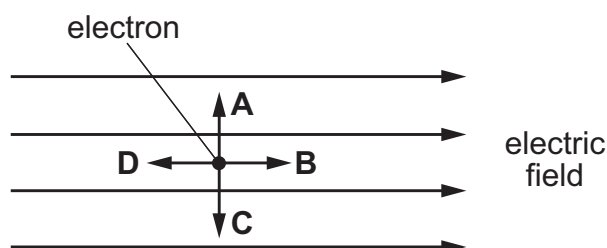


1. Question | 9702 Feb-March 2016 P1 V2 Q27

27 The diagram shows an electron in a uniform electric field.

In which direction will the field accelerate the electron?



2. Question | 9702 Feb-March 2016 P1 V2 Q28

28 The electric field strength at a certain distance from an isolated alpha particle is $3.0 \times 10^7 \text{ NC}^{-1}$.

What is the force on an electron when at that distance from the alpha particle?

A $4.8 \times 10^{-12} \text{ N}$

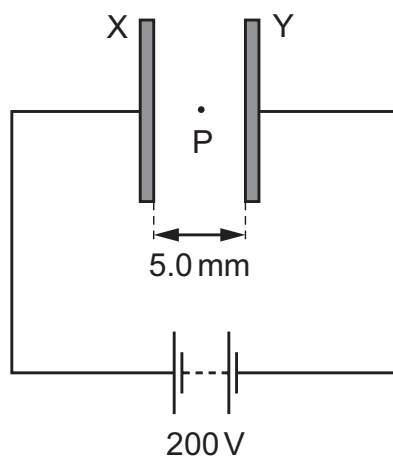
B $9.6 \times 10^{-12} \text{ N}$

C $3.0 \times 10^7 \text{ N}$

D $6.0 \times 10^7 \text{ N}$

3. Question | 9702 Feb-March 2016 P1 V2 Q29

- 29** Two large parallel plates X and Y are placed a distance of 5.0 mm apart and connected to the terminals of a 200 V d.c. supply, as shown.



A small oil drop at P carries one excess electron.

What is the magnitude of the electrostatic force acting on the oil drop due to the electric field between the plates?

- A** $6.4 \times 10^{-15} \text{ N}$
- B** $6.4 \times 10^{-18} \text{ N}$
- C** $1.6 \times 10^{-19} \text{ N}$
- D** $4.0 \times 10^{-24} \text{ N}$

4. Question | 9702 Feb-March 2016 P1 V2 Q30

- 30** An electrical conductor has a resistance of $5.6 \text{ k}\Omega$. A potential difference (p.d.) of 9.0 V is applied across its ends.

How many electrons pass a point in the conductor in one minute?

- A** 6.0×10^{20}
- B** 1.0×10^{19}
- C** 6.0×10^{17}
- D** 1.0×10^{16}

5. Question | 9702 Feb-March 2016 P1 V2 Q31

- 31** A fixed resistor of resistance 12Ω is connected to a battery. There is a current of 0.20 A in the resistor. The current is now doubled.

What is the new power dissipated in the resistor?

- A** 0.48 W
- B** 0.96 W
- C** 1.92 W
- D** 4.8 W

6. Question | 9702 Feb-March 2016 P1 V2 Q32

32 Which **measurements** are taken in order to calculate the resistivity of the metal of a piece of wire?

- A** p.d., current, area, length
- B** p.d., current, diameter, length
- C** resistance, area, length
- D** resistance, length, radius

7. Question | 9702 Feb-March 2016 P1 V2 Q33

33 A 12V battery is charged for 20 minutes by connecting it to a source of electromotive force (e.m.f.). The battery is supplied with 7.2×10^4 J of energy in this time.

How much charge flows through the battery?

- A** 5.0 C **B** 60 C **C** 100 C **D** 6000 C

8. Question | 9702 May-June 2016 P1 V1 Q28

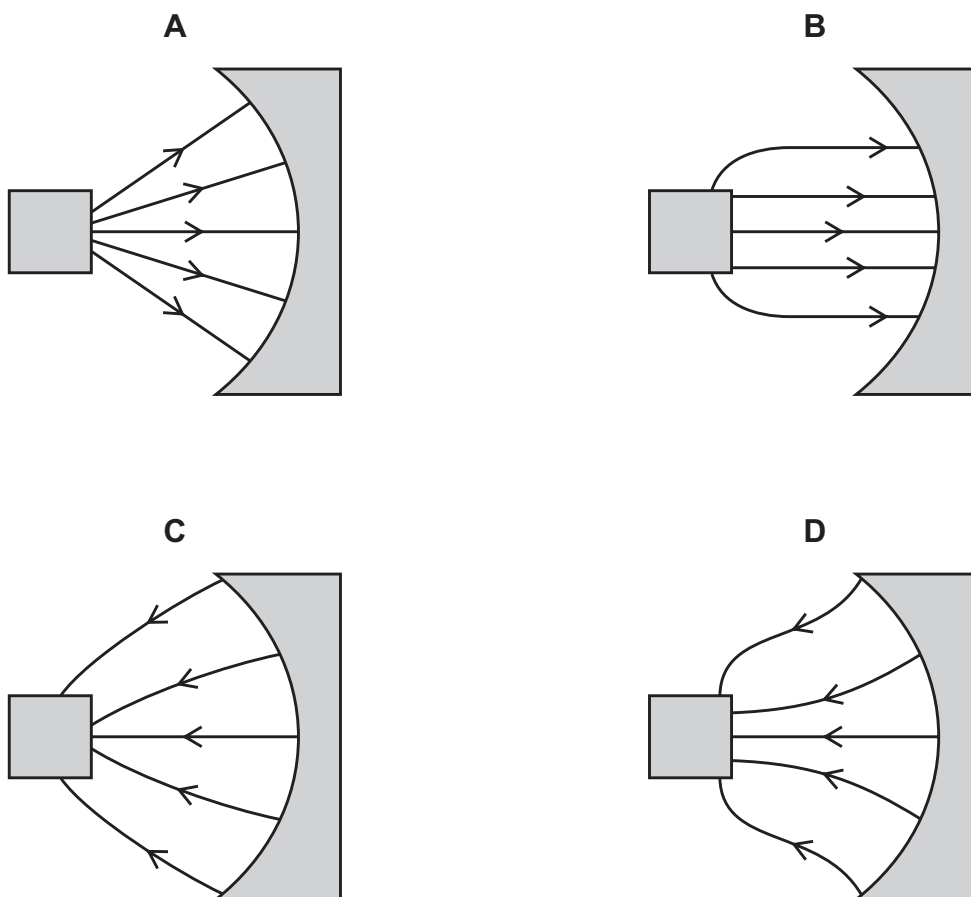
28 A charged particle is moving in a uniform electric field.

For the motion of the particle due to the field, which quantity has a constant non-zero value?

- A** acceleration
- B** displacement
- C** rate of change of acceleration
- D** velocity

9. Question | 9702 May-June 2016 P1 V1 Q29

29 Which diagram could represent the electric field lines between two oppositely charged conducting surfaces?



10. Question | 9702 May-June 2016 P1 V1 Q30

30 There is a current in a resistor for an unknown time.

Which two quantities can be used to calculate the energy dissipated by the resistor?

- A** the current in the resistor and the potential difference across the resistor
- B** the resistance of the resistor and the current in the resistor
- C** the total charge passing through the resistor and the potential difference across the resistor
- D** the total charge passing through the resistor and the resistance of the resistor

11. Question | 9702 May-June 2016 P1 V1 Q31

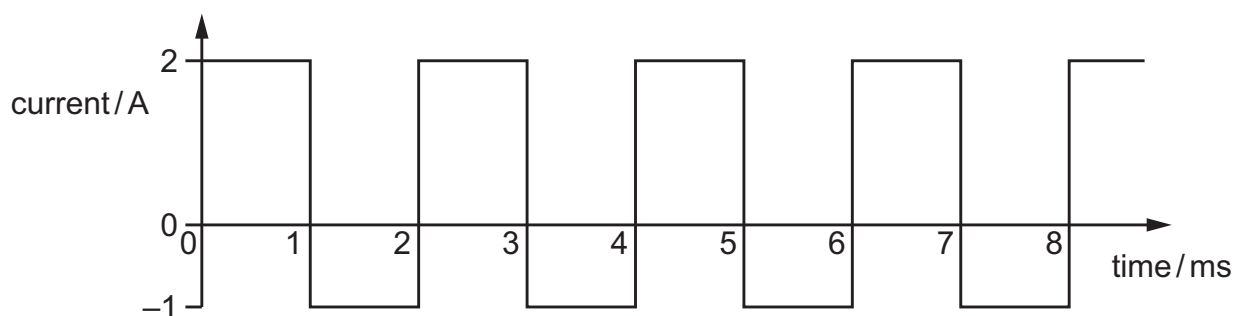
31 Two copper wires of equal length are connected in parallel. A potential difference is applied across the ends of this parallel arrangement. Wire S has a diameter of 3.0 mm. Wire T has a diameter of 1.5 mm.

What is the value of the ratio $\frac{\text{current in S}}{\text{current in T}}$?

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

12. Question | 9702 May-June 2016 P1 V1 Q32

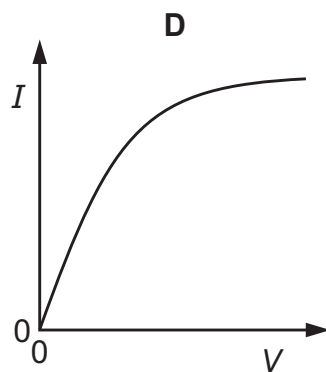
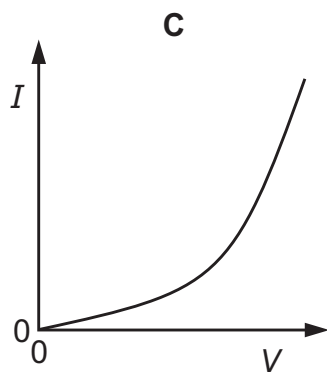
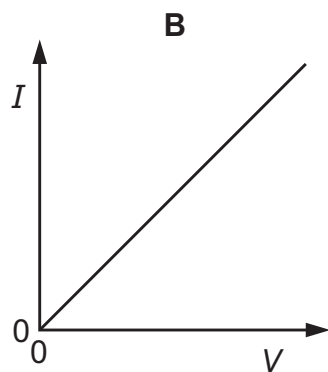
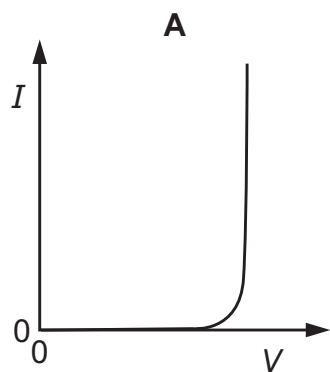
32 A $100\ \Omega$ resistor conducts a current with changing direction and magnitude, as shown.



What is the mean power dissipated in the resistor?

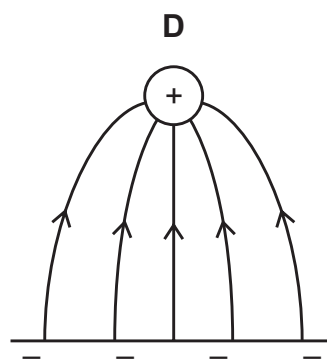
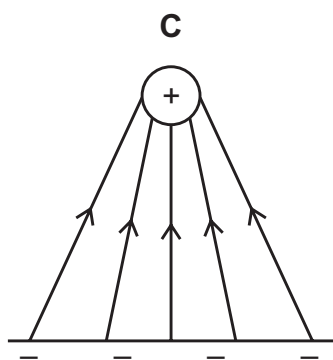
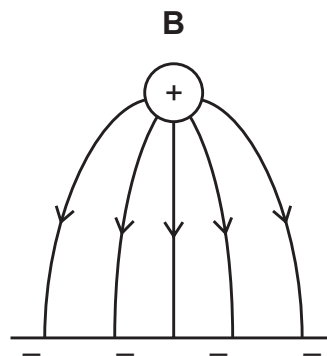
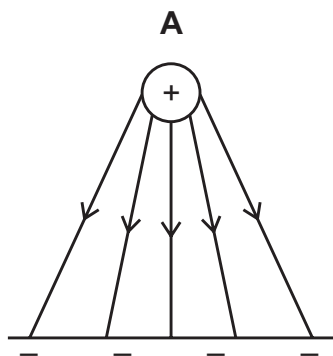
- A** 100 W
- B** 150 W
- C** 250 W
- D** 400 W

13. Question | 9702 May-June 2016 P1 V1 Q33

33 Which graph shows the I – V characteristic of a filament lamp?

14. Question | 9702 May-June 2016 P1 V2 Q29

- 29** Which diagram shows the pattern of the electric field between a positively charged metal sphere and a negatively charged metal plate?



30 Before a thunderstorm, the hairs on your head sometimes stand on end.

A hair with mass 0.50 mg and charge 1.0 pC is supported by a force due to an electric field. Ignore any forces other than the weight of the hair and the electric force.

What is the electric field strength?

A $4.9 \times 10^3 \text{ NC}^{-1}$

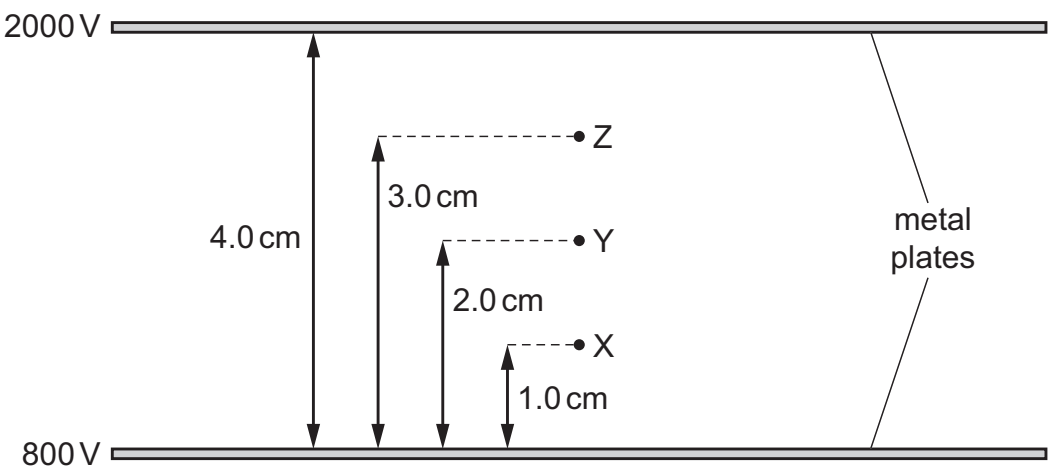
B $4.9 \times 10^5 \text{ NC}^{-1}$

C $4.9 \times 10^6 \text{ NC}^{-1}$

D $4.9 \times 10^9 \text{ NC}^{-1}$

16. Question | 9702 May-June 2016 P1 V2 Q31

- 31** Two parallel metal plates, 4.0 cm apart, are at electric potentials of 800 V and 2000 V. Points X, Y and Z are situated in the space between the plates at distances of 1.0 cm, 2.0 cm and 3.0 cm from the lower plate.



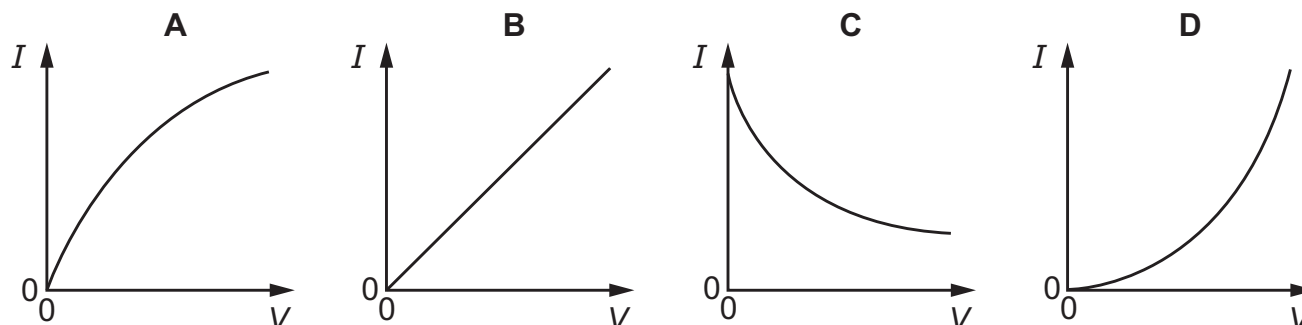
What is the electric field strength, in V m^{-1} , at X, Y and Z?

	X	Y	Z
A	300	600	900
B	1100	1400	1700
C	3.0×10^4	3.0×10^4	3.0×10^4
D	5.0×10^4	5.0×10^4	5.0×10^4

17. Question | 9702 May-June 2016 P1 V2 Q32

- 32** The potential difference V across a filament lamp is slowly raised from zero to its normal operating value.

Which graph represents the variation with V of the current I in the lamp?



18. Question | 9702 May-June 2016 P1 V2 Q34

- 34** Which equation is used to define resistance?

- A** energy = (current)² × resistance × time
- B** potential difference = current × resistance
- C** power = (current)² × resistance
- D** resistivity = resistance × area ÷ length

19. Question | 9702 May-June 2016 P1 V2 Q35

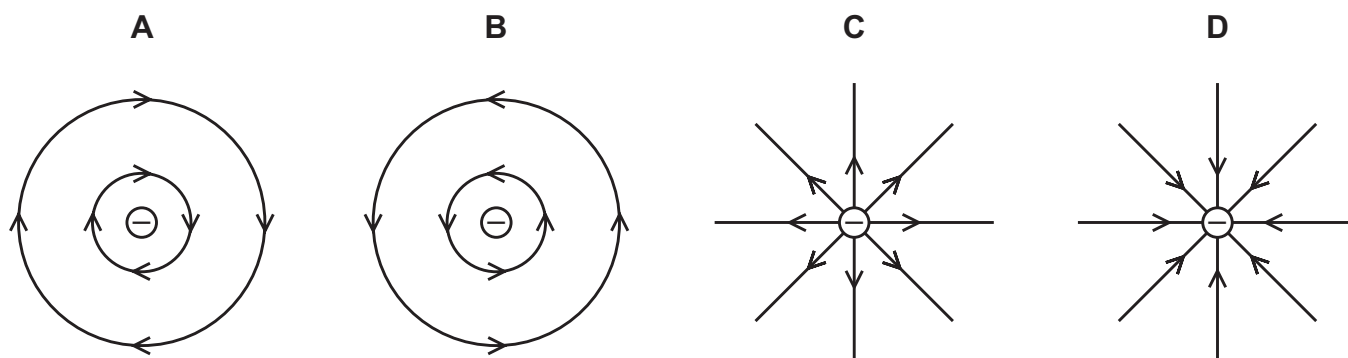
- 35** The charge that a fully charged 12 V car battery can supply is 100 kC. The starter motor of the car requires a current of 200 A for an average period of 2.0 s. The battery does not recharge because of a fault.

What is the maximum number of times the starter motor of the car can be used?

- A** 21
- B** 25
- C** 42
- D** 250

20. Question | 9702 May-June 2016 P1 V3 Q29

29 Which diagram shows the electric field pattern of an isolated negative point charge?



21. Question | 9702 May-June 2016 P1 V3 Q30

30 An electron is in an electric field of strength $5 \times 10^4 \text{ V m}^{-1}$. The field is the only influence on the electron.

The mass and charge of an electron are known.

Which quantity can be calculated without any more information?

- A** the force on the electron
- B** the momentum of the electron
- C** the kinetic energy of the electron
- D** the speed of the electron

22. Question | 9702 May-June 2016 P1 V3 Q31

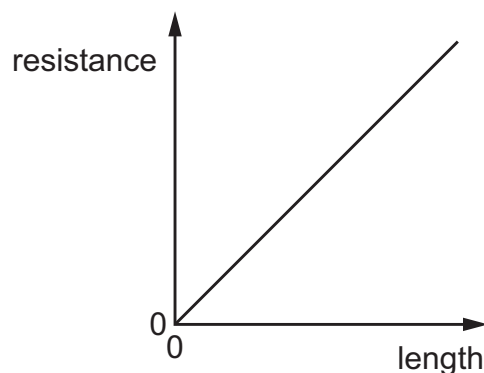
31 In an electrolyte, the electric current is carried by charged particles (ions) in solution.

What is **not** a possible value for the charge on an ion in solution?

- A** $-4.8 \times 10^{-19} \text{ C}$
- B** $+1.6 \times 10^{-19} \text{ C}$
- C** $+3.2 \times 10^{-19} \text{ C}$
- D** $+4.0 \times 10^{-19} \text{ C}$

23. Question | 9702 May-June 2016 P1 V3 Q32

32 The graph shows the variation with length of the resistance of a uniform metal wire.



The gradient of the graph is G .

The wire has cross-sectional area A .

Which expression could be used to calculate the resistivity of the metal of the wire?

