4. Electricity and magnetism

4.2 Electrical quantities

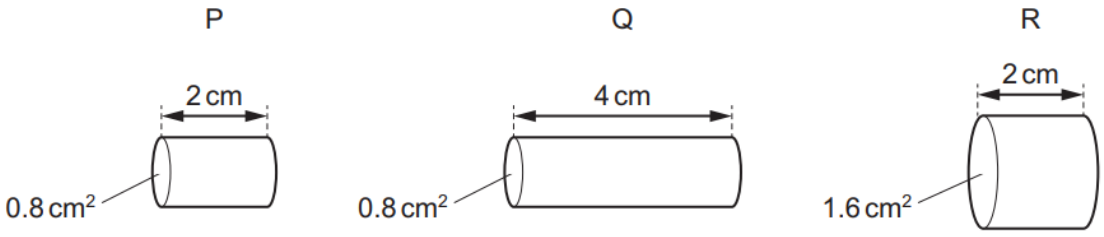
Paper 1 and 2

Question Paper

Paper 1

Questions are applicable for both core and extended candidates

1 The diagram shows three wires, P, Q and R. They are all made from the same metal.



Which list gives the wires in order of resistance, from lowest to highest?

A P → Q → R

B Q → R → P

C R → P → Q

D R → Q → P

2 A 60 W lamp operates at normal brightness for 2.0 minutes.

How much energy is transferred by the lamp?

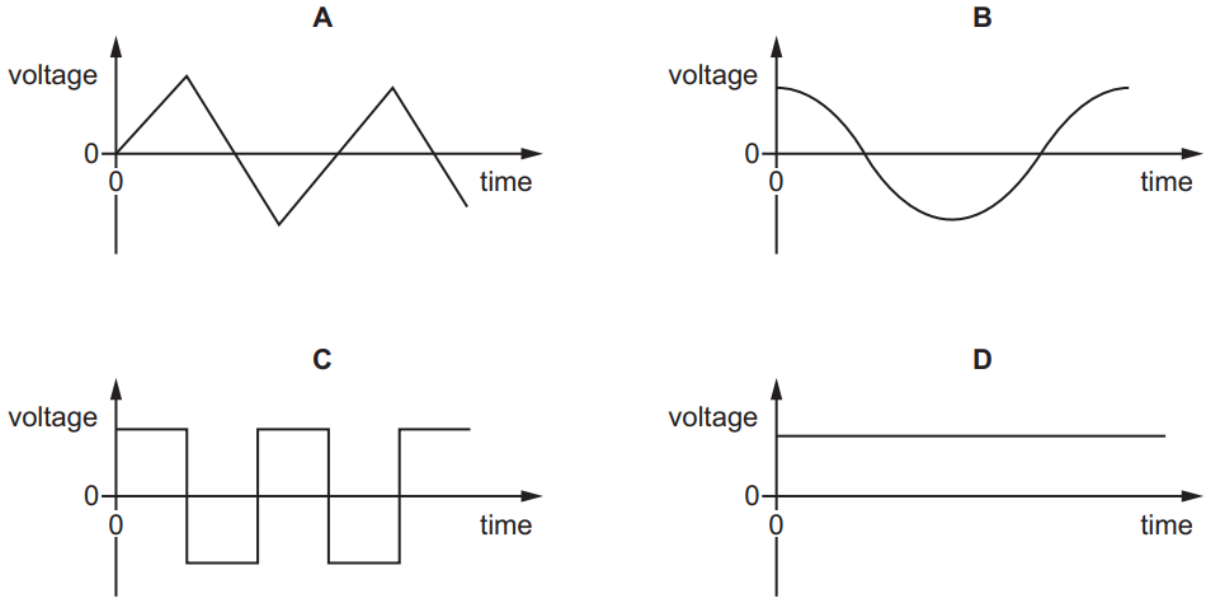
A 0.50 J **B** 30 J **C** 120 J **D** 7200 J

3 Which row about electrical conduction in metals is correct?

	statement 1	statement 2
A	It is the movement of free electrons.	Electric charge is a flow of current.
B	It is the movement of positive ions.	Electric charge is a flow of current.
C	It is the movement of free electrons.	Electric current is a flow of charge.
D	It is the movement of positive ions.	Electric current is a flow of charge.

4 Direct current (d.c.) can be represented on a voltage–time graph.

Which graph shows the correct waveform for a d.c. supply?



5 A resistor with a potential difference (p.d.) of 100 V across it carries a current of 5.0 mA.

What is the resistance of the resistor?

A 0.50 Ω **B** 20 Ω **C** 500 Ω **D** 20 000 Ω

6 The diagram shows the information label on an electric kettle.

[redacted]	
Voltage:	110 V a.c.
Power:	1500 W
Frequency:	50 Hz

What is the value of the current when the kettle is heating water?

A 0.073 A **B** 2.2 A **C** 3.7 A **D** 14 A

7 Which material is a good electrical conductor?

A glass

B copper

C rubber

D wood

8 Which unit is used for the potential difference (p.d.) between two points in an electrical circuit?

A ampere (A)

B joule (J)

C ohm (Ω)

D volt (V)

9 There is a current I in a resistor of resistance R. The potential difference (p.d.) across the resistor is V.

Which equation gives the power P dissipated by the resistor?

A $P = IR$ **B** $P = IV$ **C** $P = \frac{I}{R}$ **D** $P = \frac{I}{V}$

10 A student tests the electrical conduction of four materials.

- aluminium
- iron
- plastic
- silver

Which materials are good conductors of electricity?

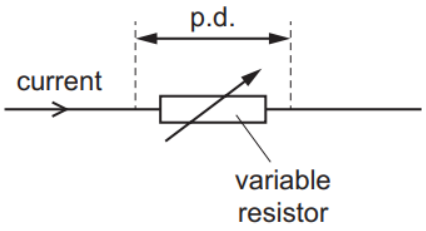
A aluminium, iron and silver

B aluminium and silver only

C iron, silver and plastic

D plastic only

11 This question is about the potential difference (p.d.) across, and the current in, a variable resistor.



The resistance of the variable resistor is increased.

