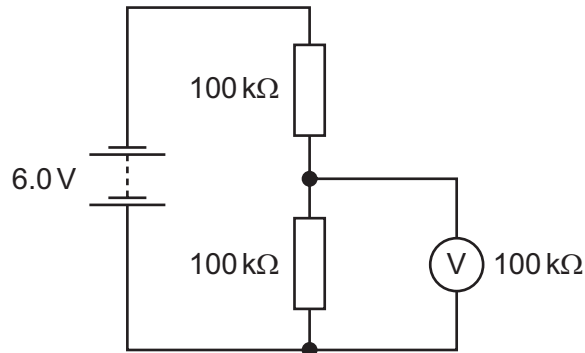


What is the internal resistance of the battery?

- A** $0.60\ \Omega$ **B** $1.2\ \Omega$ **C** $1.7\ \Omega$ **D** $2.3\ \Omega$

Space for working

- 4 Two resistors, each of resistance $100\text{ k}\Omega$, are connected in series with a 6.0 V battery of negligible internal resistance.



A voltmeter of resistance $100\text{ k}\Omega$ is connected across one of the resistors.

What is the reading on the voltmeter?

- A** 0 V **B** 2.0 V **C** 3.0 V **D** 4.0 V

Space for working

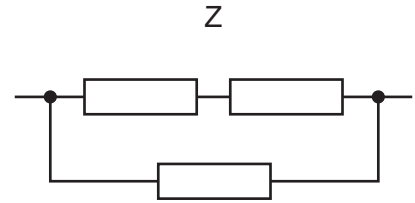
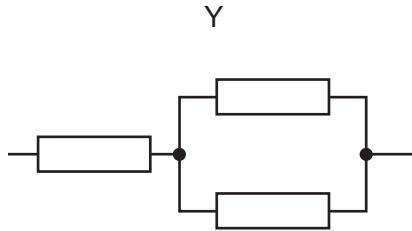
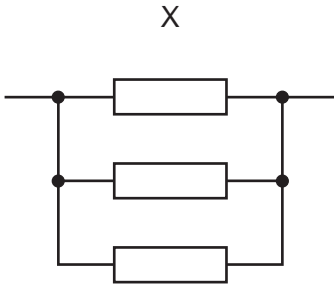
- 5 A torch is switched on and left until its battery is flat.

During this time, the current in the lamp remains steady at 0.60 A for three hours and then decreases uniformly to zero in the next hour.

What is the total charge passing through the lamp?

- A** $1.2 \times 10^2\text{ C}$ **B** $4.3 \times 10^3\text{ C}$ **C** $7.6 \times 10^3\text{ C}$ **D** $8.6 \times 10^3\text{ C}$

6 All of the resistors in the circuits X, Y and Z below are identical.



Which list shows these circuits in order of increasing resistance, lowest to highest?

- A $X \rightarrow Y \rightarrow Z$
- B $X \rightarrow Z \rightarrow Y$
- C $Y \rightarrow X \rightarrow Z$
- D $Y \rightarrow Z \rightarrow X$

7 A long piece of wire has a resistance of 2.0Ω it is cut into 40 equal lengths and these are connected in parallel to form a multi-stranded cable.

What is the resistance of the cable?

- A $1.3 \times 10^{-3}\Omega$
- B 0.05Ω
- C 80Ω
- D $3.2 \times 10^3\Omega$

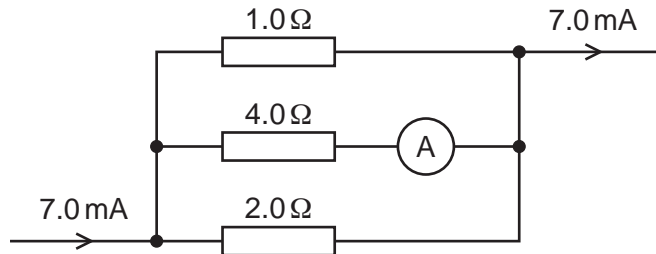
8 A battery of emf $12V$ is connected across a 22Ω resistor. The battery has an internal resistance that is **not** negligible. A current in the resistor is $0.50A$.

At which rate is heat dissipated in the internal resistance of the battery?

- A $0.50W$
- B $5.5W$
- C $6.0W$
- D $6.5W$

Space for working

- 9 The diagram shows a current of 7.0 mA flowing through a parallel arrangement of resistors. The ammeter and connecting wires are of negligible resistance.