- A** $G \times A$ **B** $\frac{G}{A}$ **C** $\frac{A}{G}$ **D** $G \times A^2$

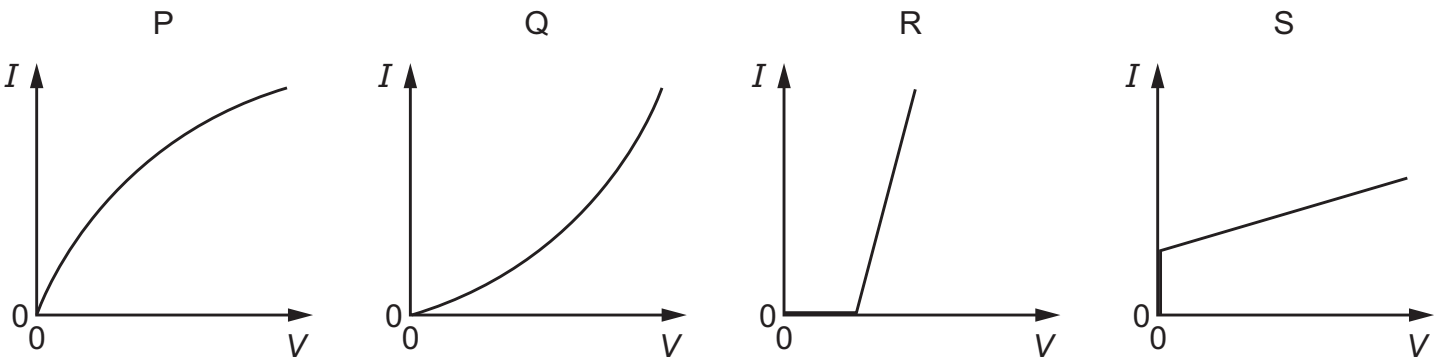
24. Question | 9702 May-June 2016 P1 V3 Q33

33 What describes the electric potential difference between two points in a wire that carries a current?

- A** the force required to move a unit positive charge between the points
B the ratio of the energy dissipated between the points to the current
C the ratio of the power dissipated between the points to the current
D the ratio of the power dissipated between the points to the charge moved

25. Question | 9702 May-June 2016 P1 V3 Q34

34 The graphs show possible current-voltage (I - V) characteristics for a filament lamp and for a semiconductor diode.

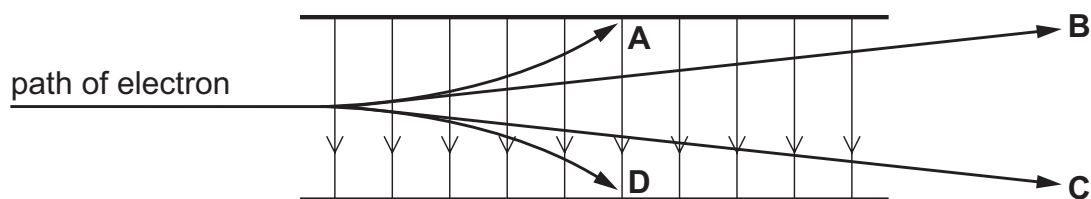


Which row in the table best specifies the correct I - V graphs for the lamp and for the diode?

	filament lamp	semiconductor diode
A	P	R
B	P	S
C	Q	R
D	Q	S

26. Question | 9702 Oct-Nov 2016 P1 V1 Q30

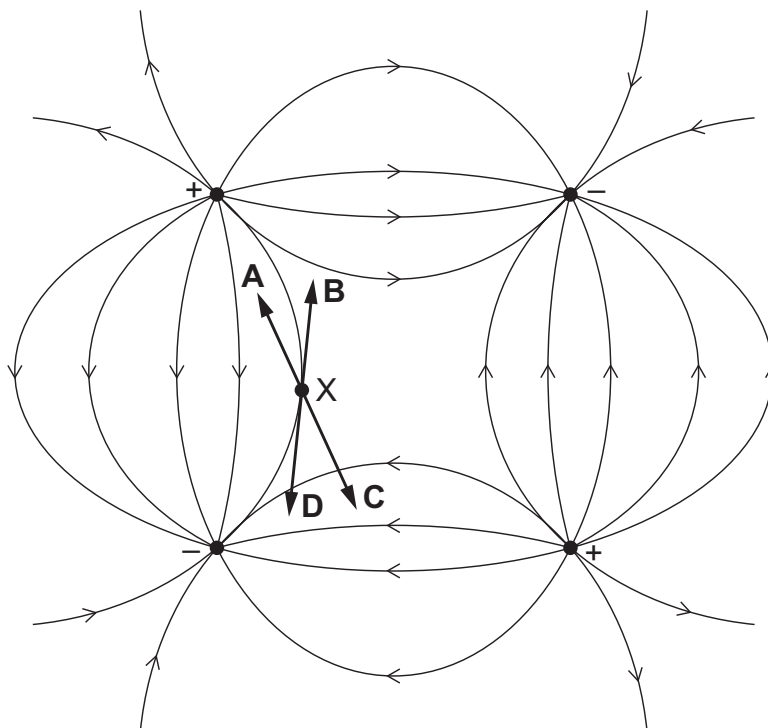
30 Which path shows a possible movement of an electron in the electric field shown?



27. Question | 9702 Oct-Nov 2016 P1 V1 Q31

31 The diagram shows an electric field pattern caused by two positive and two negative point charges of equal magnitude placed at the four corners of a square.

In which direction does the force act on an electron at point X?



28. Question | 9702 Oct-Nov 2016 P1 V1 Q32

32 Two large horizontal metal plates are separated by 4 mm. The lower plate is at a potential of -80 V .



Which potential should be applied to the upper plate to create an electric field of strength $60\,000\text{ V m}^{-1}$ upwards in the space between the plates?

- A** -320 V **B** -160 V **C** $+160\text{ V}$ **D** $+320\text{ V}$

29. Question | 9702 Oct-Nov 2016 P1 V1 Q33

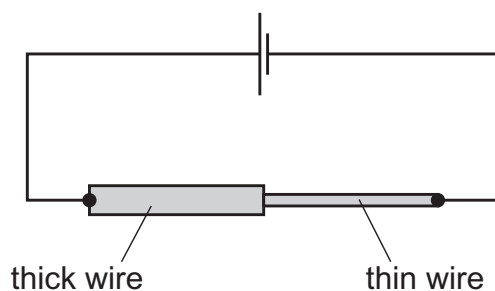
- 33** An electric kettle is marked 3.10 kW. It is used with an electrical supply of 240 V.

What is the electric current in the kettle and what is the kettle's electrical resistance when working?

	current / A	resistance / Ω
A	0.0129	18 600
B	0.0770	3100
C	12.9	18.6
D	12.9	3100

30. Question | 9702 Oct-Nov 2016 P1 V1 Q34

- 34** A thick copper wire is connected to a thin copper wire in series with a cell, as shown.



What is significantly **less** in the thick wire than in the thin wire?

- A** the charge passing a point per unit time
- B** the drift speed of the electrons
- C** the number density of the free electrons
- D** the number of free electrons passing a point per unit time

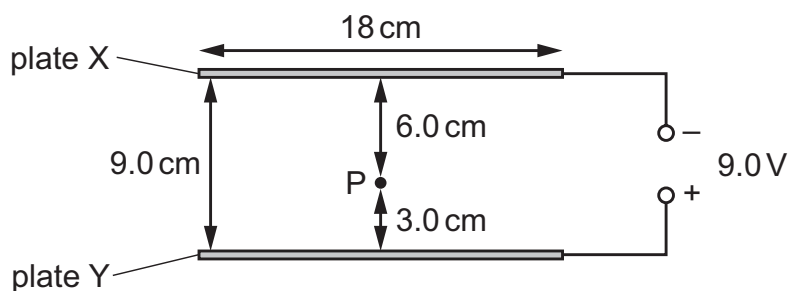
31. Question | 9702 Oct-Nov 2016 P1 V1 Q35

- 35** What is a typical value for the order of magnitude of the resistivity of copper?

- A** $10^{-13} \Omega \text{ m}$ **B** $10^{-8} \Omega \text{ m}$ **C** $10^{-3} \Omega \text{ m}$ **D** $10^2 \Omega \text{ m}$

32. Question | 9702 Oct-Nov 2016 P1 V2 Q30

- 30** Two parallel circular metal plates X and Y, each of diameter 18 cm, have a separation of 9.0 cm. A potential difference of 9.0 V is applied between them.



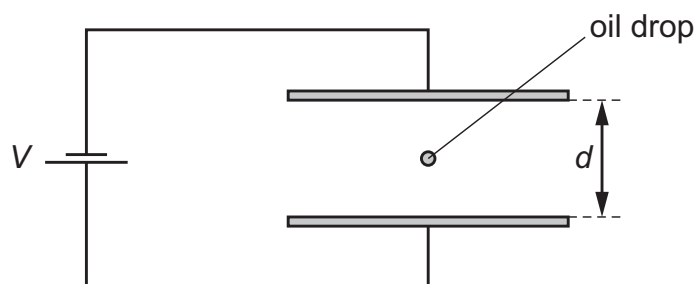
Point P is 6.0 cm from the surface of plate X and 3.0 cm from the surface of plate Y.

What is the electric field strength at P?

- A** 50 NC^{-1} **B** 100 NC^{-1} **C** 150 NC^{-1} **D** 300 NC^{-1}

33. Question | 9702 Oct-Nov 2016 P1 V2 Q31

- 31** An oil drop has mass m and charge q . The drop is held stationary in an electric field between two parallel horizontal plates, distance d apart, as shown.



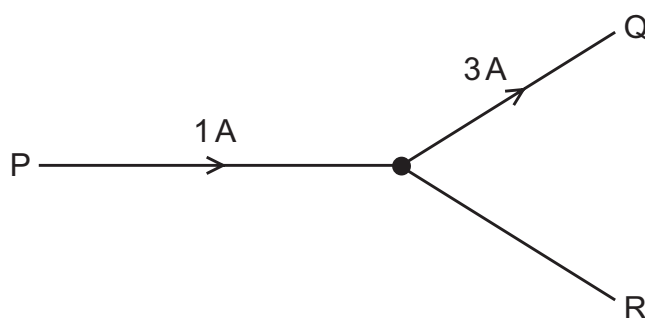
The potential difference between the plates is V and the acceleration of free fall is g .

What is the charge-to-mass ratio $\frac{q}{m}$ of the oil drop?

- A** $\frac{gd}{V}$ **B** $\frac{V}{dg}$ **C** $\frac{gV}{d}$ **D** $\frac{d}{Vg}$

34. Question | 9702 Oct-Nov 2016 P1 V2 Q32

- 32** The diagram shows a junction in a circuit where three wires P, Q and R meet. The currents in P and Q are 1 A and 3 A respectively, in the directions shown.



How much charge passes a given point in wire R in a time of 5 s?

- A** 0.4 C **B** 2 C **C** 10 C **D** 20 C

35. Question | 9702 Oct-Nov 2016 P1 V2 Q33

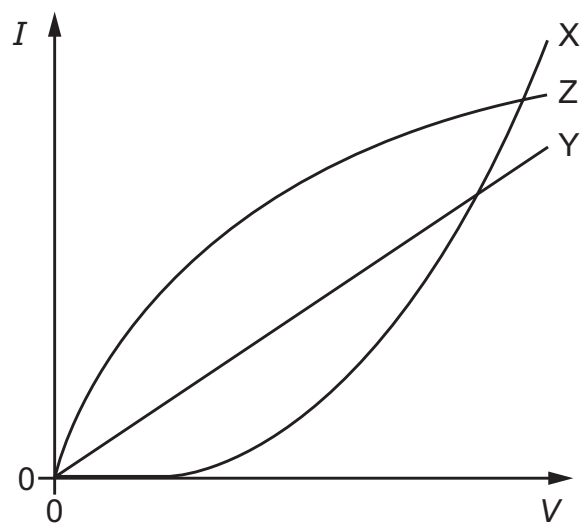
33 A wire carries a current of 2.0 A for 1.0 hour.

How many electrons pass a point in the wire in this time?

- A** 1.2×10^{-15} **B** 7.2×10^3 **C** 1.3×10^{19} **D** 4.5×10^{22}

36. Question | 9702 Oct-Nov 2016 P1 V2 Q35

35 The graph shows the variation with potential difference V of the current I in components X, Y and Z.



Which row correctly identifies the components?

	metallic conductor at constant temperature	semiconductor diode	filament lamp
A	X	Z	Y
B	Y	X	Z
C	Y	Z	X
D	Z	Y	X

37. Question | 9702 Oct-Nov 2016 P1 V2 Q36

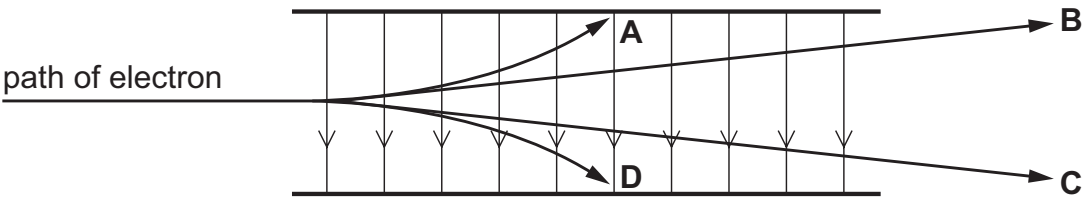
- 36** Four statements about either potential difference or electromotive force are listed.
- 1 It involves changing electrical energy into other forms.
 - 2 It involves changing other energy forms into electrical energy.
 - 3 It is the energy per unit charge to move charge around a complete circuit.
 - 4 It is the work done per unit charge by the charge moving from one point to another.

Which statements apply to potential difference and which apply to electromotive force?

	potential difference	electromotive force
A	1 and 3	2 and 4
B	1 and 4	2 and 3
C	2 and 3	1 and 4
D	2 and 4	1 and 3

38. Question | 9702 Oct-Nov 2016 P1 V3 Q30

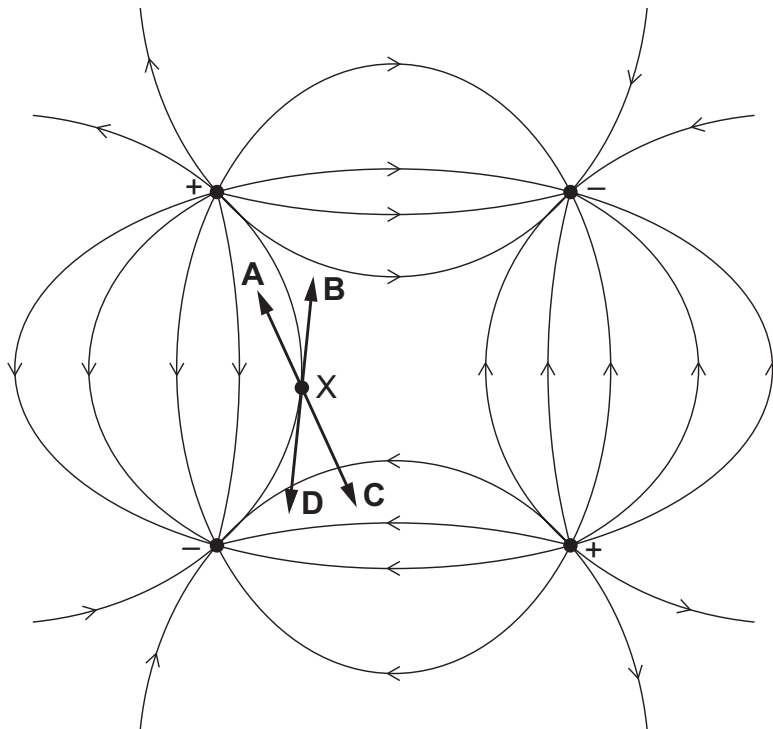
- 30** Which path shows a possible movement of an electron in the electric field shown?



39. Question | 9702 Oct-Nov 2016 P1 V3 Q31

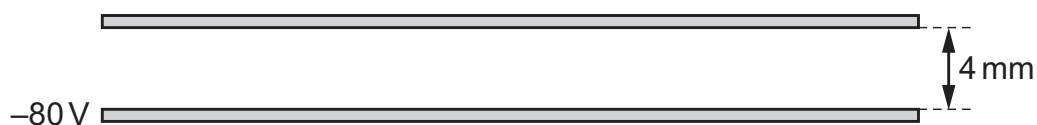
- 31** The diagram shows an electric field pattern caused by two positive and two negative point charges of equal magnitude placed at the four corners of a square.

In which direction does the force act on an electron at point X?



40. Question | 9702 Oct-Nov 2016 P1 V3 Q32

- 32** Two large horizontal metal plates are separated by 4 mm. The lower plate is at a potential of -80 V .



Which potential should be applied to the upper plate to create an electric field of strength $60\,000\text{ V m}^{-1}$ upwards in the space between the plates?

- A** -320 V **B** -160 V **C** $+160\text{ V}$ **D** $+320\text{ V}$

41. Question | 9702 Oct-Nov 2016 P1 V3 Q33

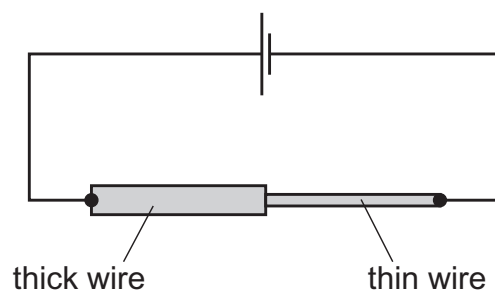
- 33** An electric kettle is marked 3.10 kW. It is used with an electrical supply of 240 V.

What is the electric current in the kettle and what is the kettle's electrical resistance when working?

	current / A	resistance / Ω
A	0.0129	18 600
B	0.0770	3100
C	12.9	18.6
D	12.9	3100

42. Question | 9702 Oct-Nov 2016 P1 V3 Q34

- 34** A thick copper wire is connected to a thin copper wire in series with a cell, as shown.



What is significantly **less** in the thick wire than in the thin wire?

- A** the charge passing a point per unit time
- B** the drift speed of the electrons
- C** the number density of the free electrons
- D** the number of free electrons passing a point per unit time

43. Question | 9702 Oct-Nov 2016 P1 V3 Q35

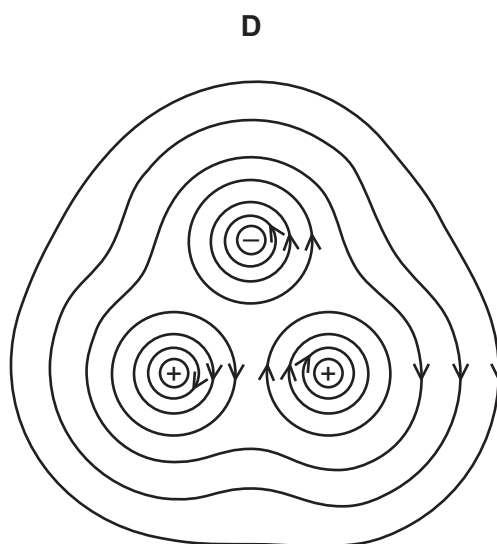
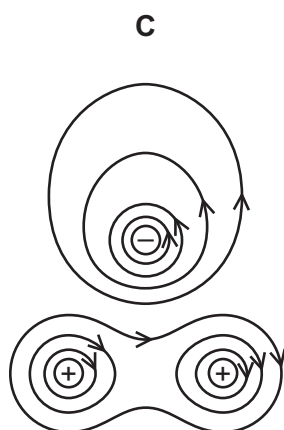
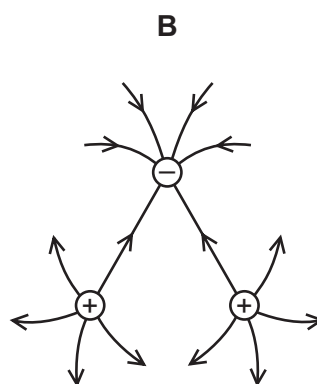
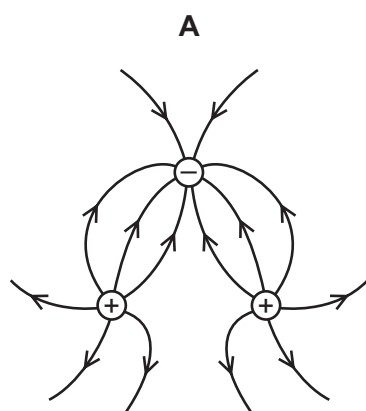
- 35** What is a typical value for the order of magnitude of the resistivity of copper?

- A** $10^{-13} \Omega \text{ m}$ **B** $10^{-8} \Omega \text{ m}$ **C** $10^{-3} \Omega \text{ m}$ **D** $10^2 \Omega \text{ m}$

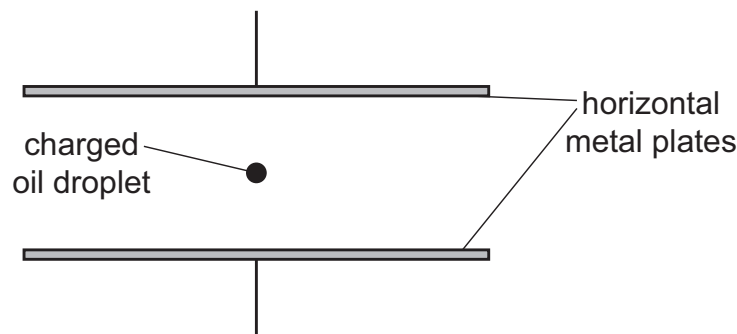
44. Question | 9702 Feb-March 2017 P1 V2 Q30

- 30** Two positive charges and one negative charge, all of equal magnitude, are set at the corners of an equilateral triangle.

Which diagram best represents the electric field surrounding the charges?



31 A constant potential difference is applied between two horizontal metal plates. A charged oil droplet is held stationary by the electric field between the plates.



As some of the oil evaporates, the droplet loses mass and starts to accelerate. Its charge remains constant.

In which direction does the droplet accelerate, and which change needs to be made to the separation of the plates in order to stop this acceleration?

	direction of acceleration	separation of the plates
A	downwards	decrease
B	downwards	increase
C	upwards	decrease
D	upwards	increase

32 An electric current I is given in the list of formulae on page 3 as $I = Anvq$.

What do each of the symbols represent for an electric current in a metal wire?

	A	n	v	q
A	area of cross-section	number of free electrons	voltage	charge of each molecule
B	area of cross-section	number of free electrons per unit volume	average drift speed of electrons	charge of each electron
C	current	number of free electrons	average drift speed of electrons	charge of each molecule
D	current	number of free electrons per unit volume	voltage	charge of each electron

33 The potential difference across a resistor is 12 V. The current in the resistor is 2.0 A.

A charge of 4.0 C passes through the resistor.

What is the energy transferred in the resistor and the time taken for the charge to pass through the resistor?

	energy / J	time / s
A	3.0	2.0
B	3.0	8.0
C	48	2.0
D	48	8.0

48. Question | 9702 Feb-March 2017 P1 V2 Q34

- 34** A coil contains N turns of insulated copper wire wound on to a cylindrical iron core of diameter D . The copper wire has a diameter d . The resistivity of copper is ρ . Diameter D is much greater than diameter d .

What is the total resistance between the two ends of the coil?

- A** $\frac{4N\rho D}{d^2}$ **B** $\frac{4N\rho d}{D^2}$ **C** $\frac{8N\rho D}{d^2}$ **D** $\frac{8N\rho d}{D^2}$

49. Question | 9702 May-June 2017 P1 V1 Q11

- 11** A particle with mass and charge is moving from left to right in a uniform gravitational field and a uniform electric field. The gravitational field is downwards. The gravitational force and the electric force on this particle act in opposite directions.

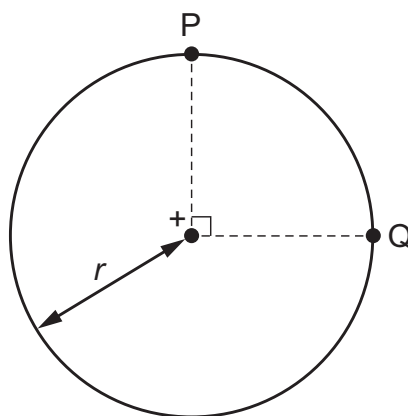
What could be the sign of the charge on the particle and the direction of the electric field?

	sign of charge	direction of electric field
A	negative	down
B	negative	up
C	positive	left
D	positive	right

50. Question | 9702 May-June 2017 P1 V1 Q30

- 30** The diagram shows two points P and Q which lie 90° apart on a circle of radius r .