Which statement is correct?

A The current can remain constant if the p.d. is decreased.

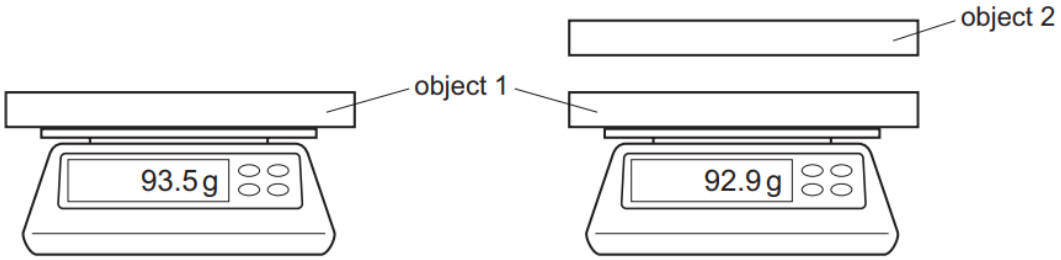
B The current can remain constant if the p.d. is increased.

C The p.d. can remain constant if the current is kept constant.

D The p.d. can remain constant if the current is increased.

12 Object 1 is given a negative charge and placed on a balance.

Object 2, which is also charged, is brought close to object 1 and the reading on the balance changes as shown.



Which action would further decrease the reading on the balance?

A Add the same number of electrons to both objects.

B Remove the same number of electrons from both objects.

C Transfer electrons from object 1 to object 2.

D Transfer electrons from object 2 to object 1.

13 Which statement about a voltmeter is correct?

A It has a scale which is marked in amperes (A).

B It must be connected in series in a circuit.

C It measures potential difference (p.d.).

D It must have three terminals.

14 How does the resistance of a metallic wire change:

- as its length increases
- as its cross-sectional area decreases?

	resistance as length increases	resistance as cross-sectional area decreases
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

15 A plastic rod is rubbed with a cloth. The rod becomes positively charged because of the movement of charged particles.

Which row gives the name of these charged particles and the direction in which they move?

	charged particles	direction of movement
A	electrons	from cloth to rod
B	electrons	from rod to cloth
C	protons	from cloth to rod
D	protons	from rod to cloth

16 Which unit is used to measure electromotive force (e.m.f.)?

A ampere

B joule

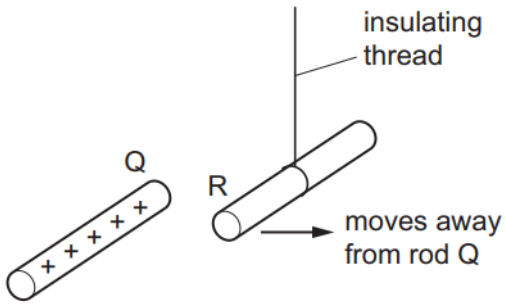
C volt

D watt

17 Which equation is correct for resistance R, potential difference (p.d.) V and current I?

A $R = \frac{V}{I}$ **B** $R = V + I$ **C** $R = \frac{I}{V}$ **D** $R = V \times I$

18 In the diagram, rod R is suspended from an insulating thread.



When the positively charged rod Q is brought close to rod R, rod R moves away from rod Q.

Which conclusion can be made from this observation?

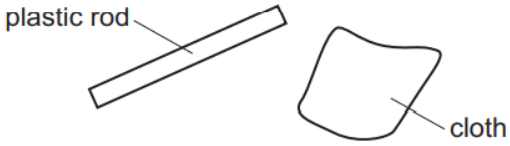
A Rod R is charged, but it is not possible to identify the sign of the charge.

B Rod R must be positively charged.

C Rod R must be negatively charged.

D Rod R is uncharged.

19 A plastic rod is rubbed with a cloth.

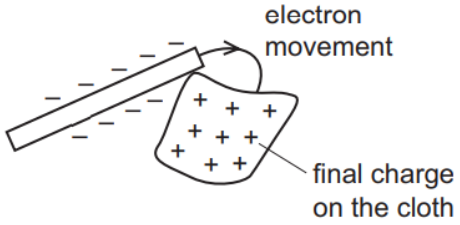


The rod and the cloth both become charged as electrons move between them.

The rod becomes negatively charged.

Which diagram shows how the rod becomes negatively charged and shows the final charge on the cloth?

A



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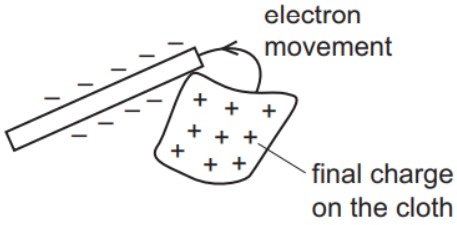

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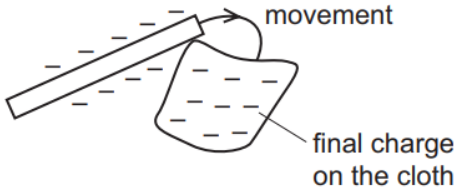

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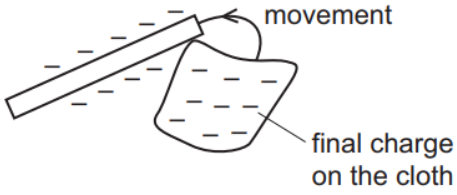


20 Which particles move to cause a current in a copper wire?

A copper atoms

B electrons from the copper atoms

C protons from the copper nuclei

D neutrons from the copper nuclei

21 A plastic rod is rubbed with a dry cloth. The rod becomes positively charged.

Why has the rod become positively charged?

A It has gained electrons.

B It has gained neutrons.

C It has lost electrons.

D It has lost neutrons.

22 Which statement about electric current in a conductor is correct?

A In a d.c. circuit, the electric current gradually decreases along the conductor.