What is the reading on the ammeter?

- A** 0.6 mA **B** 1.0 mA **C** 2.3 mA **D** 4.0 mA
- 10 A heater is rated 220 V, 500 W.

When the heater is connected to a 220 V power supply, the current is I_0 .

When the heater is connected to a 110 V power supply, what is the current and what is the power? Assume the resistance of the heater does not change.

	current	power / W
A	$\frac{I_0}{2}$	125
B	$\frac{I_0}{2}$	250
C	$\frac{I_0}{4}$	125
D	$\frac{I_0}{4}$	250

Space for working

- 11 Four lamps have filaments made from the same material. The lamps are connected in parallel across a battery.

Which filament lamp transfers the most energy into heat and light per second?

	length of filament	cross-sectional area of filament
A	l	A
B	$2l$	A
C	l	2A
D	$2l$	2A

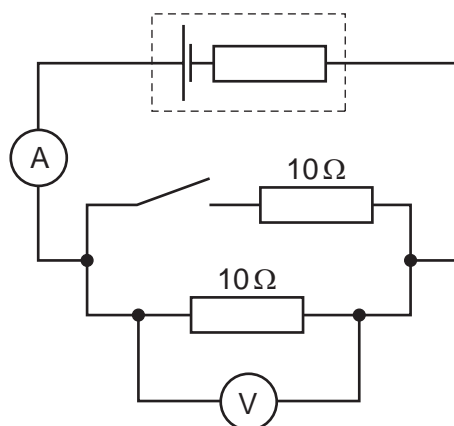
- 12 A torch has a 6 V battery made up of four cells, each with emf 1.5 V and internal resistance $1.0\ \Omega$.

If one of the cells is reversed, which row shows the emf and the internal resistance of the battery?

	emf/V	internal resistance / Ω
A	3.0	2.0
B	3.0	4.0
C	4.5	2.0
D	4.5	4.0

Space for working

13 The diagram shows a circuit.



The cell has an e.m.f. of 1.5V. The voltmeter reads 1.2V when the switch is open.

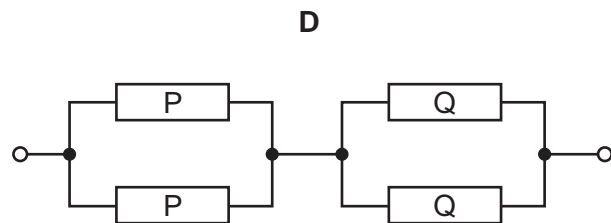
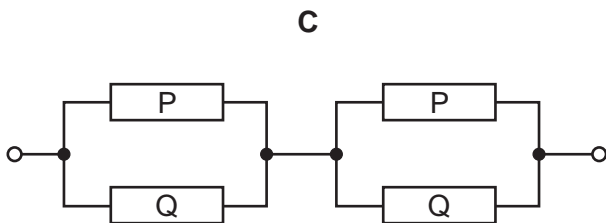
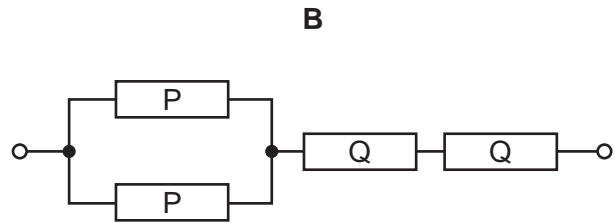
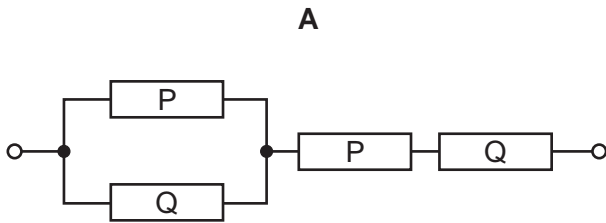
What happens to the voltmeter reading and the current through the ammeter when the switch is closed?

	voltmeter reading	current through ammeter
A	decreases	increases
B	increases	decreases
C	stays the same	decreases
D	stays the same	increases

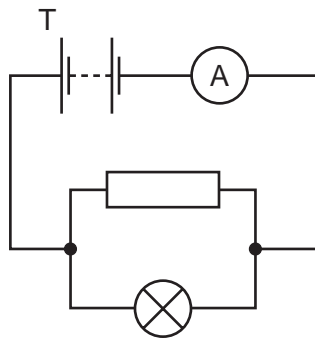
Space for working

14 In the diagrams, resistor P has twice the resistance of resistor Q.

Which network has the lowest resistance?