A positive point charge at the centre of the circle creates an electric field of magnitude E at both P and Q.

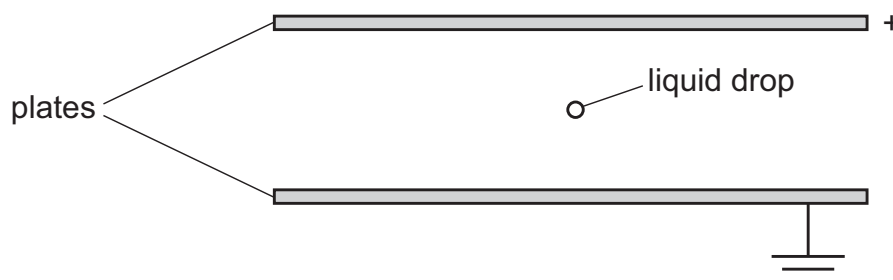


Which expression gives the work done in moving a unit positive charge from P to Q?

- A** 0 **B** $E \times r$ **C** $E \times \left(\frac{\pi r}{2}\right)$ **D** $E \times (\pi r)$

51. Question | 9702 May-June 2017 P1 V1 Q31

- 31** The diagram shows two parallel horizontal metal plates. The top plate is positively charged and the bottom plate is earthed.



A small charged liquid drop, midway between the plates, is held in equilibrium by the combination of its weight and the electric force acting on it.

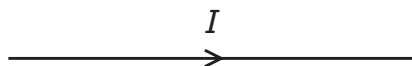
The acceleration of free fall is g and the electric field strength is E .

What is the polarity of the charge on the drop, and the ratio of charge to mass of the drop?

	polarity	$\frac{\text{charge}}{\text{mass}}$
A	negative	$\frac{E}{g}$
B	negative	$\frac{g}{E}$
C	positive	$\frac{E}{g}$
D	positive	$\frac{g}{E}$

52. Question | 9702 May-June 2017 P1 V1 Q32

- 32** The diagram shows the symbol for a wire carrying a current I .



What does this current represent?

- A** the charge flowing past a point in the wire per unit time
- B** the number of electrons flowing past a point in the wire per unit time
- C** the number of positive ions flowing past a point in the wire per unit time
- D** the number of protons flowing past a point in the wire per unit time

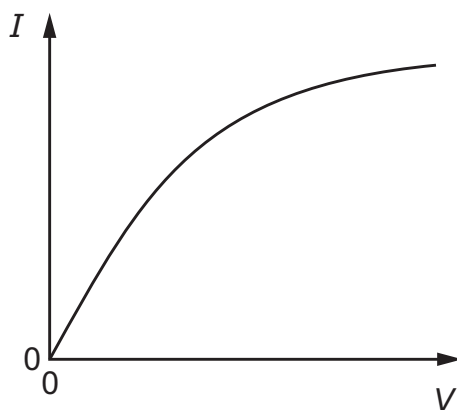
53. Question | 9702 May-June 2017 P1 V1 Q33

33 Which values of current and resistance will produce a rate of energy transfer of 16 J s^{-1} ?

	current / A	resistance / Ω
A	1	4
B	2	8
C	4	1
D	16	1

54. Question | 9702 May-June 2017 P1 V1 Q34

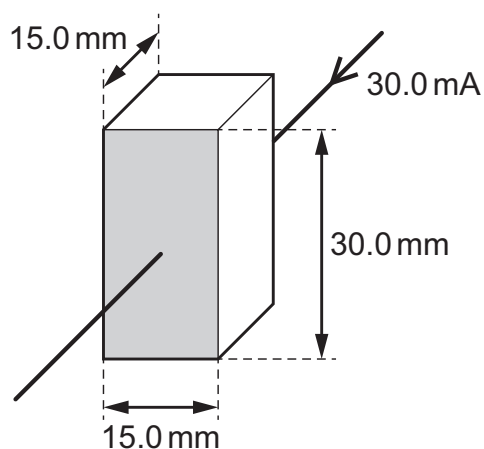
34 Which component has the I - V graph shown?



- A** filament lamp
- B** metallic conductor at constant temperature
- C** resistor of fixed resistance
- D** semiconductor diode

55. Question | 9702 May-June 2017 P1 V2 Q4

- 4** The current in a block of semiconductor is 30.0 mA when there is a potential difference (p.d.) of 10.0 V across it. The dimensions of the block and the direction of the current in it are as shown.



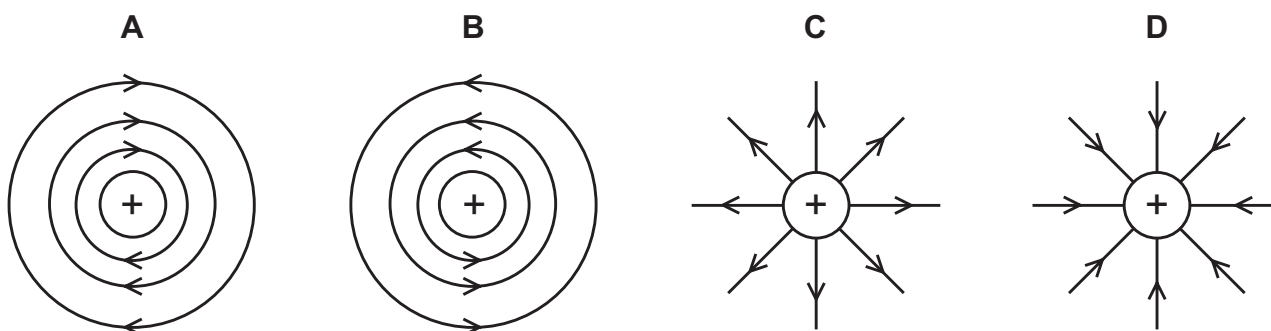
The electrical meters used are accurate to $\pm 0.1\text{ mA}$ and $\pm 0.1\text{ V}$. The dimensions of the block are accurate to $\pm 0.2\text{ mm}$.

What is the resistivity of the semiconductor?

- A** $10.0 \pm 0.2\ \Omega\text{ m}$
- B** $10.0 \pm 0.3\ \Omega\text{ m}$
- C** $10.0 \pm 0.5\ \Omega\text{ m}$
- D** $10.0 \pm 0.8\ \Omega\text{ m}$

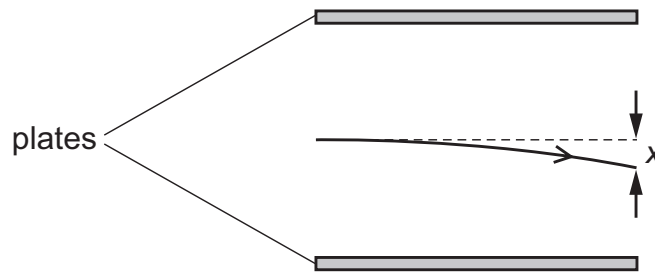
56. Question | 9702 May-June 2017 P1 V2 Q30

- 30** Which diagram best illustrates the electric field around a positive point charge?



57. Question | 9702 May-June 2017 P1 V2 Q31

31 The path of an electron with initial speed v in the uniform electric field between two parallel plates is shown.



The vertical deflection x is measured at the right-hand edge of the plates.

The distance between the plates is halved. The potential difference between the plates remains the same.

What will be the new deflection of the electron with the same initial speed v ?

A x **B** $\sqrt{2}x$ **C** $2x$ **D** $4x$

58. Question | 9702 May-June 2017 P1 V2 Q32

32 The current in a circuit component is $2.00\ \mu\text{A}$.

How many electrons pass through the component each second?

A 1.25×10^{13} **B** 1.25×10^{16} **C** 1.25×10^{19} **D** 1.25×10^{25}

59. Question | 9702 May-June 2017 P1 V2 Q33

33 The filament of a 240 V, 100 W electric lamp heats up from room temperature to its operating temperature. As it heats up, its resistance increases by a factor of 16.

What is the resistance of the filament at room temperature?

A 36Ω **B** 580Ω **C** $1.5\text{k}\Omega$ **D** $9.2\text{k}\Omega$

60. Question | 9702 May-June 2017 P1 V2 Q34

- 34** Two wires have the same length and the same resistance. Wire X is made of a metal of resistivity $1.7 \times 10^{-8} \Omega \text{ m}$ and wire Y is made of a metal of resistivity $5.6 \times 10^{-8} \Omega \text{ m}$.

The diameter of wire X is 0.315 mm.

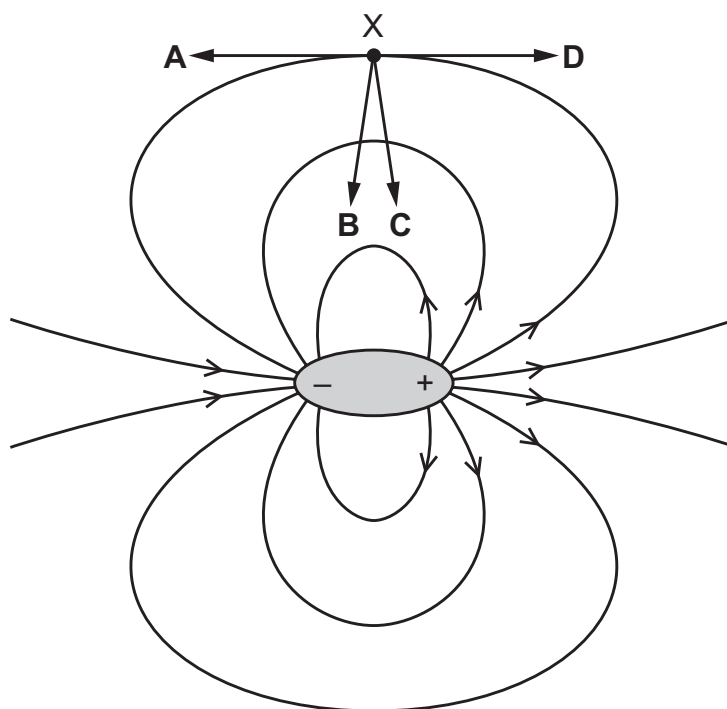
What is the diameter of wire Y?

- A** 0.17 mm **B** 0.33 mm **C** 0.57 mm **D** 1.0 mm

61. Question | 9702 May-June 2017 P1 V3 Q29

- 29** A dipole is a pair of charges of equal magnitude, one negative and one positive. The electric field of a dipole is shown below.

In which direction does the force act on an electron when at point X?



62. Question | 9702 May-June 2017 P1 V3 Q30

- 30** In a uniform electric field, which statement is correct?

- A** All charged particles experience the same force.
B All charged particles move with the same velocity.
C All electric field lines are directed towards positive charges.
D All electric field lines are parallel.

63. Question | 9702 May-June 2017 P1 V3 Q31

31 Two metal plates are a distance of 30 cm apart in a vacuum.

A current exists between the two plates consisting of electrons moving at a constant speed of $1.5 \times 10^6 \text{ m s}^{-1}$.

At any instant, there is always just one electron travelling between the plates.

What is the current between the plates?

A $3.2 \times 10^{-26} \text{ A}$

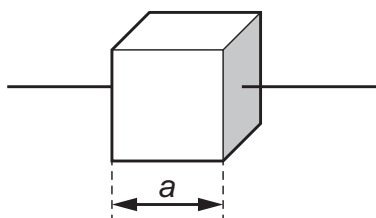
B $8.0 \times 10^{-13} \text{ A}$

C $1.6 \times 10^{-12} \text{ A}$

D $2.0 \times 10^{-7} \text{ A}$

64. Question | 9702 May-June 2017 P1 V3 Q33

33 A metal cube with sides of length a has electrical resistance R between opposite faces.



What is the resistance between the opposite faces of a cube of the same metal with sides of length $3a$?

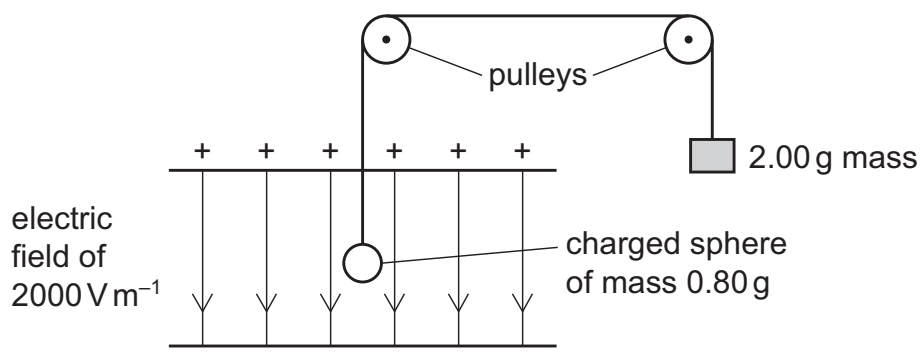
A $9R$

B $3R$

C $\frac{R}{3}$

D $\frac{R}{9}$

- 31** A small charged sphere of mass 0.80 g hangs from a light thread inside a vertical uniform electric field of strength 2000 V m^{-1} . The thread passes over two frictionless pulleys and a mass of 2.00 g hangs on the other end.

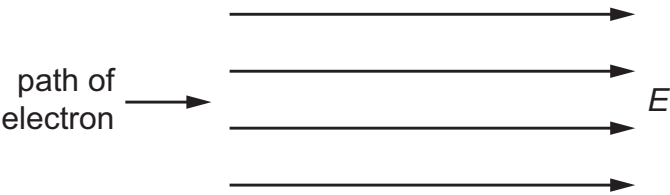


The sphere is in equilibrium.

What is the charge on the sphere?

- A** $-5.9\text{ }\mu\text{C}$ **B** $+0.60\text{ }\mu\text{C}$ **C** $+5.9\text{ }\mu\text{C}$ **D** $+9.8\text{ }\mu\text{C}$

32 An electron enters a region of space where there is a uniform electric field E as shown.



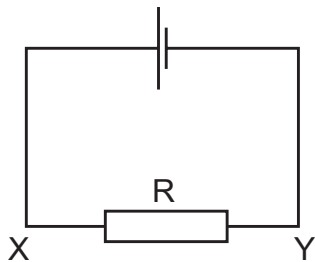
Initially, the electron is moving parallel to, and in the direction of, the electric field.

What is the subsequent path and change of speed of the electron caused by the electric field?

	path of electron	speed of electron
A	curved	decreases
B	curved	increases
C	linear	decreases
D	linear	increases

67. Question | 9702 Oct-Nov 2017 P1 V1 Q33

33 The current in the circuit shown is 3.2 mA.



What are the direction of flow and the rate of flow of electrons through the resistor R?

	direction of flow	rate of flow / s ⁻¹
A	X to Y	2.0×10^{16}
B	X to Y	5.1×10^{-22}
C	Y to X	2.0×10^{16}
D	Y to X	5.1×10^{-22}

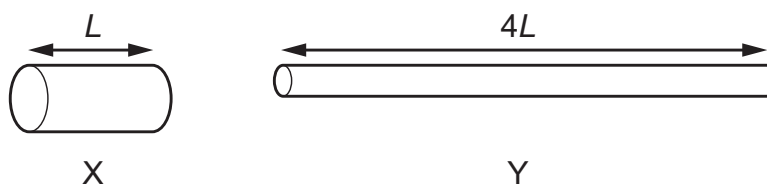
68. Question | 9702 Oct-Nov 2017 P1 V1 Q34

34 A filament lamp has a resistance of 180 Ω when the current in it is 500 mA.

What is the power dissipated in the lamp?

- A** 45 W
- B** 90 W
- C** 290 W
- D** 360 W

35 Two copper wires X and Y have the same volume. Wire Y is four times as long as wire X.



What is the ratio $\frac{\text{resistance of wire Y}}{\text{resistance of wire X}}$?

A 1

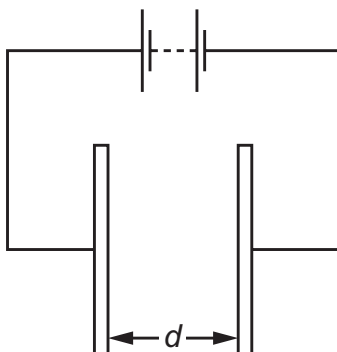
B 4

C 8

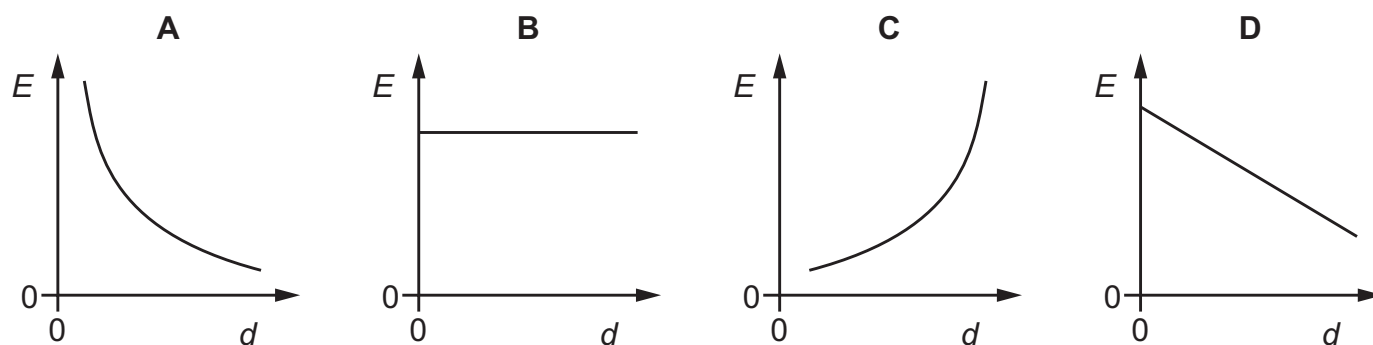
D 16

70. Question | 9702 Oct-Nov 2017 P1 V2 Q31

31 The diagram shows two metal plates connected to a constant high voltage.

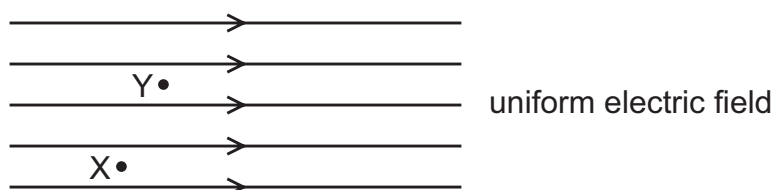


Which graph shows the variation of the electric field strength E midway between the two plates as the distance d between the two plates is increased?



71. Question | 9702 Oct-Nov 2017 P1 V2 Q32

32 An electron moves between two points X and Y in a uniform electric field, as shown.



The distance between X and Y is 4.0 cm and the line XY is at an angle of 60° to the direction of the field.

The field exerts the only force on the electron.

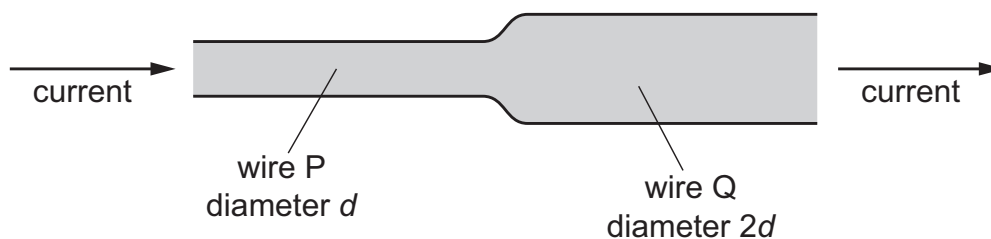
The field strength is 100 N C^{-1} .

What is the change in the kinetic energy of the electron as it moves from X to Y?

- A** -4 eV **B** -2 eV **C** $+2 \text{ eV}$ **D** $+4 \text{ eV}$

72. Question | 9702 Oct-Nov 2017 P1 V2 Q33

- 33** Two copper wires are joined together and carry a current, as shown.



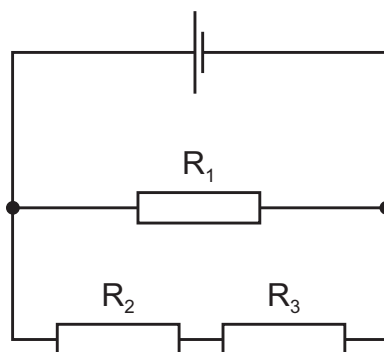
Wire P has diameter d and wire Q has diameter $2d$.

What is the ratio $\frac{\text{average drift speed of the free electrons in wire P}}{\text{average drift speed of the free electrons in wire Q}}$?

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

73. Question | 9702 Oct-Nov 2017 P1 V2 Q34

- 34** A cell of negligible internal resistance is connected to resistors R_1 , R_2 and R_3 , as shown. The cell provides power to the circuit and power is dissipated in the resistors.

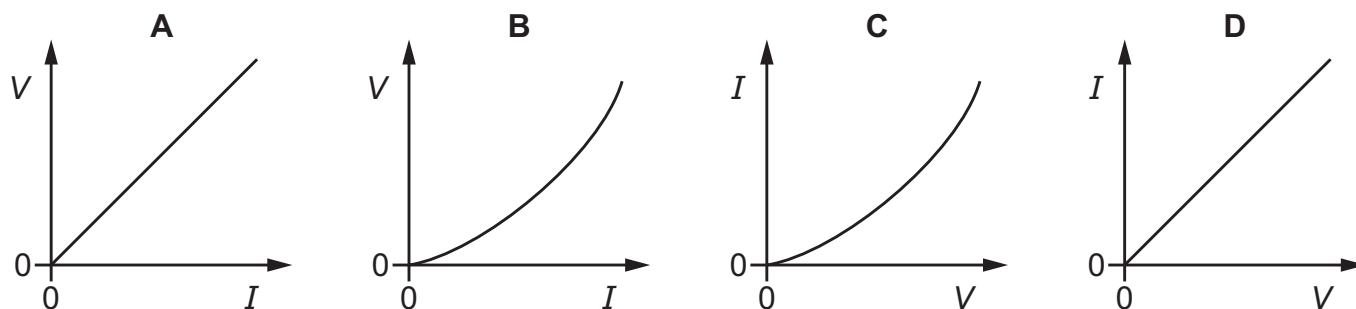


Which word equation **must** be correct?