B In a d.c. circuit, the free electrons flow back and forth.

C In an a.c. circuit, the electric current remains exactly the same all the time.

D In an a.c. circuit, the flow of charge changes direction continually.

23 A lamp rated 12 V, 2.0 A is switched on for 60 s.

How much energy is transferred?

A 0.40 J **B** 10 J **C** 360 J **D** 1400 J

24 Which description of a current in a metal is correct?

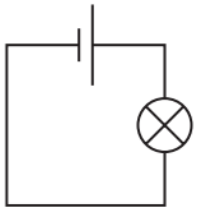
A a flow of electrons

B a flow of molecules

C a flow of positive atoms

D a flow of protons

25 The e.m.f. of the cell in this circuit is 1.5 V.



What does e.m.f. stand for?

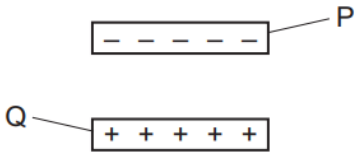
A electromagnetic field

B electromagnetic force

C electromotive field

D electromotive force

26 A negatively charged plastic rod P is placed above a positively charged plastic rod Q.



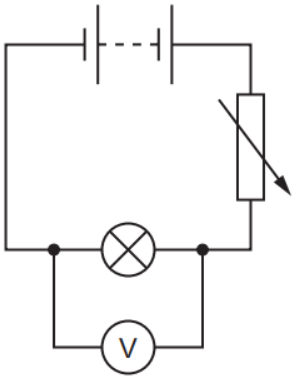
What are the directions of the electrostatic forces on rod P and on rod Q?

	electrostatic force on rod P	electrostatic force on rod Q
A	downwards	downwards
B	downwards	upwards
C	upwards	downwards
D	upwards	upwards

27 The diagram shows a circuit used to control the potential difference (p.d.) across a lamp.

The variable resistor is adjusted until the p.d. across the lamp is 6.0 V.

The current in the lamp is 0.5 A.



What is the resistance of the lamp?

A 0.083 Ω **B** 3.0 Ω **C** 6.5 Ω **D** 12.0 Ω

28 What are the units of electromotive force (e.m.f.)?

A amperes

B watts

C ohms

D volts

29 A plastic rod is rubbed with a dry woollen cloth. The rod becomes positively charged.

Which statement is correct?

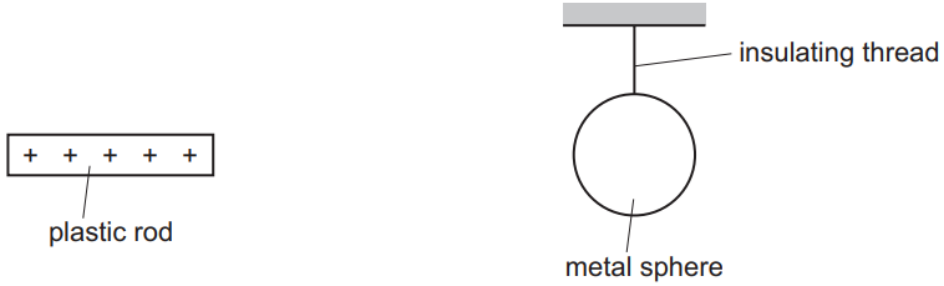
A Electrons move from the cloth to the rod.

B Electrons move from the rod to the cloth.

C Protons move from the cloth to the rod.

D Protons move from the rod to the cloth.

30 The diagram shows a charged plastic rod and an uncharged metal sphere. The metal sphere is suspended by an insulating thread.



The plastic rod is then moved close to the metal sphere.

Which row is correct?

	observation	the overall state of the metal sphere
A	The rod attracts the sphere.	charged
B	The rod attracts the sphere.	uncharged
C	The rod repels the sphere.	charged
D	The rod repels the sphere.	uncharged

31 A large battery is labelled with various items of information about the battery.

12 V	30 kg	216 kJ	680 A

One of these items of information is the electromotive force (e.m.f.) of the battery.

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

A 12 V **B** 30 kg **C** 216 kJ **D** 680 A

32 A resistor has a potential difference (p.d.) of 12 V across it and a current of 0.60 A in it.

What is the resistance of the resistor?

A 0.050 Ω **B** 2.0 Ω **C** 7.2 Ω **D** 20 Ω

33 Four wires made of the same metal have different lengths and different diameters.

Which wire has the lowest resistance?

	length	diameter
A	long	large
B	long	small
C	short	large
D	short	small

34 A student rubs a plastic rod with a cloth.

The rod becomes positively charged.

What has happened to the rod?

A It has gained electrons.

B It has gained protons.

C It has lost electrons.

D It has lost protons.

35 What is an electric current in a metal wire?

A a flow of electrons

B a flow of neutrons

C a flow of nucleons

D a flow of protons

36 Four wires are made of the same metal.

Which wire has the greatest resistance?

A a 100 cm long wire with a diameter of 3.0 mm

B a 100 cm long wire with a diameter of 6.0 mm

C a 10 cm long wire with a diameter of 3.0 mm

D a 10 cm long wire with a diameter of 6.0 mm

37 Three statements about electric charge are given.

1 An ammeter directly measures how much electric charge is in an object.

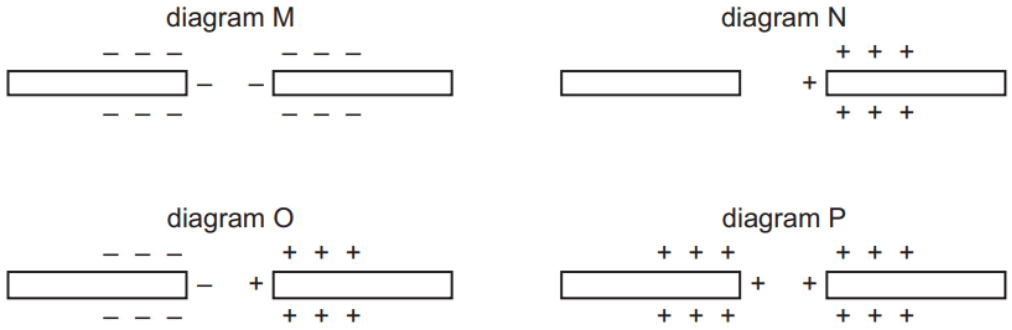
2 A moving electric charge can be detected by an ammeter.