15 A circuit is connected as shown.

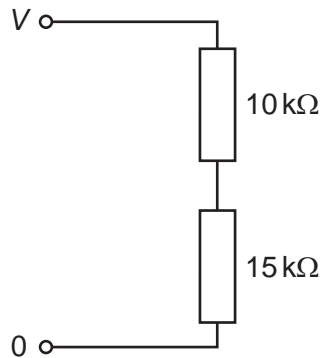


The ammeter reads 2.0 A. The battery has negligible internal resistance.

Which statement about the circuit is correct?

- A** Each second, 2.0 C of charge flows through the lamp.
- B** Each second, 6.25×10^{18} electrons flow through the resistor.
- C** Each second, 1.25×10^{19} electrons flow away from terminal T of the battery.
- D** Each second, fewer than 1.25×10^{19} electrons flow through the lamp.

- 16 A potential divider circuit is set up by connecting two resistors in series as shown. The potential difference across the circuit is V .



What is the potential difference across the $10\text{ k}\Omega$ resistor?

- A $\frac{10}{25}V$ B $\frac{15}{25}V$ C $\frac{10}{15}V$ D $\frac{15}{10}V$
- 17 Two resistors of resistance R are connected in parallel with a cell of negligible internal resistance. The power delivered by the cell is P .

One of the resistors burns out.

What is the power now delivered by the cell?

- A $\frac{1}{4}P$ B $\frac{1}{2}P$ C $2P$ D $4P$

Space for working

- 18 A wire has a length of 2.2 m and a diameter of 1.6 mm. The current in the wire is 0.44 A when a potential difference of 0.50 V is applied between its ends.

What is the resistivity of the wire?

- A $8.0 \times 10^{-7} \Omega \text{ m}$
- B $1.0 \times 10^{-6} \Omega \text{ m}$
- C $3.2 \times 10^{-6} \Omega \text{ m}$
- D $4.2 \times 10^{-6} \Omega \text{ m}$

- 19 Wire X has radius r , length l and is made of a material whose resistivity is ρ .
Wire Y has radius $3r$, length $3l$ and is made of material whose resistivity is 3ρ .

When X and Y are connected in series, their combined resistance is R_s . When X and Y are connected in parallel, their combined resistance is R_p .

What is the ratio $\frac{R_s}{R_p}$?

- A 1
- B 3
- C 4
- D $\frac{16}{3}$

- 20 When there is a current in a tungsten filament lamp, the filament gets hot and its resistance increases.

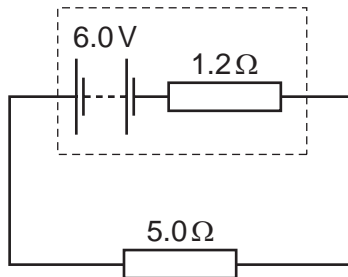
The resistance of tungsten is approximately proportional to its absolute temperature ($R \propto T$). The power supplied to the filament is proportional to the fourth power of its absolute temperature ($P \propto T^4$).

Which relationship follows from this?

- A $I^5 V^3$ is a constant.
- B $\frac{I^5}{V^3}$ is a constant.
- C $\frac{V^5}{I^3}$ is a constant.
- D $\frac{V^5}{I^4}$ is a constant.

Space for working

- 21 The diagram shows a battery of e.m.f. 6.0 V and internal resistance $1.2\ \Omega$ connected to a resistor of resistance $5.0\ \Omega$.



Another $5.0\ \Omega$ resistor is connected in parallel to the original $5.0\ \Omega$ resistor.

What is the ratio: $\frac{\text{total current with two } 5.0\ \Omega \text{ resistors}}{\text{total current with one } 5.0\ \Omega \text{ resistor}}$?

- A** 0.50 **B** 0.55 **C** 1.7 **D** 2.0

Space for working

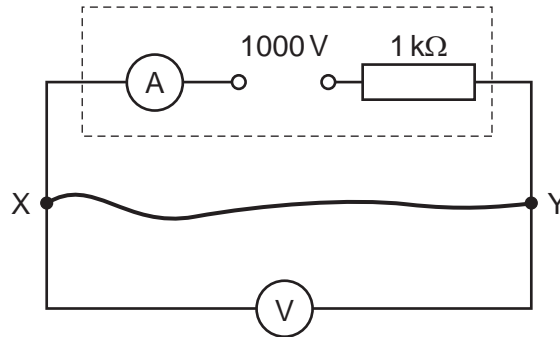
- 22 The Large Hadron Collider (LHC) at CERN is designed to accelerate groups of protons around a large circular ring.