- A** power loss in R_1 = power loss in R_2 + power loss in R_3
B power loss in R_2 = power loss in R_3
C power output of cell = power loss in R_1 + power loss in R_2 + power loss in R_3
D power output of cell = power loss in R_1

74. Question | 9702 Oct-Nov 2017 P1 V2 Q35

- 35** Which graph represents a metallic conductor, where the resistance of the conductor is given by the gradient of the graph?

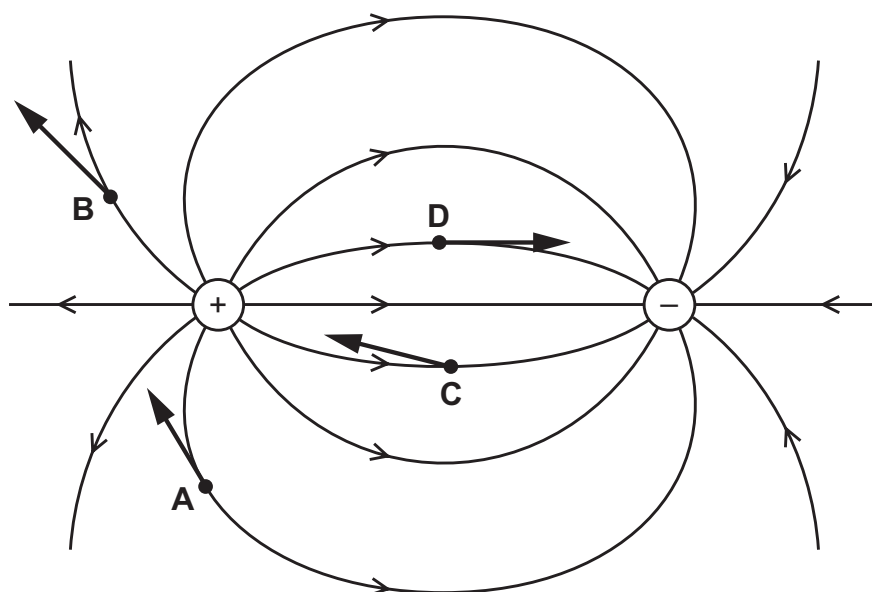


75. Question | 9702 Oct-Nov 2017 P1 V3 Q31

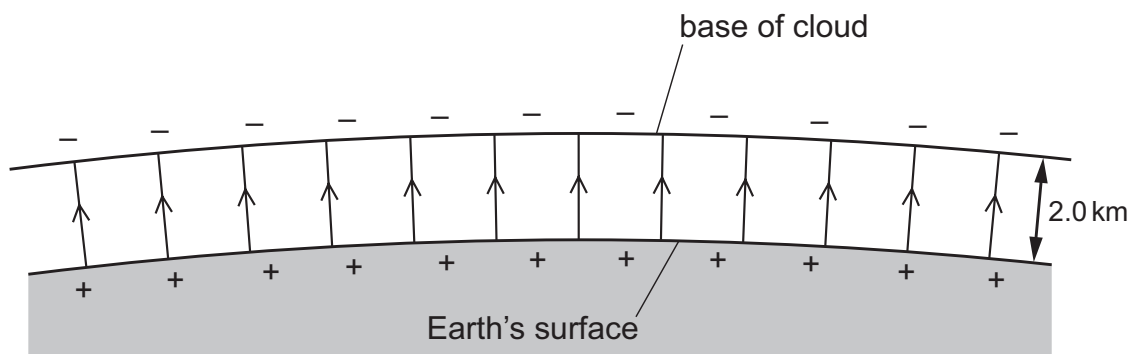
- 31** The diagram shows the electric field near a positively charged sphere and a negatively charged sphere.

Four electrons **A**, **B**, **C** and **D** are shown at different positions in the field.

On which electron is the direction of the force on the electron shown correctly?



- 32** Lightning can occur between a charged cloud and the Earth's surface when the electric field strength in the intervening atmosphere reaches 25 kNC^{-1} . The diagram shows the electric field between the base of a cloud and the Earth's surface.



What is the minimum potential difference between the Earth and the base of a cloud, 2.0 km high, for lightning to occur?

- A** 12.5 MV **B** 25 MV **C** 50 MV **D** 100 MV

- 33** The number density of conduction electrons in copper is $8.0 \times 10^{28} \text{ m}^{-3}$.

What is the average drift speed of electrons in a copper wire of diameter 0.42 mm when the current in the wire is 0.57 A?

- A** $8.0 \times 10^{-11} \text{ ms}^{-1}$
B $3.2 \times 10^{-10} \text{ ms}^{-1}$
C $8.0 \times 10^{-5} \text{ ms}^{-1}$
D $3.2 \times 10^{-4} \text{ ms}^{-1}$

78. Question | 9702 Oct-Nov 2017 P1 V3 Q34

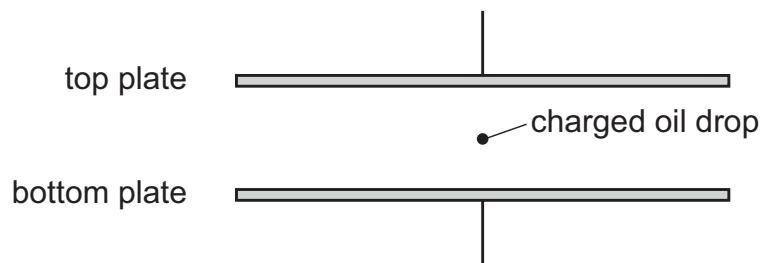
34 A simple circuit comprises a source of electromotive force (e.m.f.) connected to a load.

How does the output power P of the source depend on the internal resistance r of the source and the resistance R of the load?

- A** P is independent of both r and R .
- B** P depends on r but not on R .
- C** P depends on R but not on r .
- D** P depends on both r and R .

79. Question | 9702 Feb-March 2018 P1 V2 Q12

12 A charged oil drop is held stationary between two charged parallel plates.

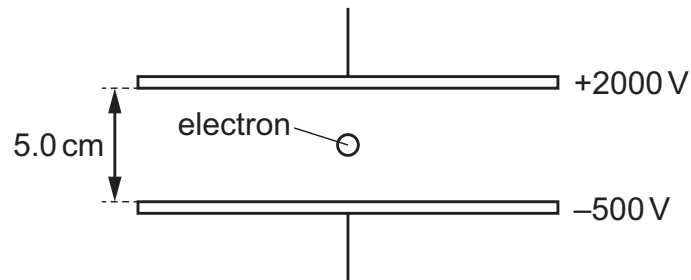


Which forces act on the oil drop?

- A** both electric and gravitational
- B** electric only
- C** gravitational only
- D** neither electric nor gravitational

80. Question | 9702 Feb-March 2018 P1 V2 Q30

- 30** An electron passes into the space between two parallel plates that are 5.0 cm apart and which are maintained at electric potentials of +2000 V and –500 V, respectively.



What is the electric force on the electron?

- A** $1.6 \times 10^{-15} \text{ N}$
- B** $4.8 \times 10^{-15} \text{ N}$
- C** $6.4 \times 10^{-15} \text{ N}$
- D** $8.0 \times 10^{-15} \text{ N}$

81. Question | 9702 Feb-March 2018 P1 V2 Q31

- 31** Which statement about electric charges in a uniform electric field is **not** correct?
- A** Electric charges of the same magnitude, whether positive or negative, experience the same magnitude of force when placed in the same uniform electric field.
 - B** The direction of the force on a positive charge placed in a uniform electric field is independent of the magnitude of the charge.
 - C** The magnitude of the force on a positive charge placed in a uniform electric field is proportional to the magnitude of the electric field strength.
 - D** The work done to move a positive charge a certain distance in a uniform electric field is independent of the direction of the movement.

82. Question | 9702 Feb-March 2018 P1 V2 Q33

- 33** A resistor has resistance R . When the potential difference across the resistor is V , the current in the resistor is I . The power dissipated in the resistor is P . Work W is done when charge Q flows through the resistor.

What is **not** a valid relationship between these variables?

A $I = \frac{P}{V}$ **B** $Q = \frac{W}{V}$ **C** $R = \frac{P}{I^2}$ **D** $R = \frac{V}{P}$

83. Question | 9702 Feb-March 2018 P1 V2 Q34

- 34** A wire of resistance $9.55\,\Omega$ has a diameter of $0.280\,\text{mm}$.

It is made of metal of resistivity $4.90 \times 10^{-7}\,\Omega\,\text{m}$.

What is the length of the wire?

A $1.20\,\text{m}$ **B** $4.80\,\text{m}$ **C** $19.0\,\text{m}$ **D** $76.8\,\text{m}$

84. Question | 9702 Feb-March 2018 P1 V2 Q35

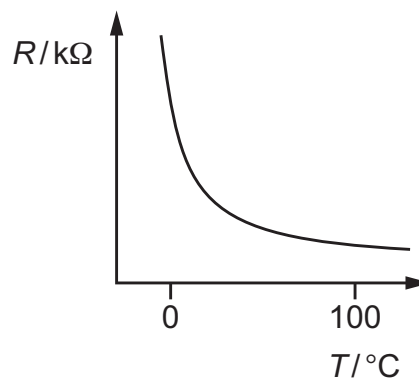
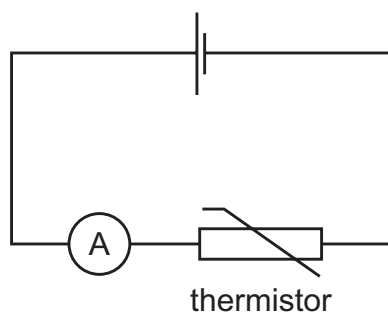
- 35** Charge carriers, each of charge q , move along a wire of fixed length. The number density of the charge carriers in the wire is n .

What is also required, for this wire, to determine the average drift velocity of the charge carriers in terms of n and q ?

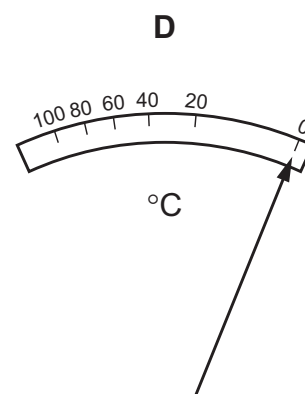
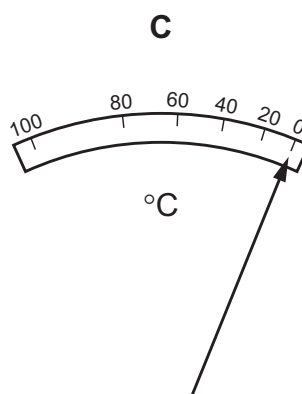
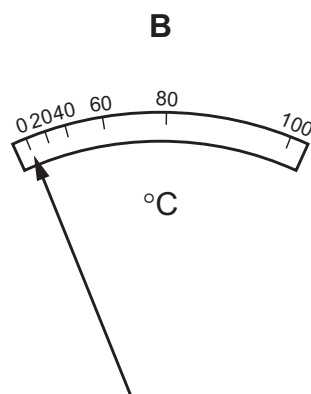
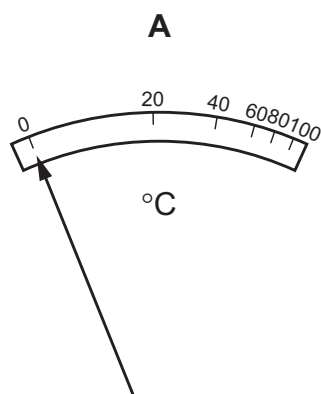
- A** current per unit of cross-sectional area
- B** potential difference per unit of length
- C** resistance and cross-sectional area
- D** resistivity and length

85. Question | 9702 May-June 2018 P1 V1 Q4

- 4** In the circuit shown, an analogue ammeter is to be recalibrated as a thermometer. The ammeter is connected in series with a thermistor. The thermistor is a component with a resistance that varies with temperature. The graph shows how the resistance R of the thermistor changes with temperature T .



Which diagram could represent the temperature scale on the ammeter?



86. Question | 9702 May-June 2018 P1 V1 Q28

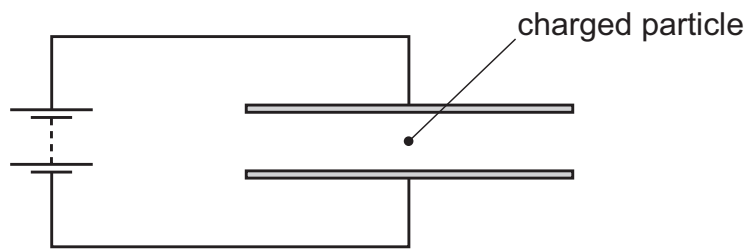
- 28** A particle has a charge of $+2.0 \text{ mC}$ and is in a vertical uniform electric field. An electric force of $1.0 \times 10^{-2} \text{ N}$ acts upwards on the particle.

What is the electric field strength?

- A** 0.20 V m^{-1} downwards
B 0.20 V m^{-1} upwards
C 5.0 V m^{-1} downwards
D 5.0 V m^{-1} upwards

87. Question | 9702 May-June 2018 P1 V1 Q29

- 29** A charged particle is in the electric field between two horizontal metal plates connected to a battery, as shown. There is a force F on the particle due to the electric field.



The separation of the plates is doubled.

What is the new force on the particle?

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

88. Question | 9702 May-June 2018 P1 V1 Q30

- 30** The current I in a metal wire is given by the expression shown.

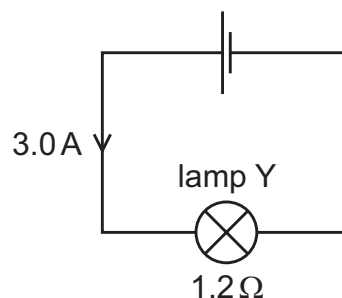
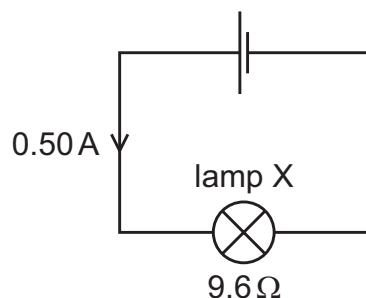
$$I = Anvq$$

What does the symbol n represent?

- A** the number of atoms per unit volume of the metal
B the number of free electrons per atom in the metal
C the number of free electrons per unit volume of the metal
D the total number of electrons per unit volume of the metal

89. Question | 9702 May-June 2018 P1 V1 Q31

- 31** The circuit diagrams show two lamps X and Y each connected to a cell. The current in lamp X is 0.50 A and its resistance is $9.6\ \Omega$. The current in lamp Y is 3.0 A and its resistance is $1.2\ \Omega$.



What is the ratio $\frac{\text{power in lamp X}}{\text{power in lamp Y}}$?

- A** 0.22 **B** 0.75 **C** 1.3 **D** 4.5

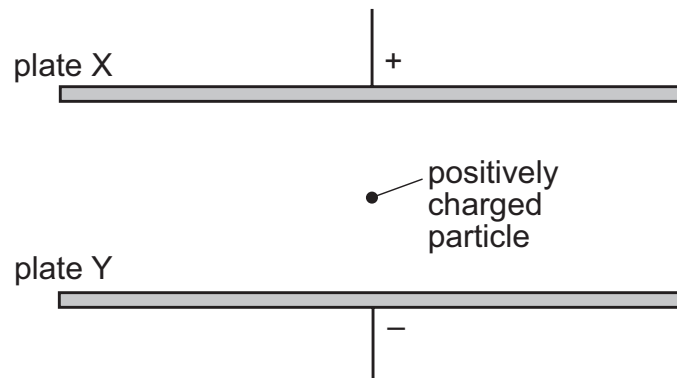
90. Question | 9702 May-June 2018 P1 V1 Q32

- 32** A cylindrical piece of a soft, electrically-conducting material has resistance R . It is rolled out so that its length is doubled but its volume stays constant.

What is its new resistance?

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

30 Two large parallel metal plates X and Y are situated in a vacuum as shown.



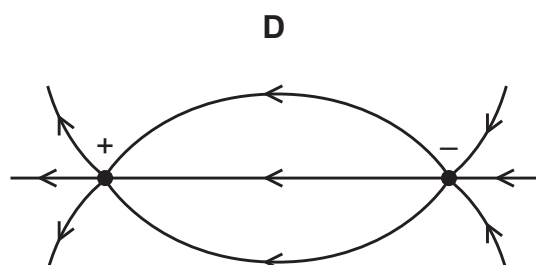
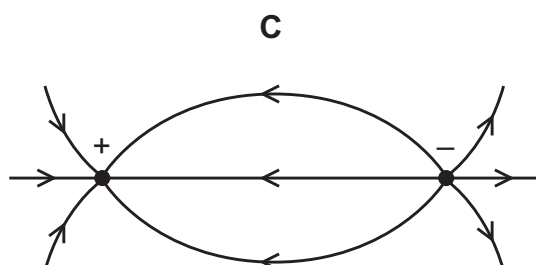
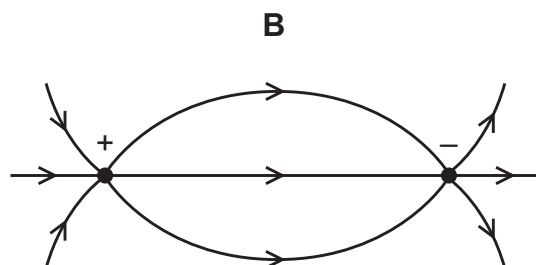
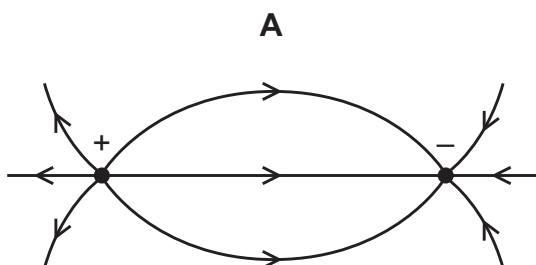
Plates X and Y carry equal and opposite charges.

What happens to the force on a positively charged particle as it moves from plate X to plate Y?

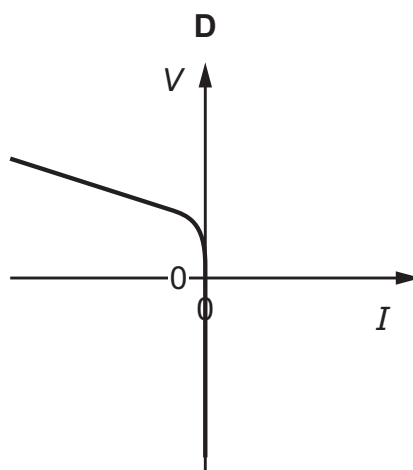
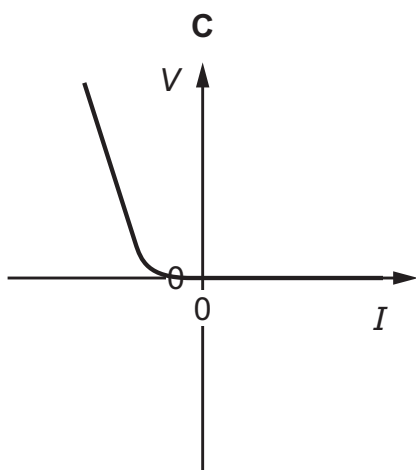
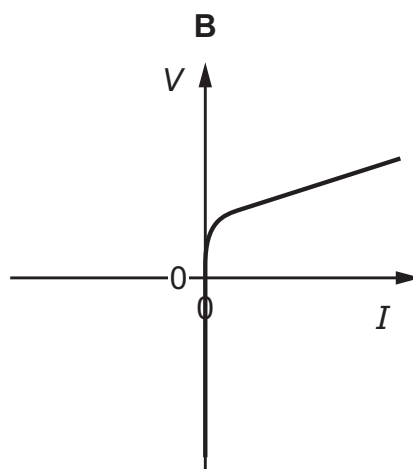
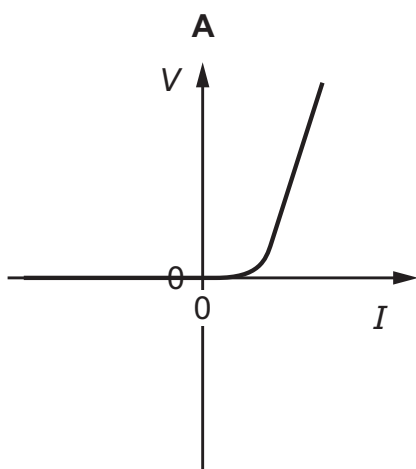
- A** It decreases because the positively charged particle is moving away from the positively charged plate.
- B** It decreases because the positively charged particle is moving in the direction of the electric field between the plates.
- C** It increases because the positively charged particle is moving closer to a negatively charged plate.
- D** It remains constant because the positively charged particle is in the uniform electric field between the plates.

- 31** Four diagrams representing the electric field between two oppositely-charged point charges are shown.

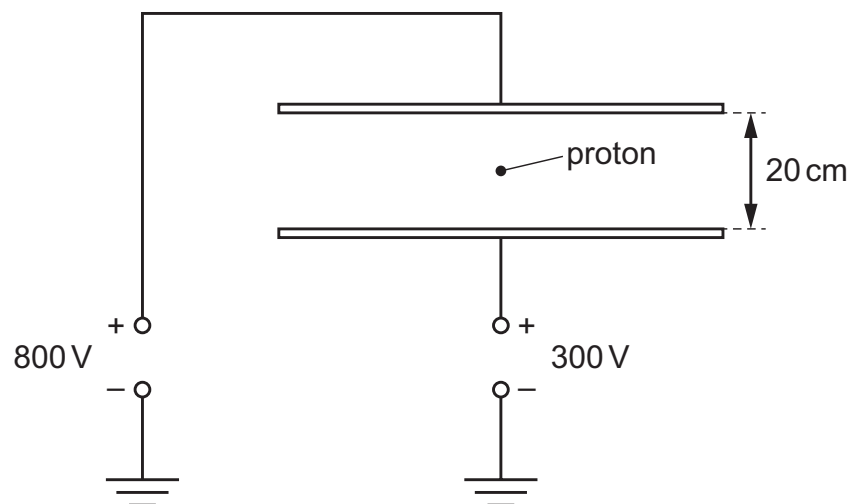
Which diagram correctly shows the electric field lines?



33 Which graph shows the variation of voltage V with current I for a semiconductor diode?



- 27** Two parallel metal plates are situated 20 cm apart in a vacuum. They are connected to two sources of potential difference as shown.



A proton is released in the space between the plates.

What is the magnitude and direction of the acceleration of the proton?