3 A flow of electric charge is an electric current.

Which statements are correct?

A 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

38 Each of the four diagrams M, N, O and P shows a separate pair of insulating rods. Each rod is charged as shown.



In which **two** arrangements do the pairs of rods experience a force of repulsion?

A M and N **B** O and P **C** M and P **D** N and O

39 Diagram 1 shows two thin, uncharged strips of plastic.

Diagram 2 shows the same strips after they have been rubbed with a dry cloth.

diagram 1 diagram 2

Which row describes the charge on the strips after rubbing, and the force between the strips after rubbing?

	charge on strips	force between strips
A	opposite	attraction
B	opposite	repulsion
C	the same	attraction
D	the same	repulsion

40 A teacher asks her class "What quantity can be recorded in volts?".

Student 1 says "The potential difference across a resistor".

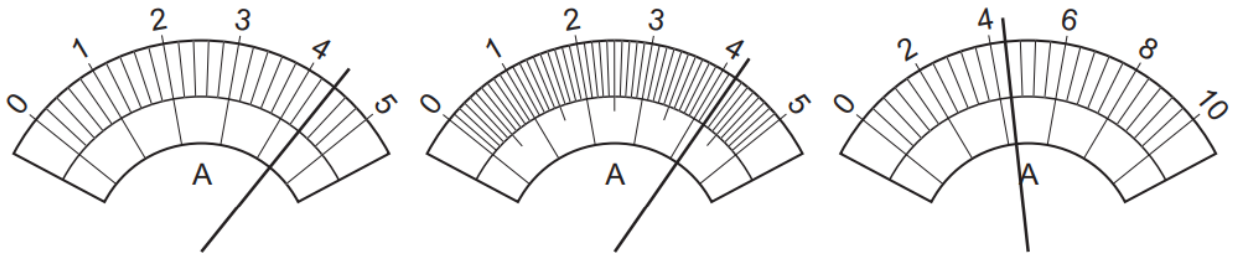
Student 2 says "The rating of a fuse".

Student 3 says "The electromotive force of a battery".

Which students are correct?

A 1 only **B** 1 and 2 **C** 1 and 3 **D** 2 and 3

41 The diagrams show the scales of three ammeters.



ammeter 1 ammeter 2 ammeter 3

Which ammeters show the same current reading?

A all three ammeters

B ammeter 1 and ammeter 2 only

C ammeter 1 and ammeter 3 only

D ammeter 2 and ammeter 3 only

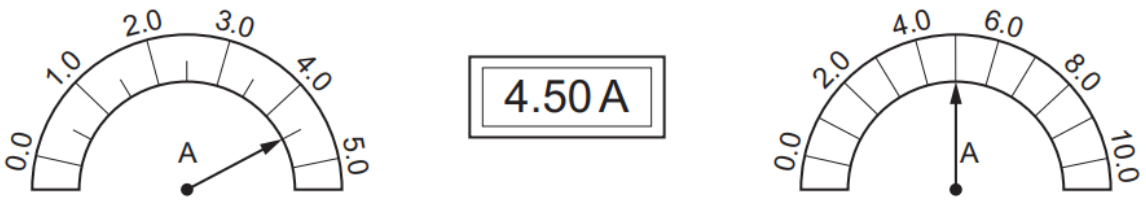
42 A plastic rod is rubbed with a cloth. The rod becomes positively charged.

What happens to the plastic rod and what is the charge on the cloth?

	plastic rod	charge on cloth
A	gains electrons	negative
B	gains electrons	positive
C	loses electrons	negative
D	loses electrons	positive

43 The diagrams show three ammeters.

1 2 3

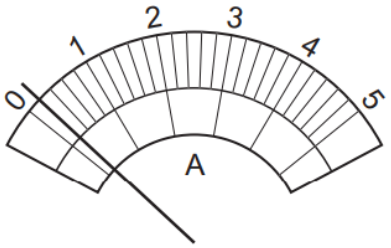


Which ammeters show the same value of current?

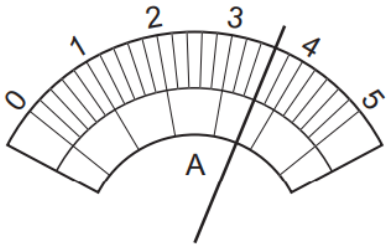
A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

44 The diagrams show the readings on an ammeter in a series circuit before and after the switch in the circuit has been closed.

switch open



switch closed



What is the current in the circuit when the switch is closed?

A 3.2 A **B** 3.4 A **C** 3.6 A **D** 3.8 A

45 A lamp is connected across one cell, then across two cells. The potential difference (p.d.) across the lamp and the current in it are measured in each case.

The results are shown.

number of cells	p.d. / V	current / A
1	2.8	0.25
2	5.4	0.40

What is the change in the resistance of the lamp when the number of cells is increased from one to two?

A It decreases by 0.015 Ω.

B It increases by 1.5 Ω.

C It increases by 2.3 Ω.

D It increases by 17 Ω.

46 A student measures the potential difference across a device and the current in the device.

Which calculation gives the resistance of the device?

A current + potential difference

B current ÷ potential difference

C potential difference ÷ current

D potential difference × current

Paper 2

Questions are applicable for both core and extended candidates unless indicated in the question

47 There is a current of 0.60 A in a closed circuit. **(extended only)**

How much charge passes a point in the circuit in 2.5 min?

A 0.24 C **B** 1.5 C **C** 90 C **D** 5400 C

48 Which two physical quantities have the unit J / C? **(extended only)**

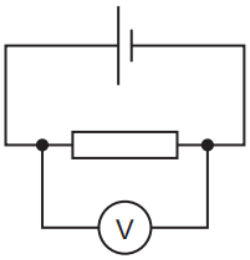
A charge and energy

B charge and potential difference (p.d.)