At any moment, there will be 3000 groups in the ring and each group will contain about 10^{11} protons. All the protons go around the ring 10^4 times per second.

What is the best estimate of the current in the ring?

- A** $50\ \mu\text{A}$ **B** $160\ \mu\text{A}$ **C** $500\ \text{mA}$ **D** $160\ \text{A}$

23 A power supply has an e.m.f. of 1000 V and an internal resistance of $1\text{ k}\Omega$. It has a built-in ammeter.



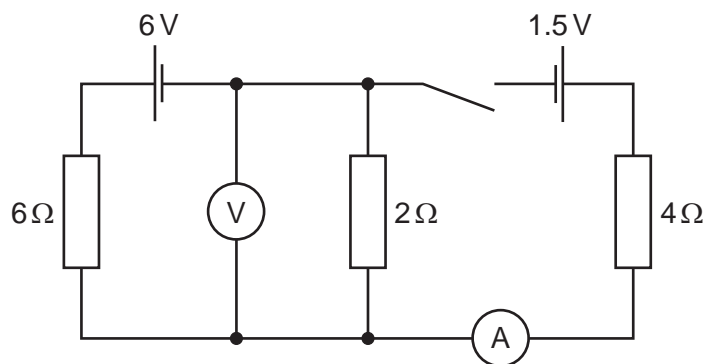
A connecting lead of negligible resistance is connected between points X and Y.

What will be the readings of the voltmeter and ammeter?

	voltmeter reading/V	ammeter reading/A
A	0	0
B	0	1
C	1000	0
D	1000	1

Space for working

24 The diagram shows a circuit.



The switch is initially open and is then closed.

What are the meter readings?

	voltmeter before closing switch / V	ammeter after closing switch / A
A	6.0	0
B	1.5	0.75
C	6.0	0.75
D	1.5	0

25 A cable is constructed of 12 parallel strands of nichrome wire, each of length 6.0m and cross-sectional area 1.00mm^2 .

What is the resistance of the cable?

Resistivity of nichrome = $1.10 \times 10^{-6}\Omega\text{m}$

- A** 0.55Ω **B** 6.6Ω **C** 14Ω **D** 79Ω

Space for working

- 26 A cable of length l and diameter d is to be replaced by a new cable of the same length and the same total resistance, but made from a material whose resistivity is half as much as in the original cable.

What is the diameter of the new cable?

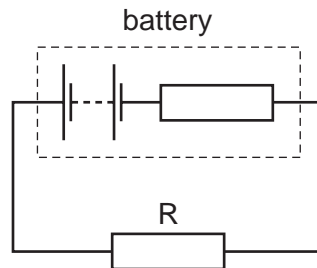
- A $0.50d$ B $0.71d$ C $1.41d$ D $2.00d$

- 27 A metal wire of length L and uniform cross-sectional area A has a resistance of 100Ω . The wire is stretched and L increases by 5%. The volume of the wire remains constant.

What is the resistance of the stretched wire?

- A 95Ω B 100Ω C 105Ω D 110Ω

- 28 A circuit is connected as shown.



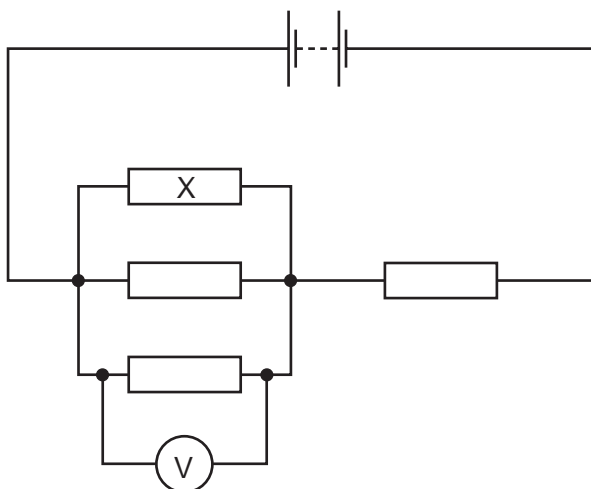
When 100 C flows around the circuit, 120 J of electrical energy is dissipated in resistor R and 20 J in the battery's internal resistance.