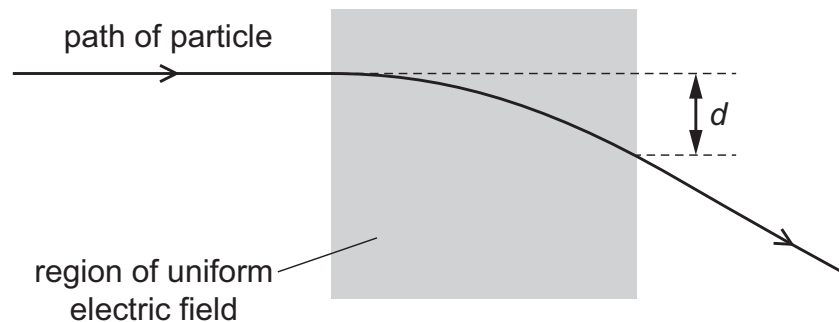
- A** $2.4 \times 10^{11} \text{ m s}^{-2}$ downwards
- B** $2.4 \times 10^{11} \text{ m s}^{-2}$ upwards
- C** $5.3 \times 10^{11} \text{ m s}^{-2}$ downwards
- D** $5.3 \times 10^{11} \text{ m s}^{-2}$ upwards

95. Question | 9702 May-June 2018 P1 V3 Q28

28 A particle having mass m and charge $+q$ enters a uniform electric field with speed v .

Initially, the particle is travelling at right-angles to the electric field.

During its movement through the field, the particle is deflected through distance d , as shown.



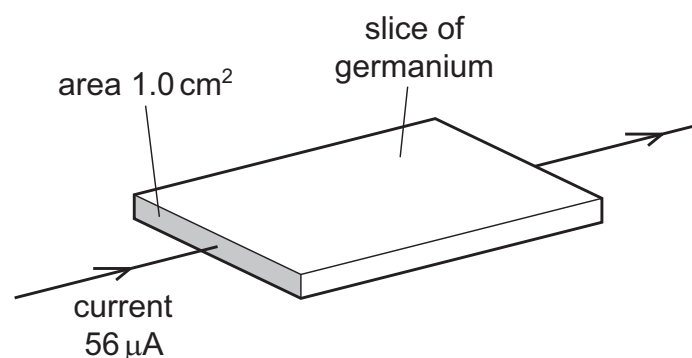
A second particle of mass $2m$, charge $+q$ and speed v enters the electric field along the same path.

What is the distance through which this particle is deflected in the electric field?

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

96. Question | 9702 May-June 2018 P1 V3 Q30

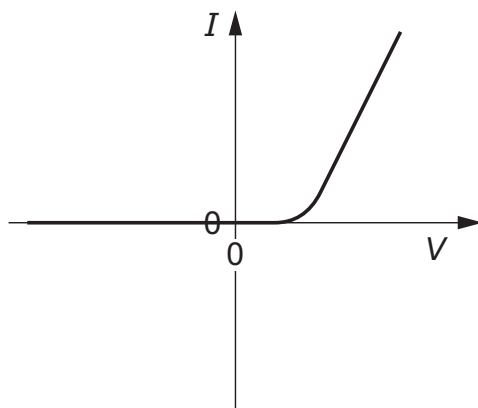
30 A slice of germanium of cross-sectional area 1.0 cm^2 carries a current of $56 \mu\text{A}$. The number density of charge carriers in the germanium is $2.0 \times 10^{13} \text{ cm}^{-3}$. Each charge carrier has a charge equal to the charge on an electron.



What is the average drift velocity of the charge carriers in the germanium?

- A** 0.18 ms^{-1} **B** 18 ms^{-1} **C** 180 ms^{-1} **D** 1800 ms^{-1}

32 The graph shows the I - V characteristic of an electrical component.



What is the component?

- A** a filament lamp
- B** a metallic conductor at constant temperature
- C** a resistor
- D** a semiconductor diode

98. Question | 9702 May-June 2018 P1 V3 Q33

33 A metal wire of length 1.4 m has a uniform cross-sectional area of $7.8 \times 10^{-7} \text{ m}^2$.

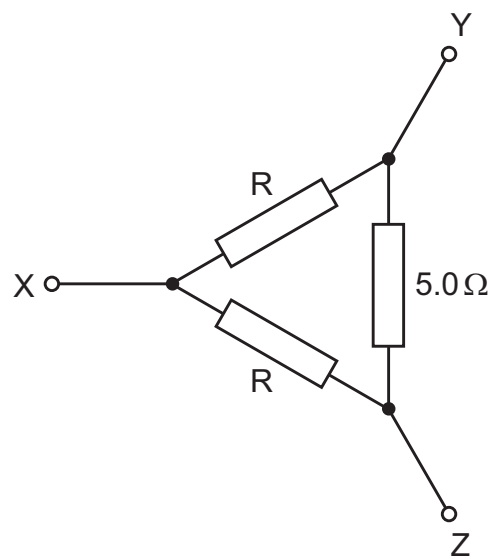
The resistivity of the metal is $1.7 \times 10^{-8} \Omega \text{ m}$.

What is the resistance of the wire?

- A** 0.016Ω **B** 0.031Ω **C** 33Ω **D** 64Ω

99. Question | 9702 May-June 2018 P1 V3 Q35

35 The diagram shows a network of three resistors. Two of these, marked R, are identical. The other resistor has a resistance of $5.0\,\Omega$.



The resistance between Y and Z is found to be $2.5\,\Omega$.

What is the resistance between X and Y?

- A** $0.30\,\Omega$ **B** $0.53\,\Omega$ **C** $1.9\,\Omega$ **D** $3.3\,\Omega$

100. Question | 9702 Oct-Nov 2018 P1 V1 Q10

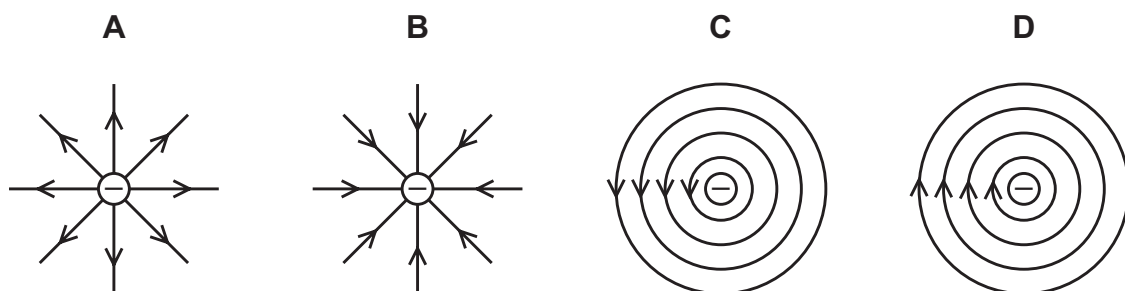
10 A charged particle is placed in a uniform field of force. The direction of the force on the particle is opposite to the direction of the field.

What is the field and what is the charge on the particle?

	field	charge on particle
A	electric	negative
B	electric	positive
C	gravitational	negative
D	gravitational	positive

101. Question | 9702 Oct-Nov 2018 P1 V1 Q30

30 Which diagram shows the electric field lines surrounding an isolated negative point charge?



102. Question | 9702 Oct-Nov 2018 P1 V1 Q31

31 A beam of electrons is directed into an electric field and is deflected by it.

Diagram 1 represents an electric field in the plane of the paper.

Diagram 2 represents an electric field directed perpendicular to the plane of the paper.

The lines **A**, **B**, **C** and **D** represent possible paths of the electron beam. All paths are in the plane of the paper.

Which line best represents the path of the electrons inside the field?

diagram 1

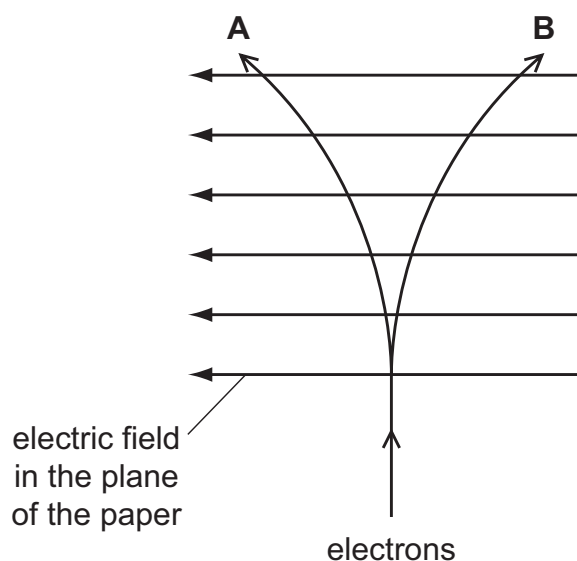
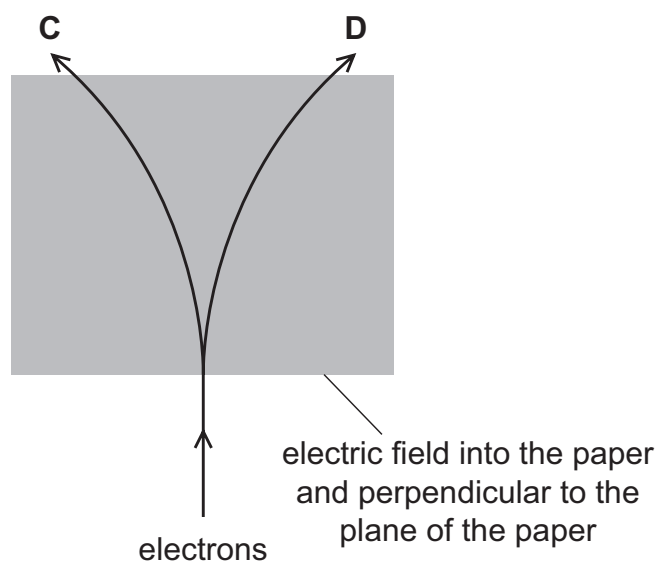


diagram 2



103. Question | 9702 Oct-Nov 2018 P1 V1 Q32

- 32** A charged particle of charge q and mass m is initially at rest in a uniform electric field. The field is produced by parallel metal plates separated by a distance d and having a potential difference V between them.

What is an expression for the acceleration of the charged particle?

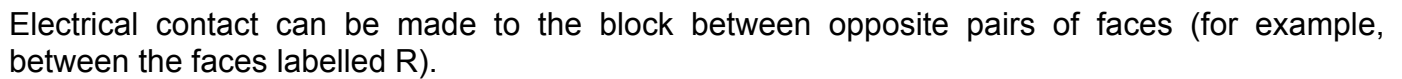
- A** $\frac{md}{qV}$ **B** $\frac{mV}{qd}$ **C** $\frac{qd}{mV}$ **D** $\frac{qV}{md}$

104. Question | 9702 Oct-Nov 2018 P1 V1 Q33

- 33** When there is a current of 5.0 A in a copper wire, the average drift velocity of the free electrons is $8.0 \times 10^{-4} \text{ m s}^{-1}$.

What is the average drift velocity in a different copper wire that has twice the diameter and a current of 10.0 A?

- A** $4.0 \times 10^{-4} \text{ m s}^{-1}$
B $8.0 \times 10^{-4} \text{ m s}^{-1}$
C $1.6 \times 10^{-3} \text{ m s}^{-1}$
D $3.2 \times 10^{-3} \text{ m s}^{-1}$



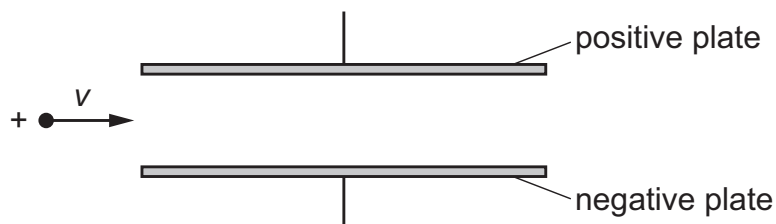
A It is maximum between the faces labelled P.

B It is maximum between the faces labelled Q.

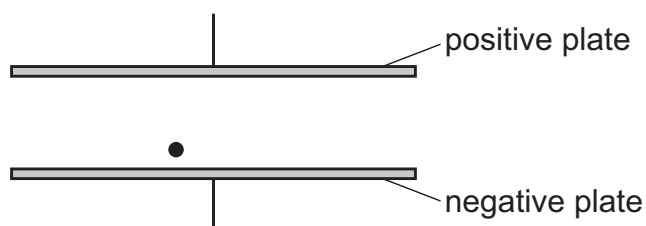
C It is maximum between the faces labelled R.

D It is the same, whichever pair of faces is used.

- 11** A positively-charged particle of negligible mass, moving at constant velocity v in a vacuum, enters a uniform electric field between two parallel plates, as shown.



A short time later, the particle is at the position shown.

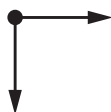


Which diagram represents the force or forces acting on the particle?

A



B



C

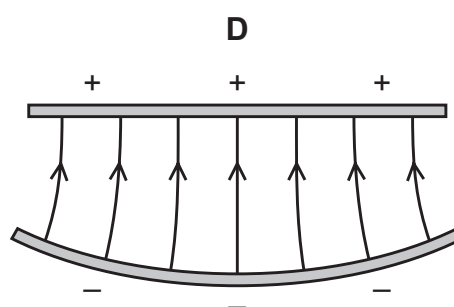
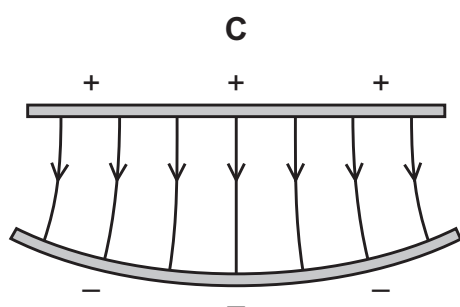
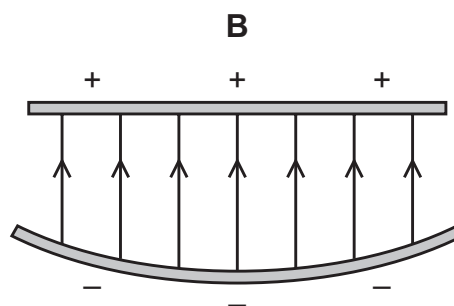
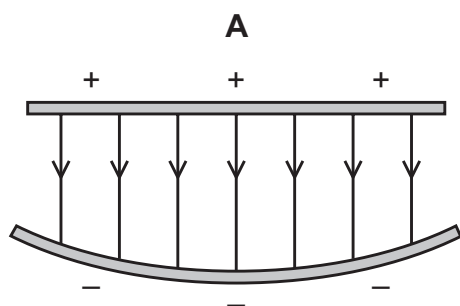


D

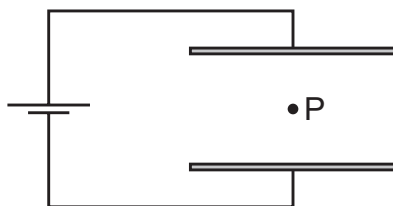


31 A flat plate is positively charged and a curved plate is negatively charged.

Which diagram shows the electric field lines between the two plates?



32 Two parallel metal plates are connected to a d.c. supply, as shown.

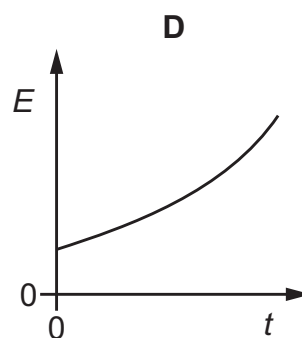
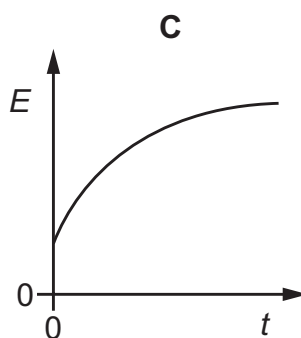
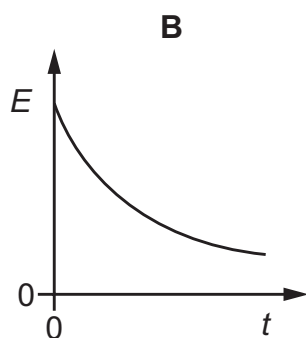
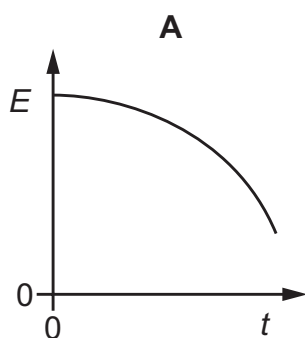


The two plates are moved towards each other at constant speed.

It may be assumed that the electric field between the plates is uniform.

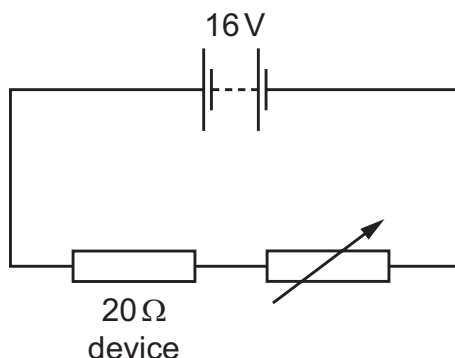
Point P is mid-way between the two plates.

Which graph shows the variation with time t of the electric field strength E at point P?



109. Question | 9702 Oct-Nov 2018 P1 V2 Q34

- 34** An electrical device of fixed resistance $20\ \Omega$ is connected in series with a variable resistor and a battery of electromotive force (e.m.f.) 16 V and negligible internal resistance.



What is the resistance of the variable resistor when the power dissipated in the electrical device is 4.0 W ?

- A** $16\ \Omega$ **B** $36\ \Omega$ **C** $44\ \Omega$ **D** $60\ \Omega$

110. Question | 9702 Oct-Nov 2018 P1 V2 Q35

- 35** A wire of length L has resistance R . The cross-section of the wire is circular with radius r .

A second wire, also of circular cross-section, and of the same material, has resistance $\frac{1}{2}R$.

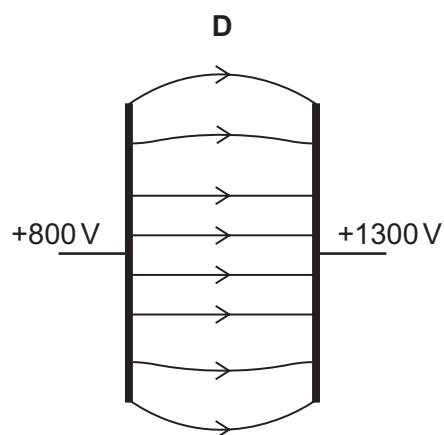
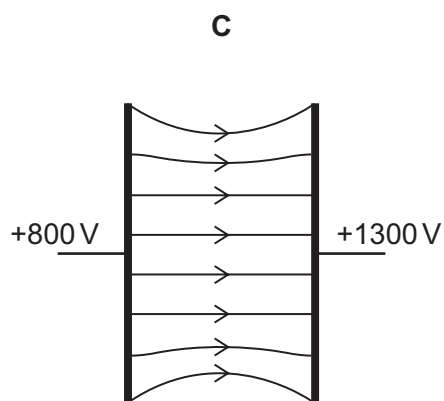
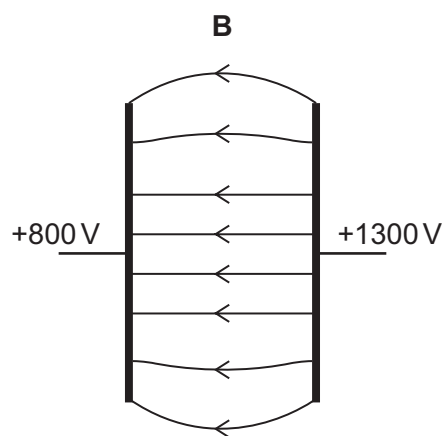
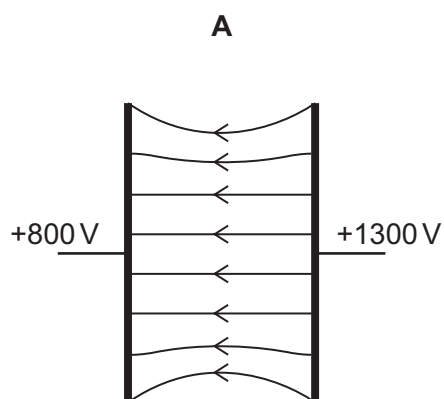
What could be the radius and the length of the second wire?

	radius	length
A	$\frac{r}{2}$	$\frac{L}{2}$
B	$\frac{r}{\sqrt{2}}$	$\frac{L}{2}$
C	$r\sqrt{2}$	$2L$
D	$2r$	$2L$

111. Question | 9702 Oct-Nov 2018 P1 V3 Q30

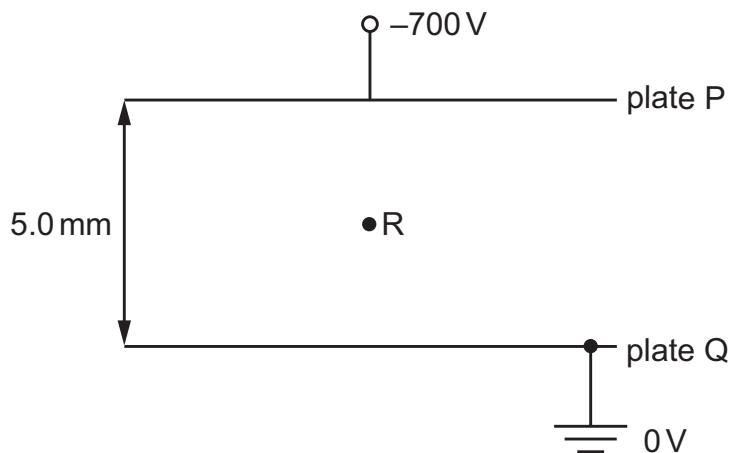
30 Two parallel metal plates are at electric potentials of $+800\text{ V}$ and $+1300\text{ V}$.

Which diagram best represents the electric field between the metal plates?



112. Question | 9702 Oct-Nov 2018 P1 V3 Q31

- 31** The diagram shows two metal plates P and Q. There is a potential difference of 700 V between the plates. Plate Q is earthed.



What is the magnitude and direction of the electric field at point R?

- A** $1.4 \times 10^2 \text{ NC}^{-1}$ from P towards Q
- B** $1.4 \times 10^2 \text{ NC}^{-1}$ from Q towards P
- C** $1.4 \times 10^5 \text{ NC}^{-1}$ from P towards Q
- D** $1.4 \times 10^5 \text{ NC}^{-1}$ from Q towards P

113. Question | 9702 Oct-Nov 2018 P1 V3 Q32

- 32** The current I in a copper wire can be calculated using the equation shown.