C electromotive force (e.m.f.) and p.d.

D e.m.f. and charge

49 In the circuit shown, the voltmeter reads 2.0 V. A charge of 5.0 C passes through the resistor in a certain time. **(extended only)**



How much energy is supplied to the resistor in this time?

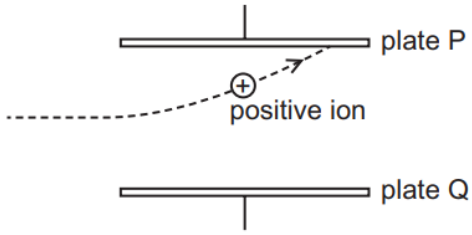
A 0.40 J **B** 2.5 J **C** 10 J **D** 20 J

50 A positive ion in a vacuum moves at a steady speed in a straight line. **(extended only)**

There is a potential difference between the two parallel metal plates P and Q so that they are oppositely charged.

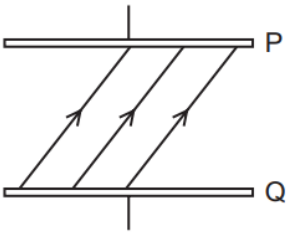
When the positive ion enters the region between plates P and Q, it changes direction as shown.

The diagram shows the view from above the ion.



Which diagram shows the direction of the electric field between the plates?

A



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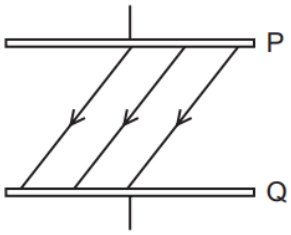

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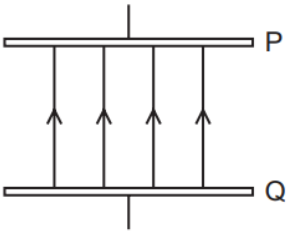

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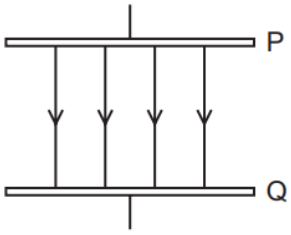
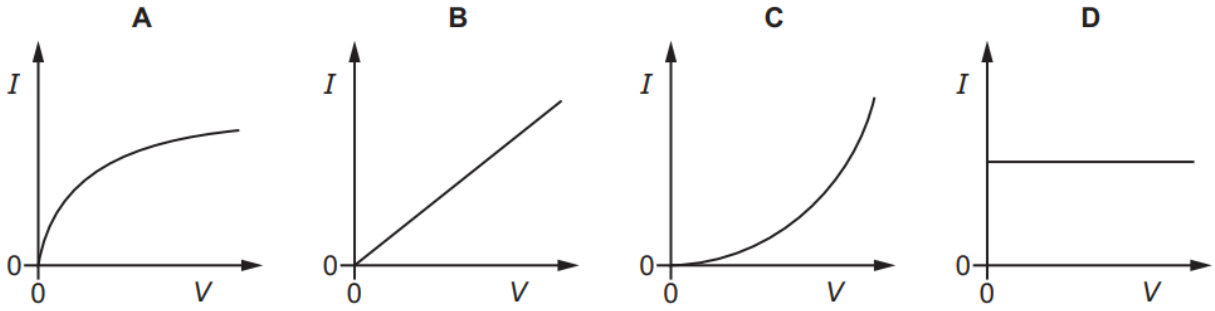


51 Which diagram shows the current–voltage (I–V) graph for a filament lamp? **(extended only)**



52 A resistor transfers 100 J of energy when a charge of 10 C flows through it. **(extended only)**

What is the potential difference across the resistor?

A 0.10 V **B** 10 V **C** 10 W **D** 1000 W

53 Wire X and wire Y are made from the same metal. **(extended only)**

The table gives information about the two wires.

	length / m	cross-sectional area / mm^2	resistance / Ω
wire X	1.0	0.40	2.0
wire Y	1.3	0.30	

What is the resistance of wire Y?

A 0.31 Ω **B** 0.78 Ω **C** 2.1 Ω **D** 3.5 Ω

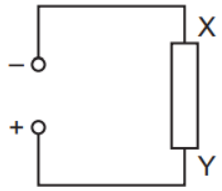
54 A wire has a resistance of 8.0 Ω. **(extended only)**

A second wire of the same material has twice the length and twice the cross-sectional area.

What is the resistance of the second wire?

A 4.0 Ω **B** 8.0 Ω **C** 16 Ω **D** 32 Ω

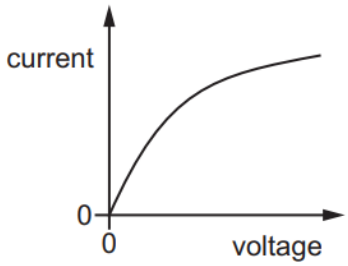
55 A power source is connected to a resistor XY. **(extended only)**



In which directions are the conventional current and the flow of free electrons through the resistor?

	conventional current	free electron flow
A	X to Y	X to Y
B	X to Y	Y to X
C	Y to X	X to Y
D	Y to X	Y to X

56 The graph shows the current–voltage characteristic for a filament lamp. **(extended only)**



Which statement describes how the resistance of the lamp changes as the voltage increases?

A The resistance decreases to zero.

B The resistance decreases, but not to zero.

C The resistance increases.

D The resistance remains constant.

57 A wire has a uniform circular cross-sectional area. **(extended only)**

Which statement is correct?

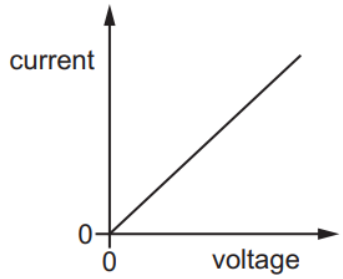
A The resistance of the wire is directly proportional to its cross-sectional area and inversely proportional to its diameter.