What is the e.m.f. of the battery?

- A 0.60 V B 0.70 V C 1.2 V D 1.4 V

Space for working

29 Four identical resistors are connected in a circuit as shown.



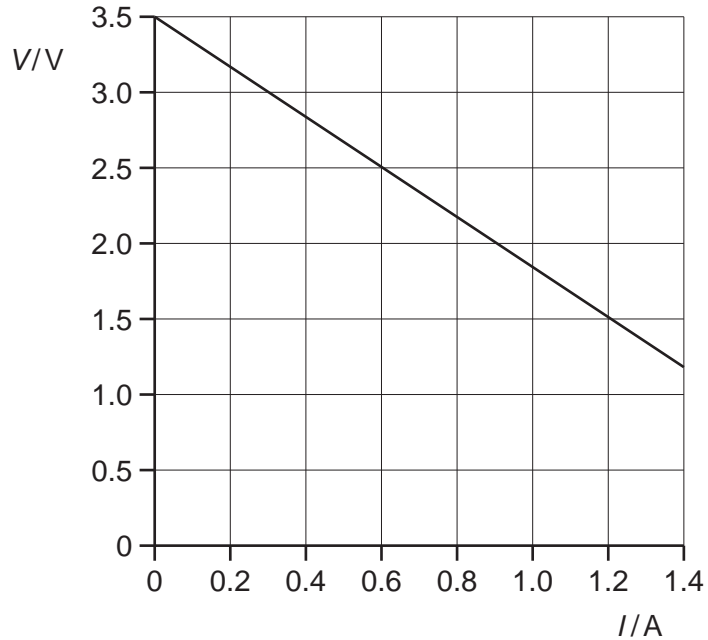
The voltmeter reads 6.0 V. The battery has negligible internal resistance.

What are the correct values for the potential difference across resistor X and the e.m.f. of the battery?

	potential difference across X /V	e.m.f. of battery /V
A	2.0	6.0
B	6.0	6.0
C	6.0	12.0
D	6.0	24.0

Space for working

- 30 The diagram shows how the potential difference (p.d.) across a battery varies with the current that is supplied.

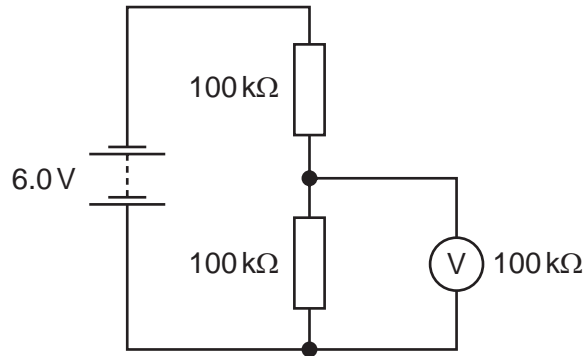


What is the internal resistance of the battery?

- A** $0.60\ \Omega$ **B** $1.20\ \Omega$ **C** $1.70\ \Omega$ **D** $2.30\ \Omega$

Space for working

31 Two resistors, each of resistance $100\text{ k}\Omega$, are connected in series with a battery of negligible internal resistance.



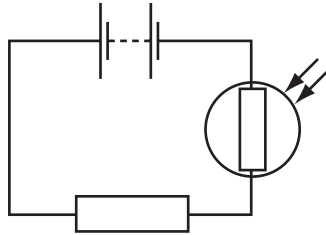
A voltmeter of resistance $100\text{ k}\Omega$ is connected across one of the resistors.

What is the reading on the voltmeter?