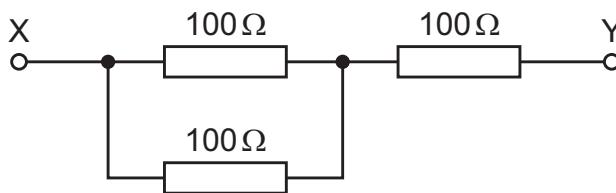
$$I = Anvq$$

What does the symbol v represent?

- A** the average drift velocity of the charge carriers
- B** the instantaneous velocity of the charge carriers
- C** the voltage applied across the wire
- D** the volume of the wire

114. Question | 9702 Oct-Nov 2018 P1 V3 Q33

33 Three resistors are to be connected into a circuit with the arrangement shown.



The power in any resistor must not be greater than $4.0\ \text{W}$.

What is the maximum voltage across XY?

- A** 24 V **B** 30 V **C** 40 V **D** 60 V

115. Question | 9702 Oct-Nov 2018 P1 V3 Q34

34 Gold is sometimes used to make very small connecting wires in electronic circuits.

A particular gold wire has length $2.50 \times 10^{-3}\ \text{m}$ and cross-sectional area $6.25 \times 10^{-8}\ \text{m}^2$. Gold has resistivity $2.30 \times 10^{-8}\ \Omega\ \text{m}$.

What is the resistance of the wire?

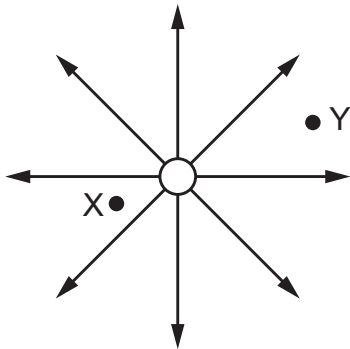
- A** $3.6 \times 10^{-18}\ \Omega$
B $5.8 \times 10^{-13}\ \Omega$
C $9.2 \times 10^{-4}\ \Omega$
D $6.8 \times 10^{-3}\ \Omega$

- 30** Two horizontal parallel plate conductors are separated by a distance of 5.0 mm in air. The lower plate is earthed and the potential of the upper plate is +50 V.

What is the electric field strength E at a point midway between the plates?

- A** $1.0 \times 10^4 \text{ V m}^{-1}$ downwards
- B** $1.0 \times 10^4 \text{ V m}^{-1}$ upwards
- C** $2.0 \times 10^4 \text{ V m}^{-1}$ downwards
- D** $2.0 \times 10^4 \text{ V m}^{-1}$ upwards

31 The diagram shows the electric field near a point charge and two electrons X and Y.



Which row describes the forces acting on X and on Y?

	direction of force	magnitude of force on X
A	radially inwards	less than force on Y
B	radially inwards	greater than force on Y
C	radially outwards	less than force on Y
D	radially outwards	greater than force on Y

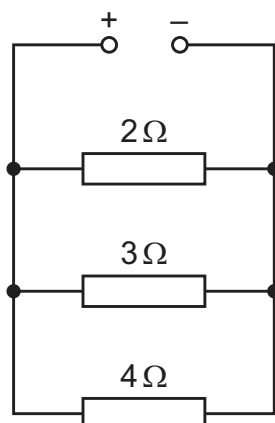
32 The electric current in a wire may be calculated using the equation $I = Anvq$.

Which statement is **not** correct?

- A** n is the number of charge carriers per unit volume of the wire.
- B** nA is the number of charge carriers per unit length of the wire.
- C** q is the charge of each charge carrier.
- D** v is the velocity of each charge carrier.

119. Question | 9702 Feb-March 2019 P1 V2 Q33

33 Three resistors are connected in parallel across a power supply, as shown.



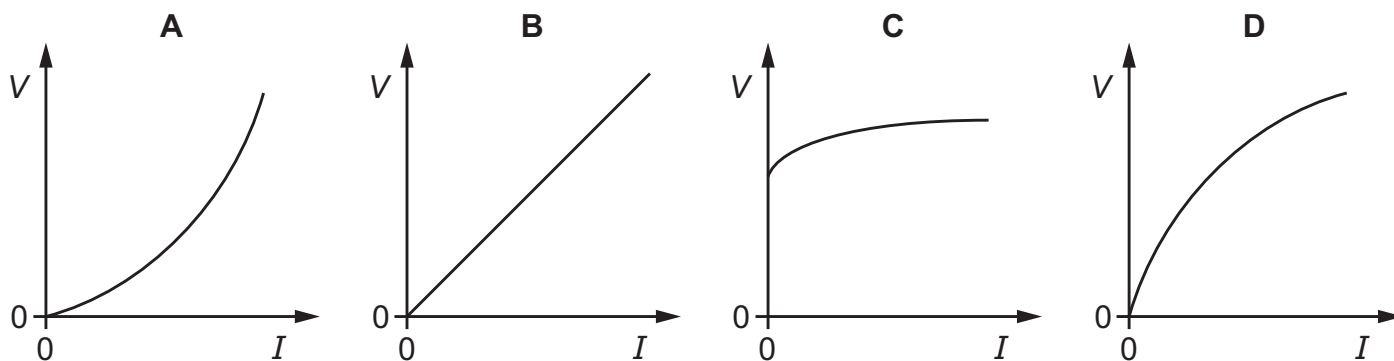
The power dissipated in each of the resistors of resistance 2Ω , 3Ω and 4Ω is P_2 , P_3 and P_4 respectively.

What is the ratio $P_2:P_3:P_4$?

- A** 2:3:4 **B** 4:3:2 **C** 6:4:3 **D** 36:16:9

120. Question | 9702 Feb-March 2019 P1 V2 Q34

34 Which graph shows the variation with current I of the potential difference V of a filament lamp?



121. Question | 9702 Feb-March 2019 P1 V2 Q35

35 A wire of cross-sectional area $5.0 \times 10^{-6} \text{ m}^2$ is made of a metal of resistivity $50 \times 10^{-8} \Omega \text{ m}$.

The potential difference across the wire is 6.0 V and the current is 3.0 A .

What is the length of the wire?

- A** 0.050 m **B** 0.20 m **C** 5.0 m **D** 20 m

122. Question | 9702 May-June 2019 P1 V1 Q8

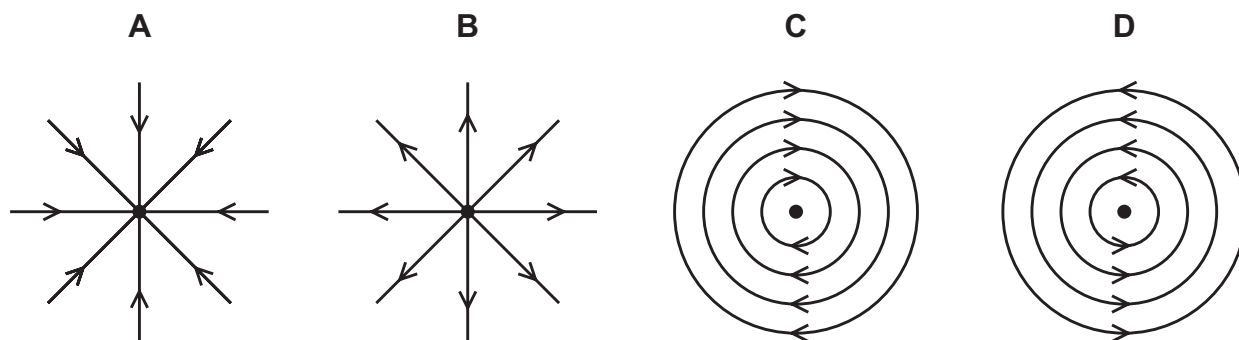
8 A positive charge of $2.6 \times 10^{-8} \text{ C}$ is in a uniform electric field of field strength $300\,000 \text{ V m}^{-1}$.

How much work must be done on the charge in order to move it a distance of 4.0 mm in the opposite direction to the direction of the field?

- A** $3.1 \times 10^{-5} \text{ J}$
B $2.0 \times 10^{-3} \text{ J}$
C $3.1 \times 10^{-2} \text{ J}$
D 2.0 J

123. Question | 9702 May-June 2019 P1 V1 Q31

31 Which diagram shows the pattern of the electric field lines due to a negative point charge?



124. Question | 9702 May-June 2019 P1 V1 Q32

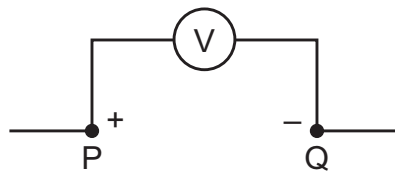
32 In an electrolyte, the electric current is carried by charged particles (ions) in solution.

What is **not** a possible value for the charge on an ion in solution?

- A** $-4.8 \times 10^{-19} \text{ C}$
- B** $+1.6 \times 10^{-19} \text{ C}$
- C** $+3.2 \times 10^{-19} \text{ C}$
- D** $+4.0 \times 10^{-19} \text{ C}$

125. Question | 9702 May-June 2019 P1 V1 Q33

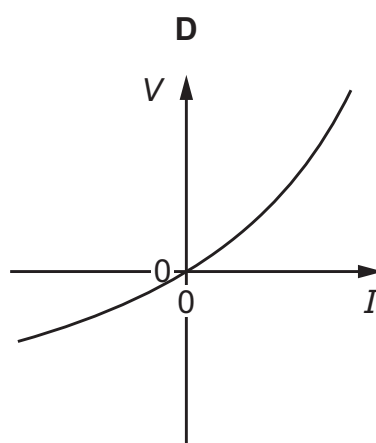
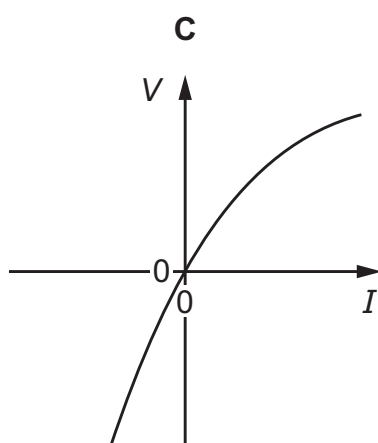
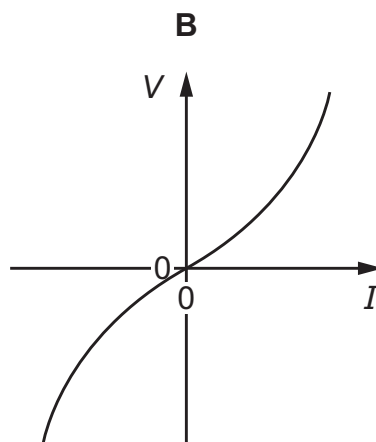
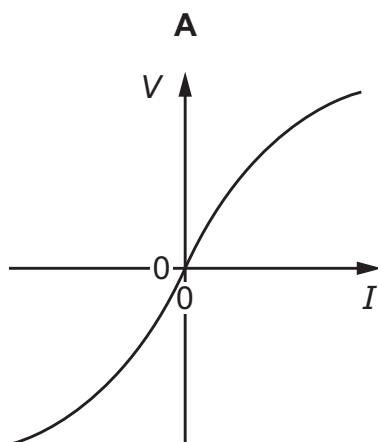
33 A voltmeter connected between two points P and Q in an electrical circuit shows a reading of 1 V.



Which statement is correct?

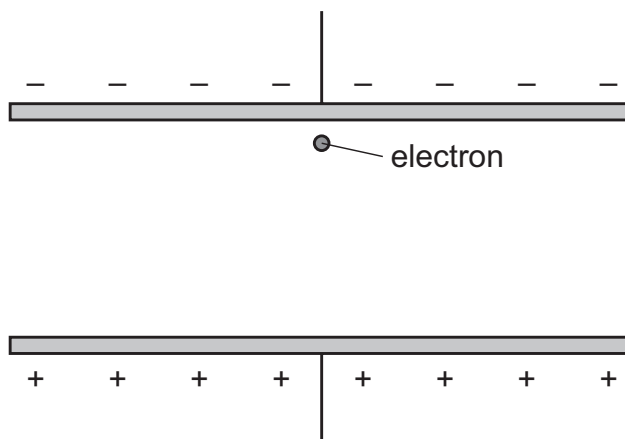
- A** The energy needed to move +1 C of charge from P to Q is 1 J.
- B** The energy needed to move +1 C of charge from Q to P is 1 J.
- C** The energy needed to move one electron from P to Q is 1 J.
- D** The energy needed to move one electron from Q to P is 1 J.

- 34** Which graph best represents the variation with current I of potential difference V for a filament lamp?



127. Question | 9702 May-June 2019 P1 V2 Q32

32 An electron is situated in a vacuum between two charged plates, as shown.

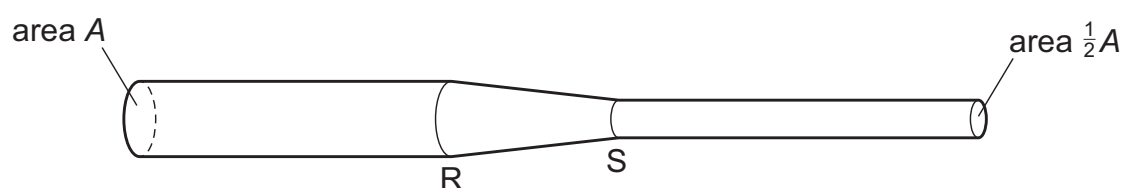


Which statement describes the motion of the electron due to the uniform electric field?

- A** It moves downwards with a constant acceleration.
- B** It moves downwards with zero acceleration.
- C** It moves upwards with a constant acceleration.
- D** It moves upwards with a decreasing acceleration.

128. Question | 9702 May-June 2019 P1 V2 Q33

33 A length of wire is connected into a circuit.



The area of the cross-section of the wire changes from A at R to $\frac{1}{2}A$ at S .

There is a constant current in the wire. Charge Q passes R in time t .

What is the charge passing point S in the same time t ?

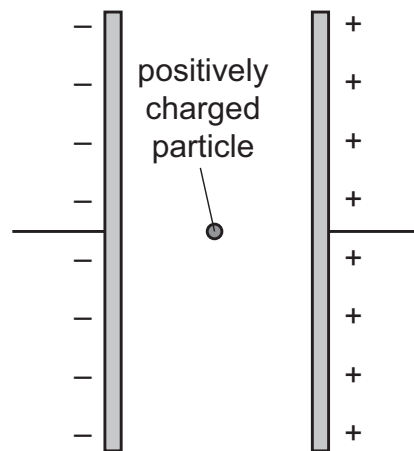
- A** $\frac{1}{2}Q$
- B** Q
- C** $Q\sqrt{2}$
- D** $2Q$

34 Four wires are made of the same metal. The cross-sectional areas, lengths and thermodynamic temperatures of the wires are shown.

Which wire has the largest resistance?

	cross-sectional area	length	temperature
A	A	$2L$	$2T$
B	A	L	T
C	$2A$	$2L$	$2T$
D	$2A$	L	T

- 10** A uniform electric field is created by two parallel vertical plates. A positively charged particle is in the vacuum between the plates, as shown.

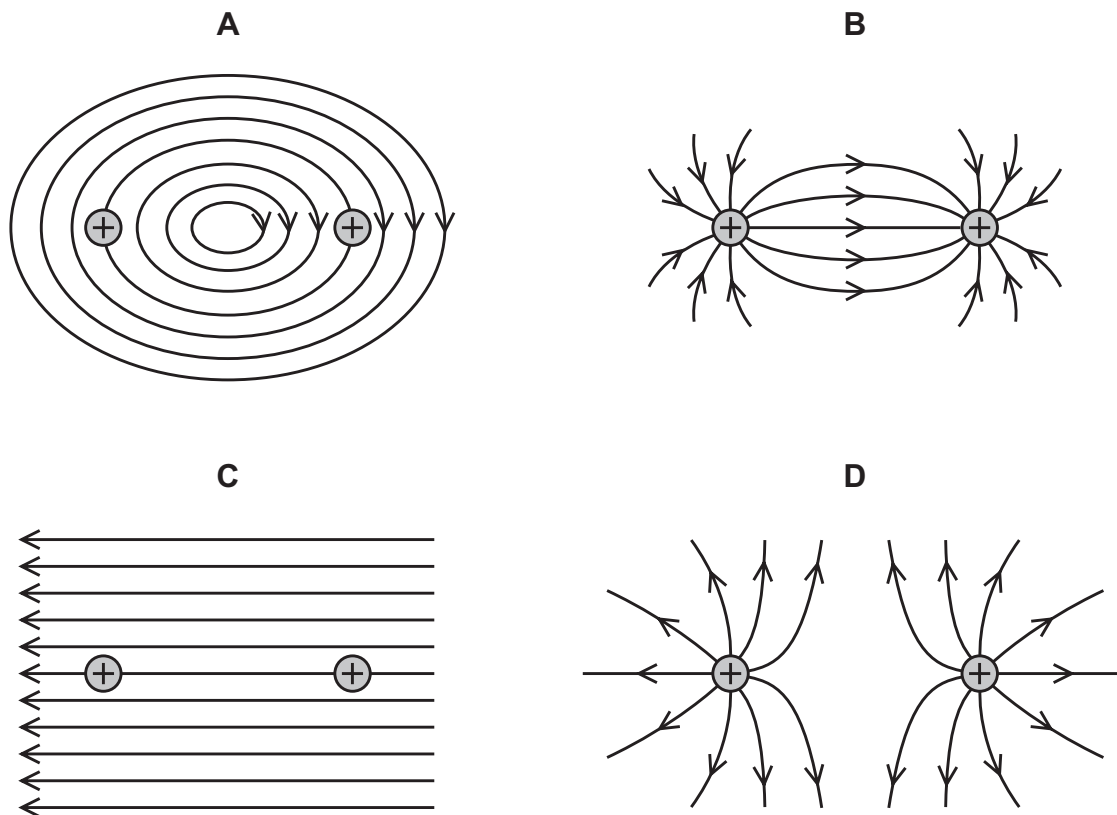


Which statement is correct?

- A** The electric field makes the particle move towards the negative plate with a constant speed.
- B** The electric field makes the particle move towards the negative plate with a constant acceleration.
- C** The electric field produces a uniform rate of decrease in the particle's acceleration.
- D** The electric field produces a uniform rate of increase in the particle's acceleration.

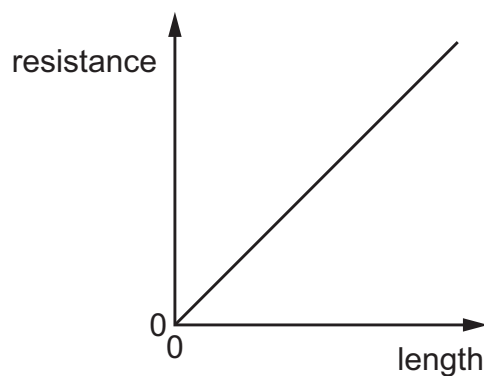
131. Question | 9702 May-June 2019 P1 V3 Q31

- 31** Which diagram represents the electric field line pattern due to a combination of two positive charges?



132. Question | 9702 May-June 2019 P1 V3 Q33

- 33** The graph shows the variation with length of the resistance of a uniform metal wire.



The gradient of the graph is G .
The wire has cross-sectional area A .

Which expression could be used to calculate the resistivity of the metal of the wire?

- A** $G \times A$ **B** $\frac{G}{A}$ **C** $\frac{A}{G}$ **D** $G \times A^2$

133. Question | 9702 May-June 2019 P1 V3 Q35

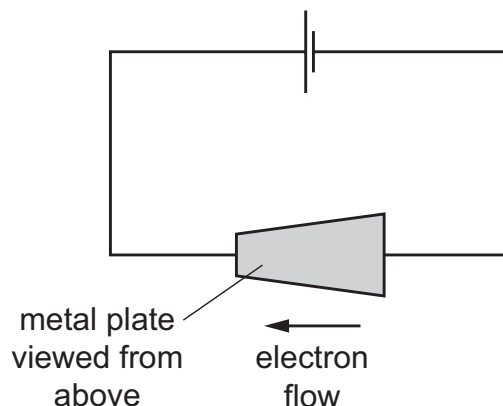
35 A wire supplying a shower heater with a current of 35 A has a resistance of $25\text{ m}\Omega$.

What is the power dissipated in the wire?

- A** 31 W **B** 49 W **C** 31 kW **D** 49 kW

134. Question | 9702 Oct-Nov 2019 P1 V1 Q30

30 A metal plate of uniform thickness is connected to a cell as shown.



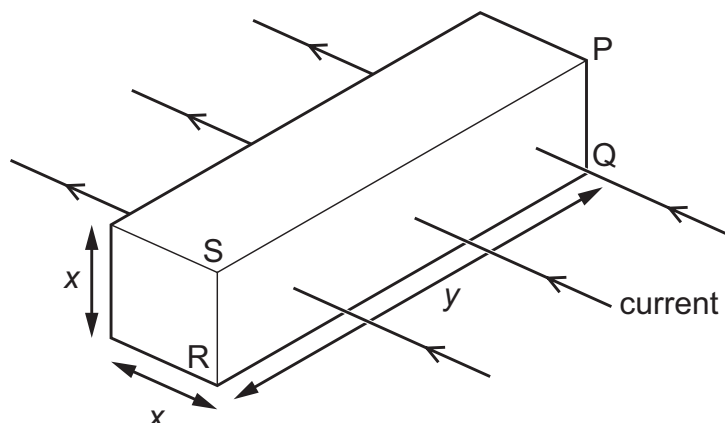
Electrons move clockwise around the circuit.

Which statement about the metal plate is correct?

- A** The average drift speed of the conduction electrons decreases as they move from right to left through the plate.
- B** The average drift speed of the conduction electrons increases as they move from right to left through the plate.
- C** The number density of the conduction electrons decreases from right to left through the plate.
- D** The number density of the conduction electrons increases from right to left through the plate.

135. Question | 9702 Oct-Nov 2019 P1 V1 Q31

- 31** The diagram shows the direction of the current in a metal block. The charge carriers enter the block through the face PQRS and leave the block through the opposite face.