B The resistance of the wire is directly proportional to its cross-sectional area and inversely proportional to its length.

C The resistance of the wire is directly proportional to its length and inversely proportional to its cross-sectional area.

D The resistance of the wire is directly proportional to its length and inversely proportional to its diameter.

58 The diagram shows the current–voltage graph for a metal wire. **(extended only)**



What can be deduced from the graph?

A As voltage increases, the temperature of the wire increases.

B As voltage increases, the temperature of the wire decreases.

C As voltage increases, the resistance of the wire increases.

D As voltage increases, the resistance of the wire remains constant.

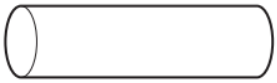
59 A piece of metal wire X with a uniform diameter has resistance R. **(extended only)**

X

A second piece of wire Y is made of the same metal and has a uniform diameter.

Y has double the cross-sectional area of X and half the length of X.

Y



What is the resistance of Y?

A $\frac{R}{4}$ **B** $\frac{R}{2}$ **C** R **D** $4R$

60 An electric fire is connected to a 240 V supply and transfers energy at a rate of 1.0 kW.

How much charge passes through the fire in 1.0 h? **(extended only)**

A 42 C **B** 250 C **C** 1.5×10^4 C **D** 2.4×10^5 C

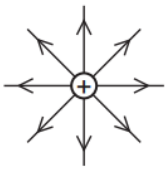
61 A battery is connected to a circuit. It is switched on for 1.0 minute. During that time, there is a current of 0.40 A in the circuit and the battery supplies a total of 48 J of energy.

Which row gives the charge that passes and the electromotive force (e.m.f.) of the battery?

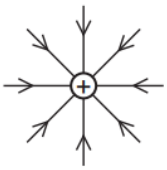
	charge that passes in 1.0 minute / C	e.m.f. of the battery / V
A	0.40	2.0
B	0.40	120
C	24	2.0
D	24	120

62 Which diagram shows the electric field pattern around a positive charge? **(extended only)**

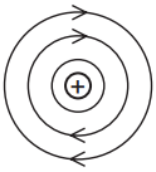
A



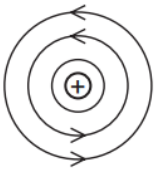
B



C



D



63 A lamp rated 12 V, 2.0 A is switched on for one minute.

How much energy is transferred by the lamp?

A 6.0 J **B** 24 J **C** 360 J **D** 1440 J

64 A student makes four resistors using different pieces of wire. The wires have different diameters and lengths. All the pieces of wire are made of the same material.

Which piece of wire will make the resistor with the largest resistance?

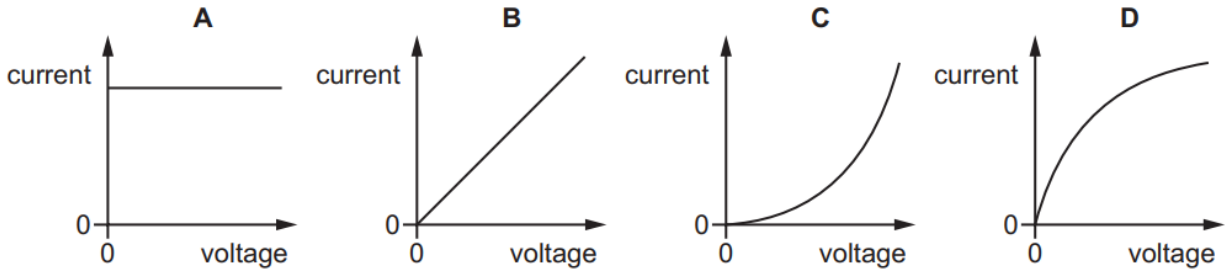
	diameter / mm	length / cm
A	0.8	10
B	0.8	17
C	2.0	10
D	2.0	17

65 A charge Q flows for time t through a resistor of resistance R.

Which equation gives the current I in the resistor?

A $I = Qt$ **B** $I = Rt$ **C** $I = \frac{Q}{t}$ **D** $I = \frac{R}{t}$

66 Which diagram shows a graph of current against voltage for a filament lamp? **(extended only)**



67 A plastic rod is brought near to a small plastic sphere suspended from a stand. The sphere is repelled by the rod.

Why is this?

A The rod and the sphere have like charges.

B The rod and the sphere have unlike charges.

C The rod is charged and the sphere is uncharged.

D The rod is uncharged and the sphere is charged.

68 Which unit is equivalent to a volt (V)? **(extended only)**

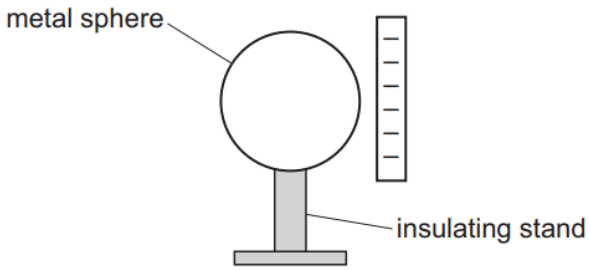
A A/Ω **B** J/C **C** J/s **D** W/C

69 A resistor converts 360 J of energy when there is a current of 3.0 A in it. The potential difference across the resistor is 6.0 V.

For how long is there this current in the resistor?

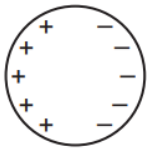
A 0.05 s **B** 20 s **C** 180 s **D** 720 s

70 A negatively charged rod is brought near to an uncharged metal sphere that is placed on an insulating stand.

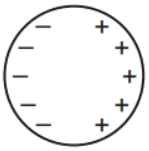


Which diagram shows the distribution of charges on the sphere?

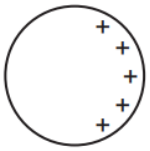
A



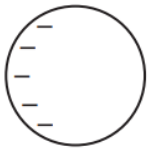
B



C



D



71 There is a current I in a resistor of resistance R for a time t. The potential difference (p.d.) across the resistor is V.