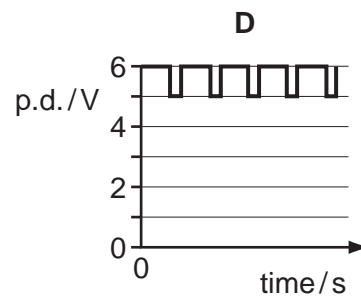
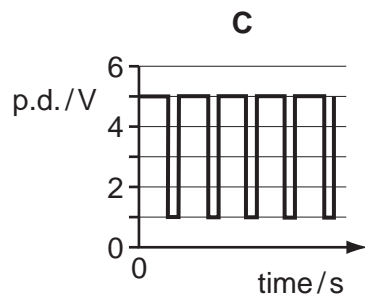
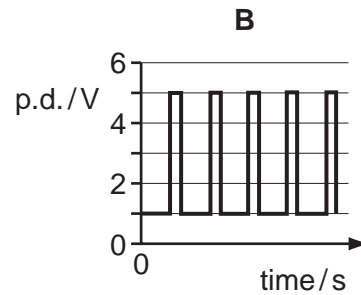
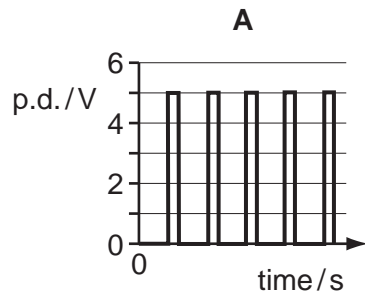
- A** 0V **B** 2.0V **C** 3.0V **D** 4.0V

Space for working

- 32 The resistance of a light-dependent resistor (LDR) is $5\text{M}\Omega$ in the dark and $1\text{ k}\Omega$ when light shines on it. The LDR is connected in series with a 6 V battery with negligible internal resistance and a $5\text{ k}\Omega$ resistor. The circuit is placed in a dark room and the LDR is then illuminated by a flashing lamp.



Which diagram shows how the p.d. across the $5\text{ k}\Omega$ resistor varies with time?



Space for working

33 A woman touches the body of a car that has become charged during its journey.

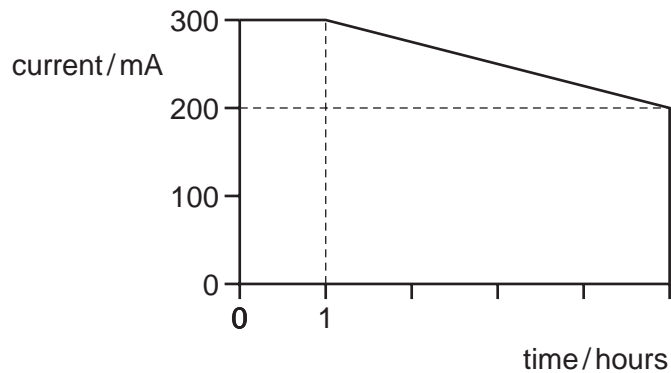
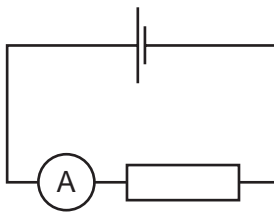
A current of 10 mA passes through her for 20 ms.

How much charge flows through her?

- A** $2 \times 10^{-4} \text{ C}$ **B** 0.5 C **C** 2 C **D** 200 C

Space for working

34 A cell is connected to a resistor and the current is measured. The graph shows how the current varies with time.

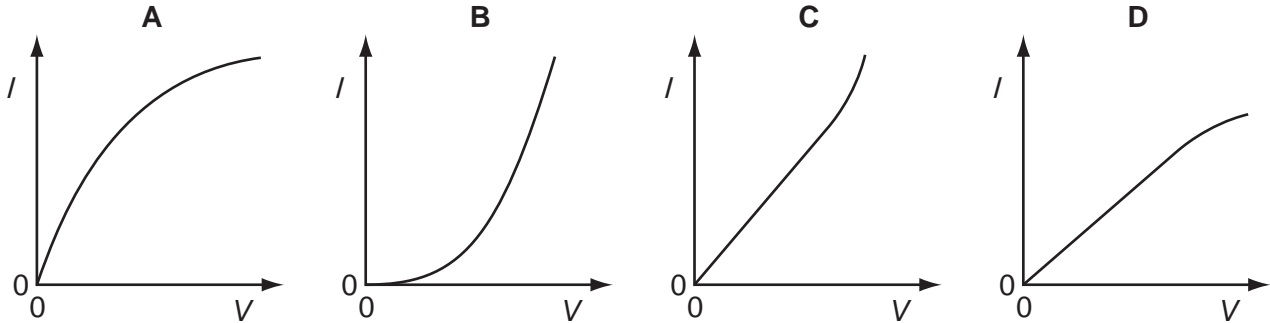


How much charge passes through the cell during this time?