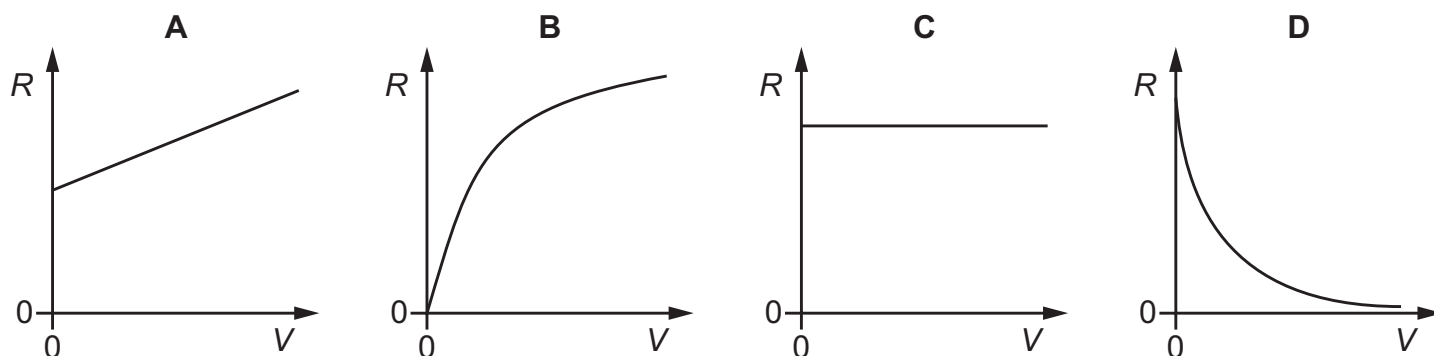
The number density of charge carriers is n . Each charge carrier has charge e . The average drift speed of the charge carriers is v .

Which expression gives the current in the block?

- A** $envx^2$ **B** $envxy$ **C** $envx^3y^2$ **D** $envx^4y$

136. Question | 9702 Oct-Nov 2019 P1 V1 Q33

- 33** Which graph could show how the resistance R of a filament lamp varies with the applied potential difference (p.d.) V , as V is increased to the normal operating p.d.?



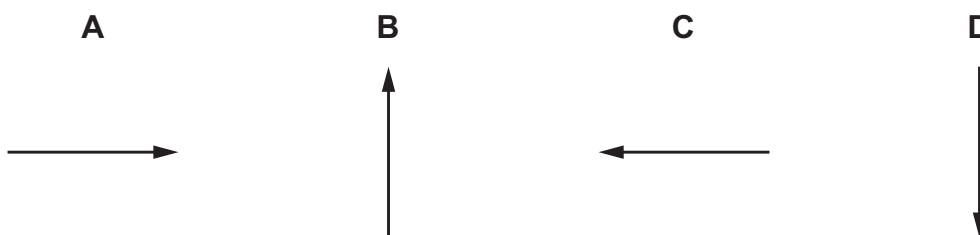
137. Question | 9702 Oct-Nov 2019 P1 V2 Q29

29 P is a point near to charge X as shown.



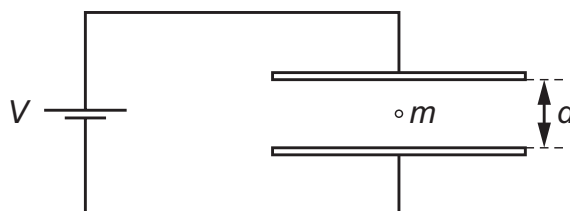
When a negatively charged test charge is placed at point P, it is found to experience a force of repulsion from X that is radially away from X.

Which arrow correctly shows the direction of the electric field at point P due to the charge X?



138. Question | 9702 Oct-Nov 2019 P1 V2 Q30

30 A charged oil drop of mass m , with n excess electrons, is held stationary in the uniform electric field between two horizontal plates separated by a distance d .



The voltage between the plates is V , the elementary charge is e and the acceleration of free fall is g .

What is the value of n ?

- A** $\frac{eV}{mgd}$
 B $\frac{mgd}{eV}$
 C $\frac{meV}{gd}$
 D $\frac{gd}{meV}$

139. Question | 9702 Oct-Nov 2019 P1 V2 Q31

- 31** When the current in a wire is 5.0 A, the average drift speed of the conduction electrons in the wire is $7.4 \times 10^{-4} \text{ m s}^{-1}$.

Which row gives a possible cross-sectional area and number of conduction electrons per unit volume for this wire?

	cross-sectional area / m^2	number of conduction electrons per unit volume / m^{-3}
A	7.2×10^{-7}	1.2×10^{28}
B	7.2×10^{-7}	5.9×10^{28}
C	2.3×10^{-6}	7.3×10^{26}
D	2.3×10^{-6}	3.7×10^{27}

140. Question | 9702 Oct-Nov 2019 P1 V2 Q32

- 32** A fixed resistor of resistance 12Ω is connected to a battery. There is a current of 0.20 A in the resistor. The current is now doubled.

What is the new power dissipated in the resistor?

- A** 0.48 W **B** 0.96 W **C** 1.9 W **D** 4.8 W

141. Question | 9702 Oct-Nov 2019 P1 V2 Q33

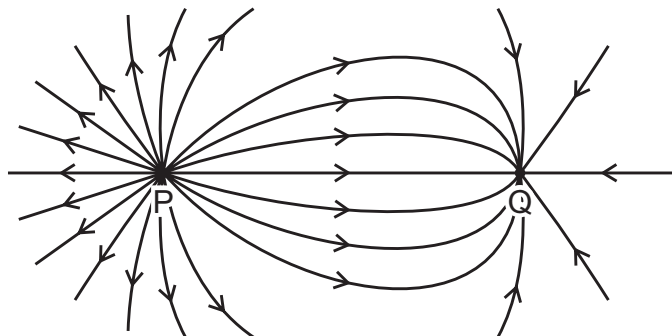
- 33** There is a current in a resistor for an unknown time.

Which two quantities can be used to calculate the energy dissipated by the resistor?

- A** the current in the resistor and the potential difference across the resistor
B the resistance of the resistor and the current in the resistor
C the total charge passing through the resistor and the potential difference across the resistor
D the total charge passing through the resistor and the resistance of the resistor

142. Question | 9702 Oct-Nov 2019 P1 V3 Q31

- 31** The diagram shows the electric field pattern between two opposite and unequal point charges P and Q.

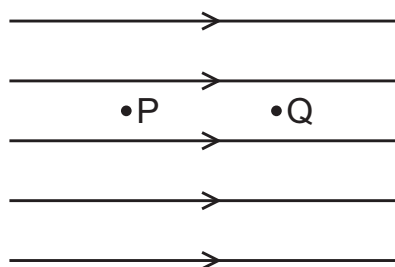


Which statement about the charges is correct?

- A** P is negatively charged and has a smaller charge than Q.
- B** P is negatively charged and has a greater charge than Q.
- C** P is positively charged and has a smaller charge than Q.
- D** P is positively charged and has a greater charge than Q.

143. Question | 9702 Oct-Nov 2019 P1 V3 Q32

- 32** A uniform electric field is represented by five horizontal field lines.



P and Q are two points in the field. The field causes a positively charged particle in a vacuum to move from P to Q.

Which statement must be correct?

- A** The acceleration of the particle between P and Q is increasing.
- B** The kinetic energy of the particle at P is the same as the kinetic energy of the particle at Q.
- C** The force on the particle at Q is greater than the force on the particle at P.
- D** Work is done on the particle as it moves from P to Q.

144. Question | 9702 Oct-Nov 2019 P1 V3 Q33

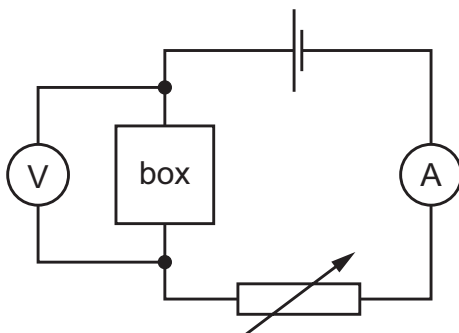
- 33** A metal electrical conductor has a resistance of $5.6\text{ k}\Omega$. A potential difference (p.d.) of 9.0 V is applied across its ends.

How many electrons pass a point in the conductor in one minute?

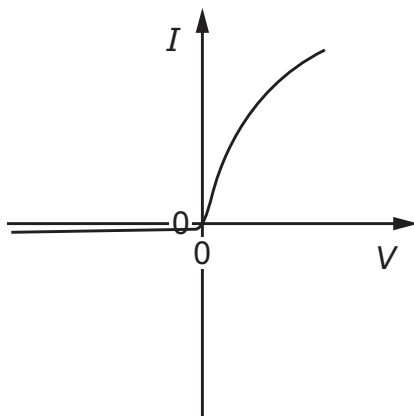
- A** 6.0×10^{20} **B** 1.0×10^{19} **C** 6.0×10^{17} **D** 1.0×10^{16}

145. Question | 9702 Oct-Nov 2019 P1 V3 Q35

- 35** A box containing two electrical components is connected into a circuit.



The variable resistor is adjusted and measurements are taken to determine the I – V characteristic for the box, as shown.

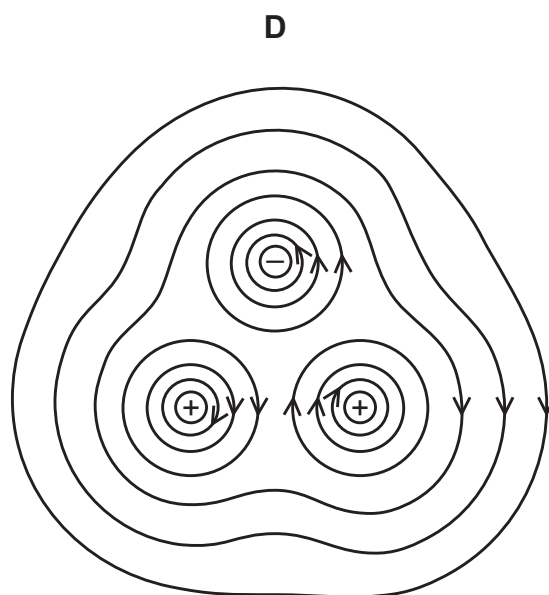
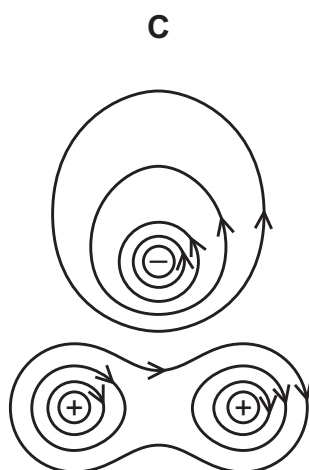
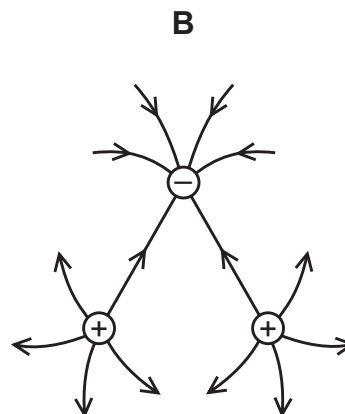
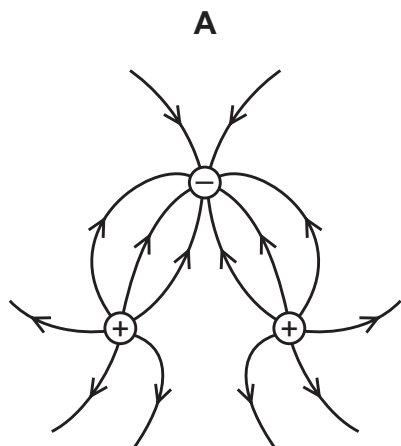


Which arrangement of two electrical components in the box would create the best fit to the measured I – V characteristic?

- A** a filament lamp and a fixed resistor in parallel
B a filament lamp and a fixed resistor in series
C a semiconductor diode and a filament lamp in parallel
D a semiconductor diode and a filament lamp in series

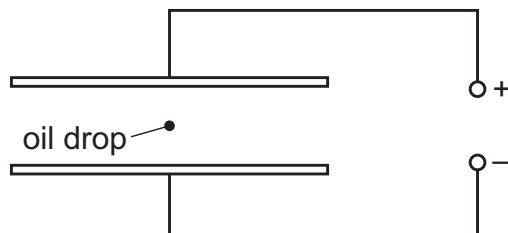
- 30** Two positive charges and one negative charge, all of equal magnitude, are set at the corners of an equilateral triangle.

Which diagram represents the electric field surrounding the charges?



147. Question | 9702 Feb-March 2020 P1 V2 Q31

- 31** A negatively charged oil drop is held stationary, equidistant between two plates connected to a high voltage supply, as shown.



Which change would **not** increase the upward electrical force on the drop?

- A** decreasing the distance between the plates whilst keeping the drop equidistant from them
- B** increasing the amount of negative charge on the drop
- C** increasing the supply voltage
- D** moving the drop closer to the positive plate

148. Question | 9702 Feb-March 2020 P1 V2 Q32

- 32** Electrons move in a vacuum from one metal plate to another metal plate. As a result of this, there is an electric current of $48\ \mu\text{A}$ between the two plates.

How many electrons are emitted by the first plate in a time of 5.0 minutes?

- A** 1.4×10^4 **B** 1.5×10^{15} **C** 1.8×10^{16} **D** 9.0×10^{16}

149. Question | 9702 Feb-March 2020 P1 V2 Q34

- 34** A manufacturer recommends that the longer the extension cord you use with an electric drill, the bigger the cross-sectional area of the cord should be.

What is a reason for this recommendation?

- A** Resistance is inversely proportional to both the length and the cross-sectional area.
- B** Resistance is inversely proportional to the length and directly proportional to the cross-sectional area.
- C** Resistance is proportional to both the length and the cross-sectional area.
- D** Resistance is proportional to the length and inversely proportional to the cross-sectional area.

150. Question | 9702 May-June 2020 P1 V1 Q31

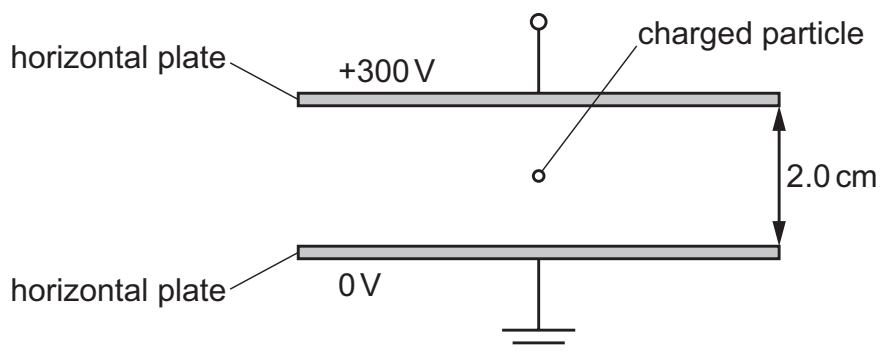
- 31** A small charge q is placed in the electric field of a large charge Q .

Both charges experience a force F .

What is the electric field strength of the charge Q at the position of the charge q ?

- A** $\frac{F}{Qq}$ **B** $\frac{F}{Q}$ **C** FqQ **D** $\frac{F}{q}$

32 A charged particle is in a vacuum between two horizontal metal plates as shown.



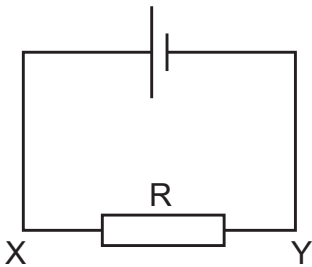
The acceleration of the particle is $7.15 \times 10^{11} \text{ ms}^{-2}$ downwards. The particle has a mass of $3.34 \times 10^{-27} \text{ kg}$.

What is the charge on the particle?

- A** $+1.6 \times 10^{-19} \text{ C}$
- B** $-1.6 \times 10^{-19} \text{ C}$
- C** $+1.6 \times 10^{-17} \text{ C}$
- D** $-1.6 \times 10^{-17} \text{ C}$

152. Question | 9702 May-June 2020 P1 V1 Q33

33 The current in the circuit shown is 3.2 mA.

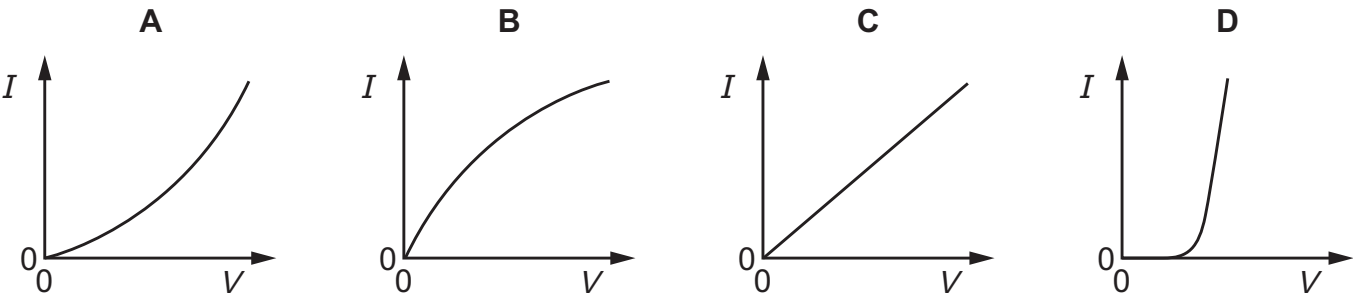


What are the direction of flow and the rate of flow of electrons through the resistor R?

	direction of flow	rate of flow / s ⁻¹
A	X to Y	2.0×10^{16}
B	X to Y	5.1×10^{-22}
C	Y to X	2.0×10^{16}
D	Y to X	5.1×10^{-22}

153. Question | 9702 May-June 2020 P1 V1 Q34

34 Which graph best represents the way the current I through a filament lamp varies with the potential difference V across it?



154. Question | 9702 May-June 2020 P1 V1 Q35

- 35** A cylindrical metal wire X has resistance R . The same volume of the same metal is made into a cylindrical wire Y of double the length.

What is the resistance of wire Y?

- A** R **B** $2R$ **C** $4R$ **D** $8R$

37 Three identical resistors can be connected together in four different ways.

The resistances of two of these combinations are $4.0\,\Omega$ and $9.0\,\Omega$.

What is the resistance of each individual resistor?

A $3.0\,\Omega$

B $6.0\,\Omega$

C $12\,\Omega$

D $18\,\Omega$

156. Question | 9702 May-June 2020 P1 V2 Q3

- 3** A galvanometer of resistance $5\ \Omega$ is to be used in a null method.

In order to protect the galvanometer from damage due to an excessive initial current, resistors of resistance $0.5\ \Omega$ and $1\ \text{k}\Omega$ are available.

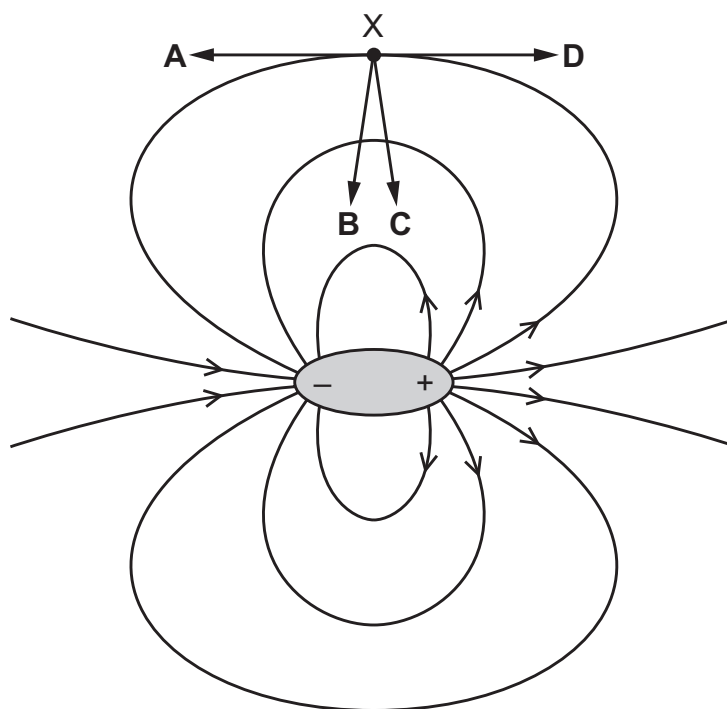
Which arrangement would provide this protection?

- A** the $0.5\ \Omega$ resistor in series with the galvanometer
- B** the $0.5\ \Omega$ resistor in parallel with the galvanometer and this combination placed in series with the $1\ \text{k}\Omega$ resistor
- C** the $1\ \text{k}\Omega$ resistor in parallel with the galvanometer
- D** the $1\ \text{k}\Omega$ resistor in parallel with the galvanometer and this combination placed in series with the $0.5\ \Omega$ resistor

157. Question | 9702 May-June 2020 P1 V2 Q31

- 31** A dipole is a pair of charges of equal magnitude, one negative and one positive. The electric field of a dipole is shown below.

In which direction does the force act on an electron when at point X?



158. Question | 9702 May-June 2020 P1 V2 Q32

- 32** A charged oil droplet of mass m is falling, initially freely, in a vacuum between two horizontal metal plates that are separated by a distance x .

A potential difference (p.d.) V is then applied across the plates. This results in the oil droplet continuing to accelerate downwards but with a reduced acceleration a .

The polarity of the applied p.d. is then reversed so that the direction of the electric force on the droplet is reversed. This results in the downwards acceleration of the oil droplet increasing to $3a$.

What is the magnitude of the charge on the oil droplet?

- A** $\frac{max}{V}$ **B** $2\frac{max}{V}$ **C** $3\frac{max}{V}$ **D** $4\frac{max}{V}$

159. Question | 9702 May-June 2020 P1 V2 Q33

- 33** The number density of free electrons in copper is $8.0 \times 10^{28} \text{ m}^{-3}$.

A copper wire has diameter 0.42 mm.

What is the average drift speed of the free electrons in the wire when the current in the wire is 0.57 A?

- A** $8.0 \times 10^{-11} \text{ m s}^{-1}$
B $3.2 \times 10^{-10} \text{ m s}^{-1}$
C $8.0 \times 10^{-5} \text{ m s}^{-1}$
D $3.2 \times 10^{-4} \text{ m s}^{-1}$

160. Question | 9702 May-June 2020 P1 V2 Q34

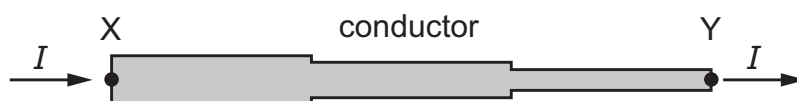
- 34** An electric kettle is rated at 2.0 kW, which describes the power supplied to the heating coil in the kettle.

The coil has a resistance of 5.0 k Ω .

What is the current in the coil?