Which equation gives the power P dissipated in the resistor?

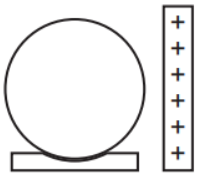
A $P = IR$ **B** $P = It$ **C** $P = IV$ **D** $P = \frac{IV}{t}$

72 A copper wire is placed in an electrical circuit and its resistance is measured. The wire is then replaced with a second copper wire with twice the length and a quarter of the diameter.

What is the ratio of the resistance for the two wires? **(extended only)**

A 1 : 2 **B** 1 : 4 **C** 1 : 8 **D** 1 : 32

73 An uncharged, metal sphere is placed on an insulating support. A positively charged rod is brought close to the sphere, but does not touch it.



How do the charges in the sphere move and what is now the charge on the sphere?

	movement of charges	charge on sphere
A	negative charges move to the right of the sphere	positive
B	negative charges move to the right of the sphere	neutral
C	positive charges move to the left of the sphere	positive
D	positive charges move to the left of the sphere	neutral

74 There is a current I in a resistor. The potential difference (p.d.) across the resistor is V.

Which other physical quantity is needed to be able to determine the energy transferred W by the resistor?

A the electromotive force (e.m.f.) E of the source

B the power P dissipated

C the resistance R of the resistor

D the time t for which there is a current in the resistor

75 Which quantity is defined as the energy transferred by a cell in driving unit charge around a complete circuit?

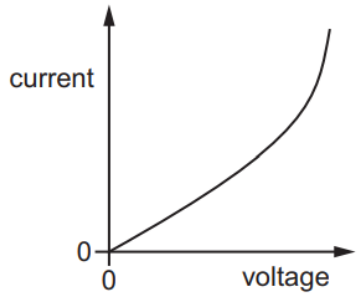
A current

B electromotive force (e.m.f.)

C power

D resistance

76 The graph shows the current–voltage relationship for a circuit component X. **(extended only)**



What happens to the resistance of X and what happens to the temperature of X as the voltage increases?

	resistance of X	temperature of X
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

77 A negatively charged plastic rod is brought near to an uncharged metal sphere and held there.

What happens when the metal sphere is earthed?

A Electrons flow from the metal sphere to earth.

B Electrons flow from earth to the metal sphere.

C Positive charge flows from the metal sphere to earth.

D Positive charge flows from earth to the metal sphere.

78 Which statement defines the electromotive force (e.m.f.) of a cell?

A the current in the cell when 1.0 C of charge flows in 1.0 s

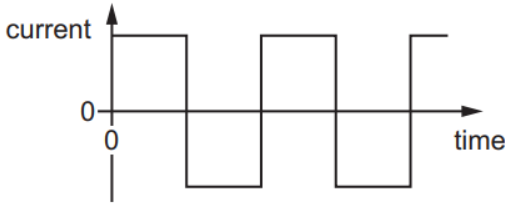
B the current supplied by the cell to drive 1.0 C of charge around a complete circuit

C the energy supplied by the cell to drive 1.0 C of charge around a complete circuit

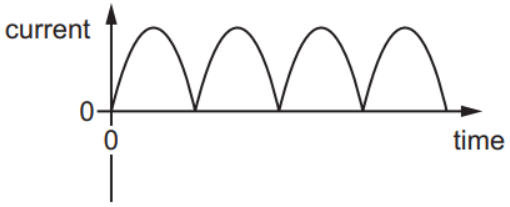
D the energy supplied by the cell to drive 1.0 A of current around a complete circuit

79 Which graph represents an alternating current (a.c.)?

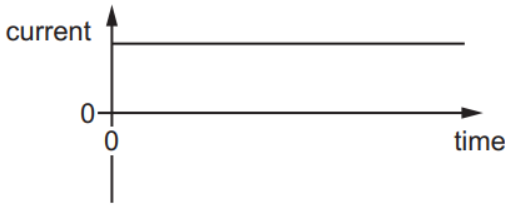
A



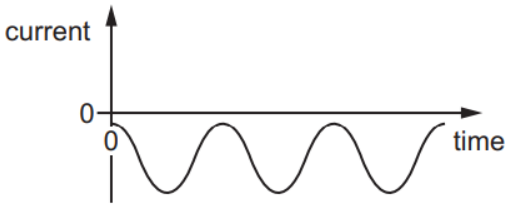
B



C



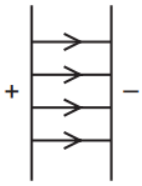
D



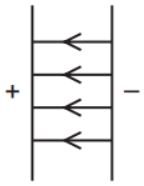
80 Which diagram shows the electric field pattern between two oppositely charged parallel metal plates?

(extended only)

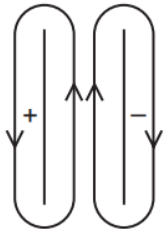
A



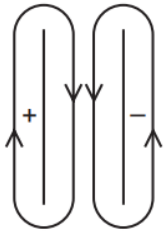
B



C

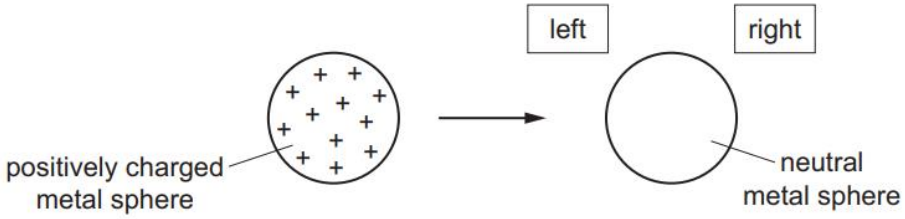


D



81 An isolated metal sphere is positively charged.

It is then brought near to another isolated metal sphere that is neutral.



What happens to the charges on the neutral sphere as the positively charged sphere is brought close to it?