- A** 1.50 kC **B** 4.68 kC **C** 5.40 kC **D** 5400 kC

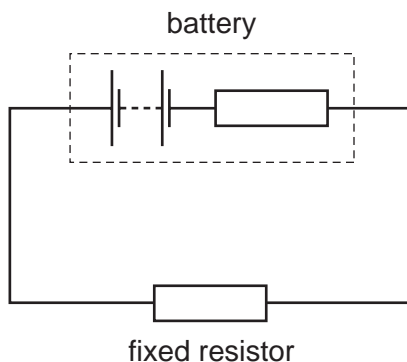
- 35 The graphs show how the current varies with the voltage for four electrical components, **A**, **B**, **C** and **D**.

For which component is the resistance initially constant before increasing?



Space for working

36 A battery is connected to a fixed resistor.



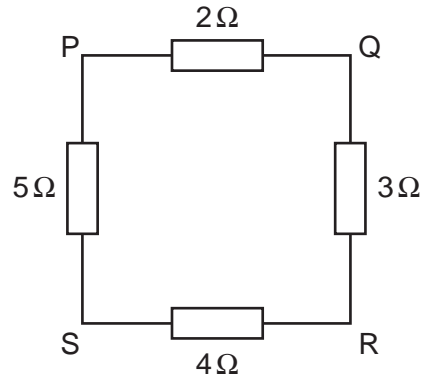
The battery is replaced by one of the same e.m.f. but with a larger internal resistance.

What happens to the terminal potential difference across the battery and the current through the fixed resistor?

	terminal potential difference across the battery	current through the fixed resistor
A	decreases	decreases
B	decreases	stays the same
C	stays the same	decreases
D	stays the same	stays the same

Space for working

- 37 The diagram shows four resistors connected in a square. An ohmmeter measures the resistance between different points.



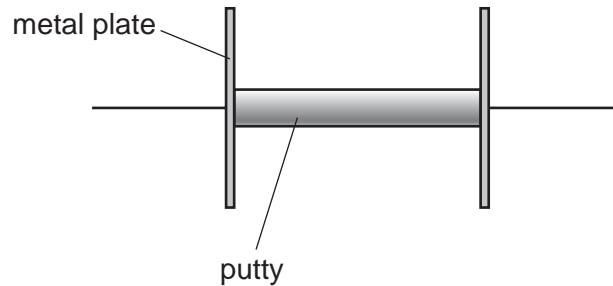
Between which points will the ohmmeter reading be the **smallest**?

- A** P and Q **B** Q and R **C** R and S **D** S and P

Space for working

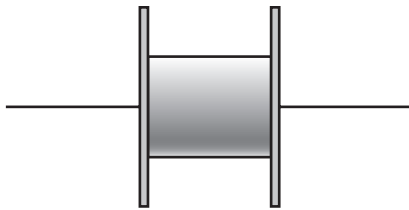
- 38 Conducting putty is a soft material which can easily be made into different shapes. It conducts electricity.

50g of conducting putty is placed between two metal plates as shown.



With the putty arranged like this, it has a resistance of $8\ \Omega$.

The plates are now squeezed together so that the distance between them is halved.



What is the resistance of the putty now?

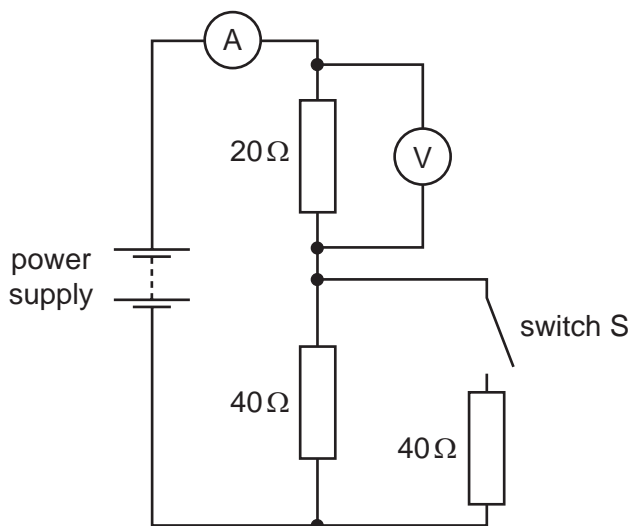
- A** $2\ \Omega$ **B** $4\ \Omega$ **C** $8\ \Omega$ **D** $16\ \Omega$

Space for working

39 Which statement about dry cells is **not** correct?

- A A 6 V cell transfers 6 J of energy to every coulomb of charge passing through it.
- B Conventional current flows through a cell from its negative terminal to its positive terminal.
- C Inside a cell, chemical energy is used to do work on electric charges.
- D When a cell becomes ‘discharged’ it has used up its store of electric charge.

40 A circuit is connected as shown.



What will happen to the readings on the voltmeter and ammeter when switch S is closed?

	voltmeter reading	ammeter reading
A	decrease	decrease
B	decrease	increase
C	increase	increase
D	no change	increase

Space for working

- 41 Three identical resistors are connected in series across a cell. The same three resistors are then connected in parallel across the same cell. Assume that the cell has zero internal resistance and does not run down during the experiment.

What is the value of the ratio $\frac{\text{power from cell (resistors in parallel)}}{\text{power from cell (resistors in series)}}$?

- A** $\frac{1}{3}$ **B** $\frac{1}{9}$ **C** $\frac{3}{1}$ **D** $\frac{9}{1}$

- 42 A copper wire of length 3.0 m has a resistivity of $1.7 \times 10^{-8} \Omega \text{m}$ and resistance 15.9Ω .
What is the diameter of the wire? (Assume the wire has a uniform circular cross-section.)

- A** $3.2 \times 10^{-4} \text{m}$ **B** $2.1 \times 10^{-5} \text{m}$ **C** $3.2 \times 10^{-5} \text{m}$ **D** $6.4 \times 10^{-5} \text{m}$

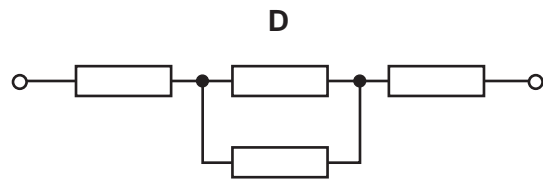
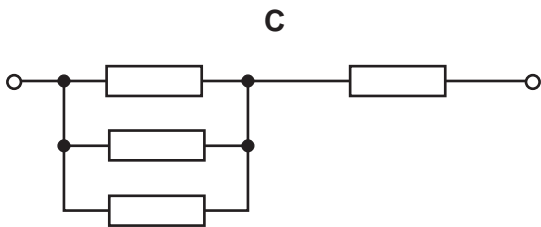
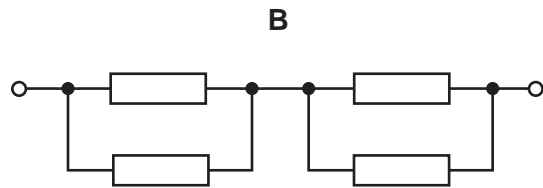
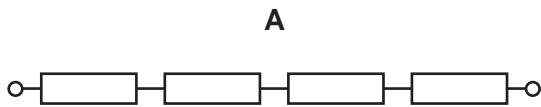
- 43 One type of charger for a mobile phone supplies a current of 240 mA for one hour.
How many electrons flow to the mobile phone?

- A** 1.5×10^{18} **B** 9.0×10^{19} **C** 5.4×10^{21} **D** 5.4×10^{24}

Space for working

44 In the diagrams, all resistors are identical.

Which network has the lowest resistance?



45 A high-resistance voltmeter connected directly across the terminals of a cell reads 1.50 V.

When a $2.0\ \Omega$ resistor is also connected across the cell the voltmeter reading drops to 1.20 V.

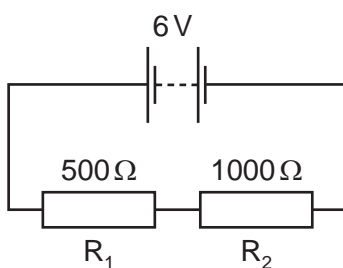
What is the internal resistance of the cell?

- A** $0.50\ \Omega$ **B** $1.6\ \Omega$ **C** $2.0\ \Omega$ **D** $2.5\ \Omega$

Space for working

- 46 The diagram shows a 6 V battery, with negligible internal resistance, connected in series to two resistors R_1 and R_2 .

R_1 has a resistance of $500\ \Omega$ and R_2 has a resistance of $1000\ \Omega$.



A third resistor with a resistance of $500\ \Omega$ is placed in parallel across R_2 .

Which statement about the new circuit is correct?

- A The current in R_2 is larger than before.
- B The current through the battery is smaller than before.
- C The potential difference (p.d.) across R_1 is larger than before.
- D The p.d. across R_2 is now greater than the p.d. across R_1 .

Space for working