A Some positive charges move to the left and some negative charges move to the right.

B Some positive charges move to the right and some negative charges move to the left.

C Some positive charges move to the right, but the negative charges do not move.

D The positive charges do not move, but some negative charges move to the left.

82 Which statement about the resistance of a metal wire is correct? **(extended only)**

A The resistance is directly proportional to its length and directly proportional to its cross-sectional area.

B The resistance is directly proportional to its length and inversely proportional to its cross-sectional area.

C The resistance is inversely proportional to its length and directly proportional to its cross-sectional area.

D The resistance is inversely proportional to its length and inversely proportional to its cross-sectional area.

83 A cloth is used to rub an uncharged plastic rod.

Both the rod and the cloth become charged.

Why does the plastic rod become negatively charged and the cloth become positively charged?

A The rod gains electrons and the cloth gains positive charges.

B The rod gains electrons and the cloth loses electrons.

C The rod loses electrons and the cloth gains electrons.

D The rod loses electrons and the cloth loses positive charges.

84 A cell passes a current of 2.0 A in a circuit for 30 s. In this time the cell transfers 120 J of energy.

What is the electromotive force (e.m.f.) of the cell?

A 0.50 V **B** 1.5 V **C** 2.0 V **D** 8.0 V

85 A circuit contains a cell of electromotive force (e.m.f.) of 2.0 V. The current in the circuit is 2.0 A.

How much energy is converted by the cell in 2.0 minutes?

A 2.0 J **B** 4.0 J **C** 8.0 J **D** 480 J

86 There is a current of 2.0 A in a resistor for 30 s. The potential difference (p.d.) across the resistor is 12 V.

How much energy is transferred in the resistor?

A 1.25 J **B** 5.0 J **C** 180 J **D** 720 J

87 A cell has an electromotive force (e.m.f.) of 1.5 V.

What does this statement mean?

A The cell converts 1.0 J of energy when driving 1.5 C of charge round a complete circuit.

B The cell converts 1.5 J of energy when driving 1.0 C of charge round a complete circuit.

C The cell converts 1.5 J of energy per second when driving 1.0 C of charge round a complete circuit.

D The cell converts 1.5 W of power when driving 1.0 C of charge round a complete circuit.

88 Which two changes to a metal wire both increase resistance?

A decreasing its length and increasing its temperature

B increasing its length and decreasing its temperature

C decreasing its thickness and increasing its temperature

D increasing its thickness and decreasing its temperature

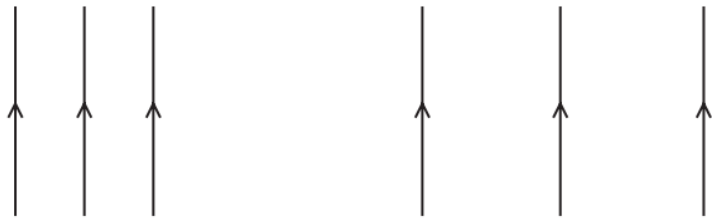
89 A metal wire of length 100 cm and cross-sectional area 0.20 mm^2 has a resistance of 8.0 Ω.

What is the resistance of a wire of the same metal of length 50 cm and cross-sectional area of 0.40 mm^2?

(extended only)

A 2.0 Ω **B** 8.0 Ω **C** 16 Ω **D** 32 Ω

90 The diagrams represent two different electric fields. **(extended only)**



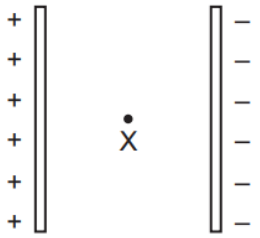
field 1 field 2

A single electron is located in each of the fields.

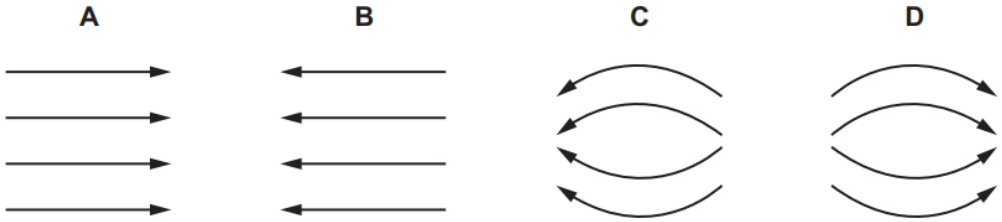
Which row gives the correct direction of the force on the electron and the field in which there is a larger force on it?

	direction of the force	larger force
A	↓	field 1
B	↓	field 2
C	↑	field 1
D	↑	field 2

91 The diagram shows point X between two charged plates. **(extended only)**



Which diagram shows the electric field pattern near point X?



92 Copper wire is available in fixed lengths but in various diameters *d*. Each diameter has a different resistance *R*.

Which relationship between *R* and *d* is correct? **(extended only)**

A *R* is directly proportional to *d*.

B *R* is directly proportional to d^2.

C *R* is inversely proportional to *d*.

D *R* is inversely proportional to d^2.

93 The electromotive force (e.m.f.) of a rechargeable battery is 6.0 V.

What does this mean?

A 6.0 J is the maximum energy the battery can provide in 1.0 s.

B 6.0 J is the total energy the battery can provide before it has to be recharged.

C 6.0 J of energy is provided by the battery to drive a charge of 1.0 C around a complete circuit.

D 6.0 J of energy is provided by the battery to drive a current of 1.0 A around a complete circuit.

94 What is the electromotive force (e.m.f.) of a cell?

A the amount of charge that passes through the cell per unit time

B the energy gained per unit charge as charge passes through the cell

C the total amount of charge flowing through the cell

D the total energy stored in the cell

95 A piece of wire is 40 cm long and has a diameter of 2.0 mm. **(extended only)**

Its resistance is 0.30 Ω.

Which wire of the same material has a resistance of 0.15 Ω?

	length / cm	diameter / mm
A	20	1.0
B	20	4.0
C	80	1.0
D	80	4.0