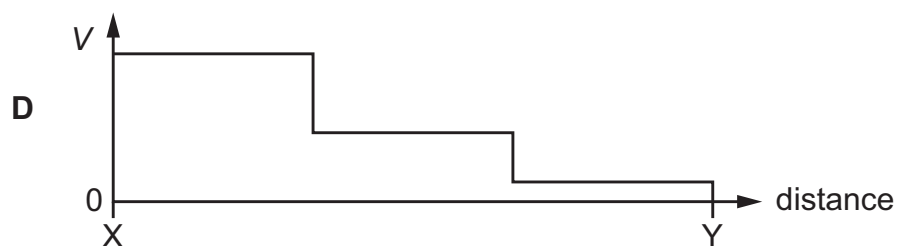
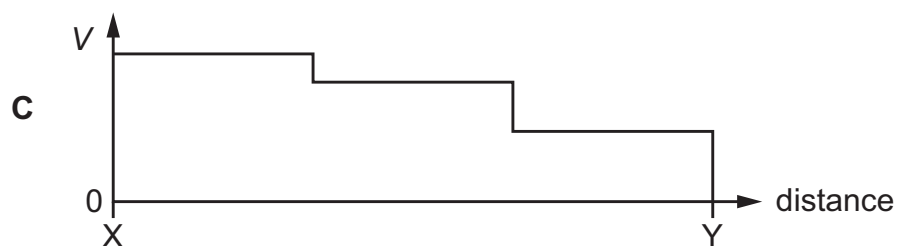
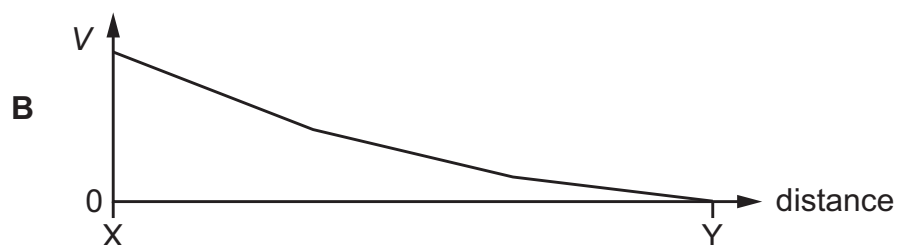
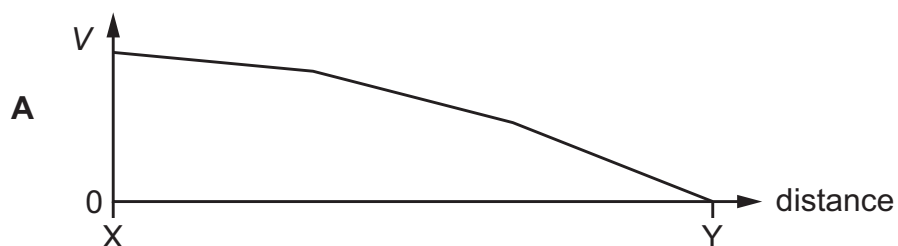
- A** 0.40 A **B** 0.63 A **C** 1.6 A **D** 2.5 A

- 35** A conductor consists of three wires connected in series. The wires are all made of the same metal but have different cross-sectional areas. There is a current I in the conductor.



Point Y on the conductor is at zero potential.

Which graph best shows the variation of potential V with distance along the conductor?

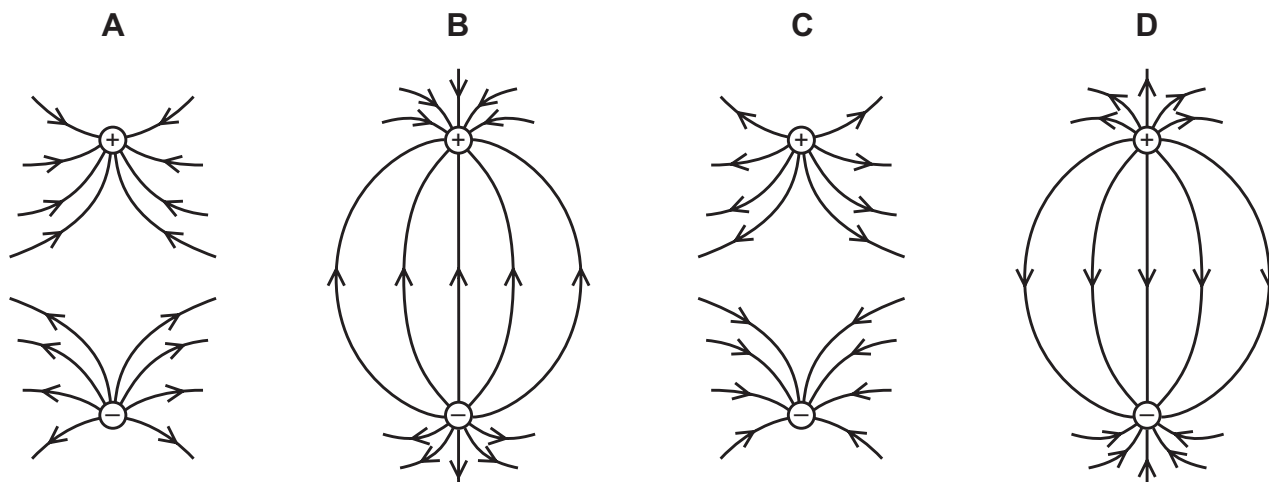


37 Kirchhoff's first and second laws link to the conservation of physical quantities.

Which quantities do they link to?

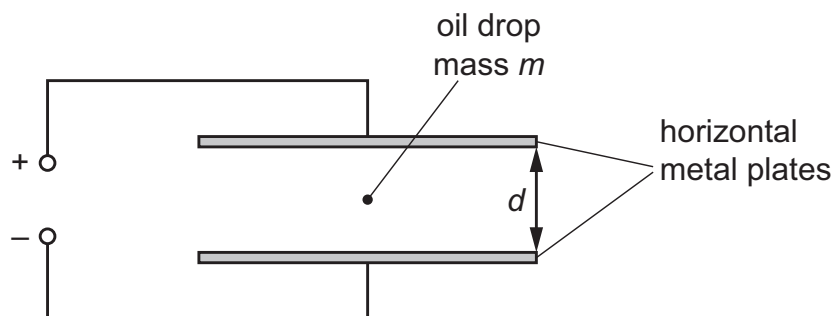
	first law	second law
A	charge	energy
B	charge	momentum
C	energy	charge
D	energy	momentum

- 31** Which diagram best represents the electric field between two point charges of equal magnitude and opposite sign?



164. Question | 9702 May-June 2020 P1 V3 Q32

- 32** A negatively charged oil drop of mass m is between two horizontal parallel metal plates a distance d apart.



When the potential difference (p.d.) between the plates is V_1 the oil drop rises at a constant speed. When the p.d. is decreased to a value V_2 the oil drop falls at the same constant speed.

Air resistance acts on the drop when it is moving. The upthrust on the drop is negligible.

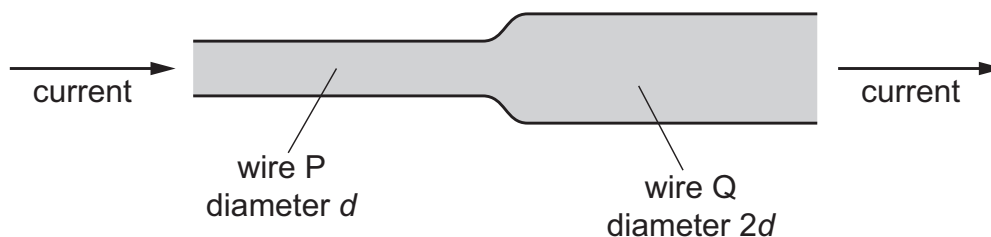
The acceleration of free fall is g .

What is the charge on the oil drop?

- A** $\frac{mdg}{V_1 - V_2}$ **B** $\frac{mdg}{V_1 + V_2}$ **C** $\frac{2mdg}{V_1 - V_2}$ **D** $\frac{2mdg}{V_1 + V_2}$

165. Question | 9702 May-June 2020 P1 V3 Q34

- 34** Two copper wires are joined together and carry a current, as shown.



Wire P has diameter d and wire Q has diameter $2d$.

What is the ratio $\frac{\text{average drift speed of the free electrons in wire P}}{\text{average drift speed of the free electrons in wire Q}}$?

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

- 36** The wire of a heating element has resistance R . The wire breaks and is replaced by a different wire.

Data for the original wire and for the replacement wire are shown in the table.

	length	diameter	resistivity of metal
original wire	l	d	ρ
replacement wire	l	$2d$	2ρ

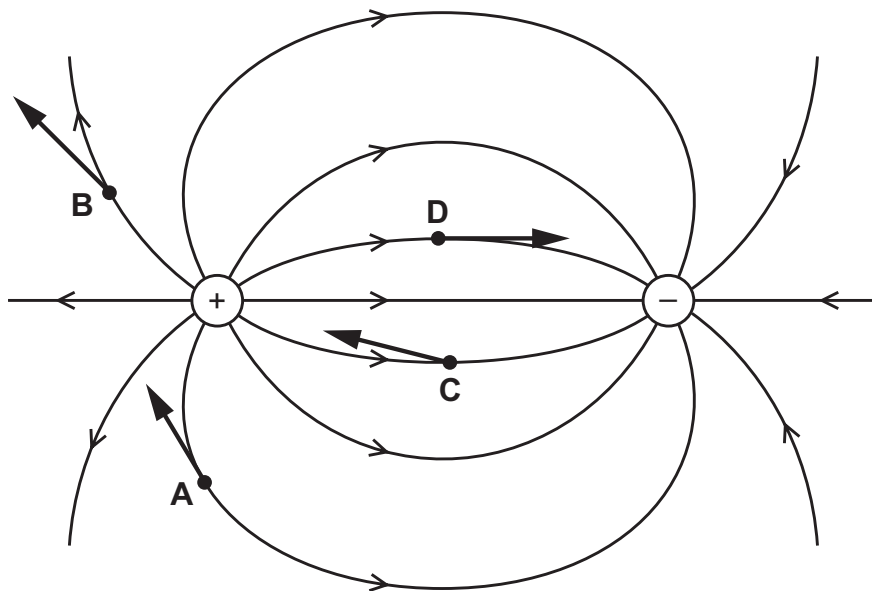
What is the resistance of the replacement wire?

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

- 30** The diagram shows the electric field near a positively charged sphere and a negatively charged sphere.

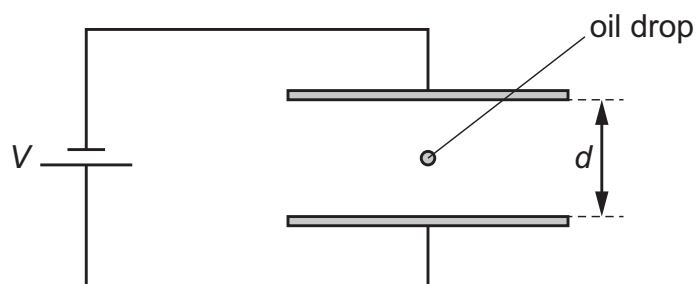
Four electrons **A**, **B**, **C** and **D** are shown at different positions in the field.

On which electron is the direction of the force on the electron shown correctly?



168. Question | 9702 Oct-Nov 2020 P1 V1 Q31

- 31** An oil drop has mass m and charge q . The drop is held stationary in an electric field between two parallel horizontal plates, a distance d apart, as shown.



The potential difference between the plates is V and the acceleration of free fall is g .

What is the charge-to-mass ratio $\frac{q}{m}$ of the oil drop?

- A** $\frac{gd}{V}$ **B** $\frac{V}{dg}$ **C** $\frac{gV}{d}$ **D** $\frac{d}{Vg}$

169. Question | 9702 Oct-Nov 2020 P1 V1 Q32

- 32** Free electrons flow along a copper wire X of radius $5.0 \times 10^{-5} \text{ m}$ with an average drift speed of $2.8 \times 10^{-2} \text{ m s}^{-1}$. The current in the wire is 3.0 A .

There is a current of 2.0 A in a copper wire Y of radius $1.0 \times 10^{-4} \text{ m}$.

What is the average drift speed of the free electrons in copper wire Y?

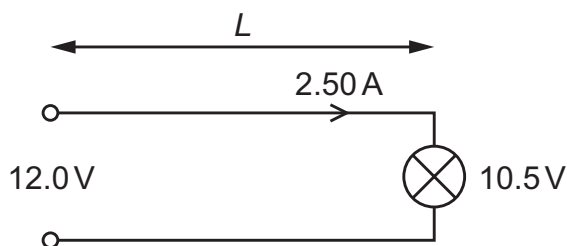
- A** $4.7 \times 10^{-3} \text{ m s}^{-1}$
B $9.3 \times 10^{-3} \text{ m s}^{-1}$
C $1.1 \times 10^{-2} \text{ m s}^{-1}$
D $1.9 \times 10^{-2} \text{ m s}^{-1}$

170. Question | 9702 Oct-Nov 2020 P1 V1 Q33

- 33** What is the definition of potential difference?
- A** power per unit current
 - B** product of current and resistance
 - C** product of electric field strength and distance
 - D** work done per unit charge

171. Question | 9702 Oct-Nov 2020 P1 V1 Q34

- 34** A cable of length L consisting of two wires is used to connect a 12.0 V power supply of negligible internal resistance to a lamp, as shown.



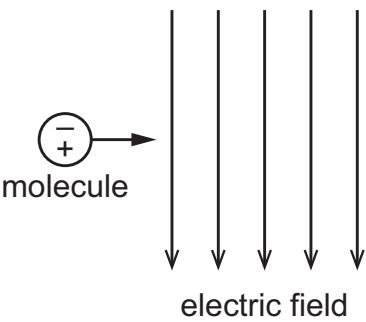
The potential difference across the lamp is 10.5 V. The current in the wire is 2.50 A.

Each wire is made of metal of resistivity $1.70 \times 10^{-8} \Omega \text{ m}$ and has a cross-sectional area of $6.00 \times 10^{-7} \text{ m}^2$.

What is the length L of the cable?

- A** 10.6 m **B** 21.2 m **C** 29.4 m **D** 58.8 m

31 A molecule behaves as an electric ‘dipole’ consisting of two equal point charges of opposite sign, separated by a fixed distance. The molecule moves with constant horizontal velocity as it enters a vertical uniform electric field, as shown.



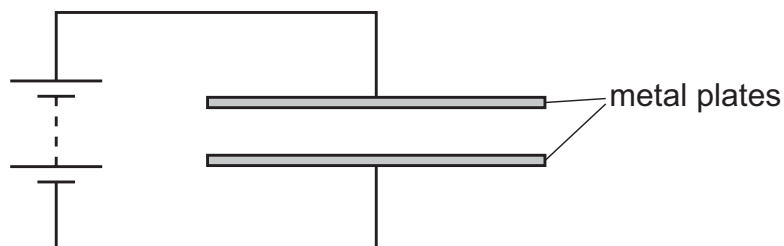
The positive and negative charges of the molecule enter the field at the same time.

What describes the effect of the electric field on the velocity of the molecule?

	horizontal component of velocity	vertical component of velocity
A	constant	increases
B	constant	zero
C	increases	increases
D	increases	zero

173. Question | 9702 Oct-Nov 2020 P1 V2 Q32

- 32** Two parallel metal plates are connected to a battery of negligible internal resistance.



One of the plates is slowly moved towards the other.

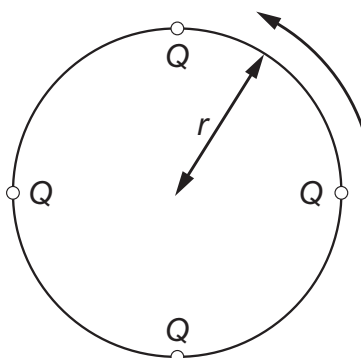
Which row is correct?

	electric field strength between the plates	potential difference between the plates
A	decreases	constant
B	increases	constant
C	decreases	increases
D	increases	increases

174. Question | 9702 Oct-Nov 2020 P1 V2 Q33

- 33** Four point charges, each of charge Q , are placed on the edge of an insulating disc of radius r .

The disc rotates at a rate of n revolutions per unit time.

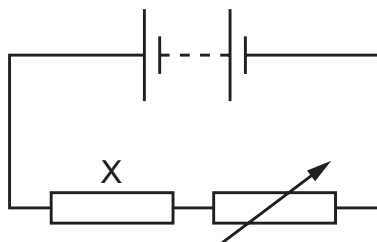


What is the equivalent electric current at the edge of the disc?

- A** $4Qn$ **B** $\frac{4Q}{n}$ **C** $8\pi rQn$ **D** $\frac{2Qn}{\pi r}$

175. Question | 9702 Oct-Nov 2020 P1 V2 Q34

- 34** In the circuit shown, a fixed resistor X is connected in series with a battery and a variable resistor.



The power dissipated in resistor X is 7.2 W when a current of 3.0 A passes through it.

The variable resistor is adjusted so that the power dissipated in X increases by 50%.

What is the new current in the circuit?

- A** 2.4 A **B** 3.7 A **C** 4.5 A **D** 14 A

176. Question | 9702 Oct-Nov 2020 P1 V3 Q31

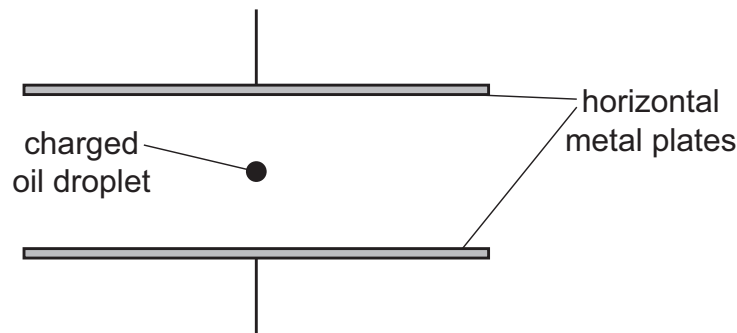
- 31** A stationary particle is in an electric field.

The only force on the particle is that from the electric field.

In which case is the electric field strength $5.0 \times 10^5 \text{ V m}^{-1}$?

- A** a force of $1.6 \times 10^{-14} \text{ N}$ acting on an electron
B a force of $3.2 \times 10^{-14} \text{ N}$ acting on an alpha-particle
C a force of $8.0 \times 10^{-14} \text{ N}$ acting on an alpha-particle
D a force of $8.0 \times 10^{-14} \text{ N}$ acting on a proton

32 A constant potential difference is applied between two horizontal metal plates. A charged oil droplet is held stationary by the electric field between the plates.



As some of the oil evaporates, the droplet loses mass and starts to accelerate. Its charge remains constant.

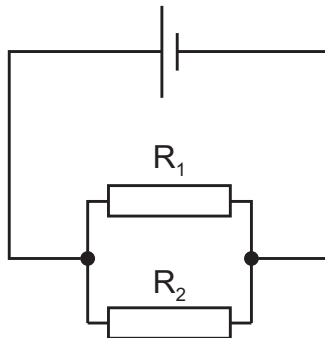
In which direction does the droplet accelerate, and which change needs to be made to the separation of the plates in order to stop this acceleration?

	direction of acceleration	separation of the plates
A	downwards	decrease
B	downwards	increase
C	upwards	decrease
D	upwards	increase

178. Question | 9702 Oct-Nov 2020 P1 V3 Q33

33 Two resistors R_1 and R_2 are made from wire of the same material.

They are connected in parallel to each other in a circuit, as shown.



The diameter of R_2 is half the diameter of R_1 .

The resistance of R_2 is three times the resistance of R_1 .

What is the value of the ratio $\frac{\text{average drift speed of free electrons in } R_1}{\text{average drift speed of free electrons in } R_2}$?

A $\frac{3}{2}$

B $\frac{3}{4}$

C $\frac{1}{6}$

D $\frac{1}{12}$

179. Question | 9702 Oct-Nov 2020 P1 V3 Q34

34 A student describes potential difference as the energy transferred per unit charge.

Which statement about the energy transfer is correct?

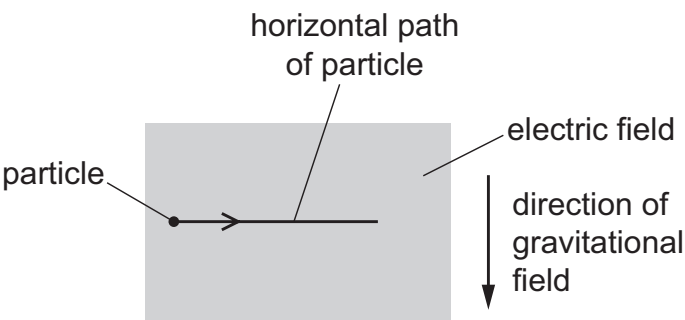
A It is from electrical energy into other forms.

B It is from other forms into electrical energy.

C It only takes place inside a power supply.

D It only takes place inside resistors.

11 A particle with mass moves in a horizontal straight line through a uniform electric field in a vacuum. The electric field is vertical.

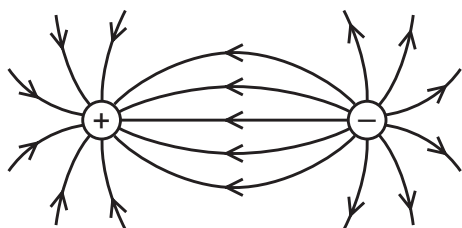
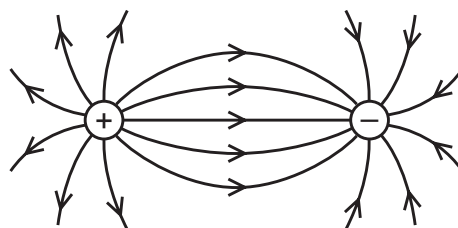
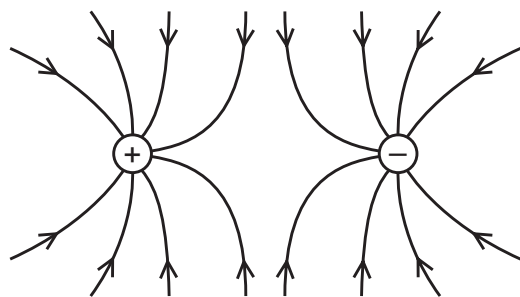
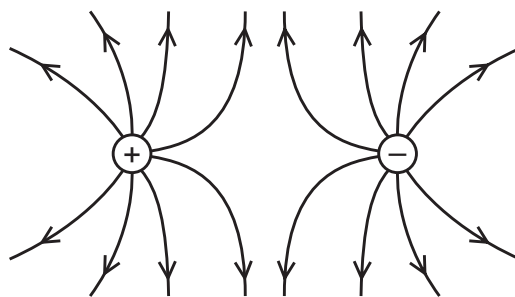


There is a significant gravitational effect on the motion of the particle.

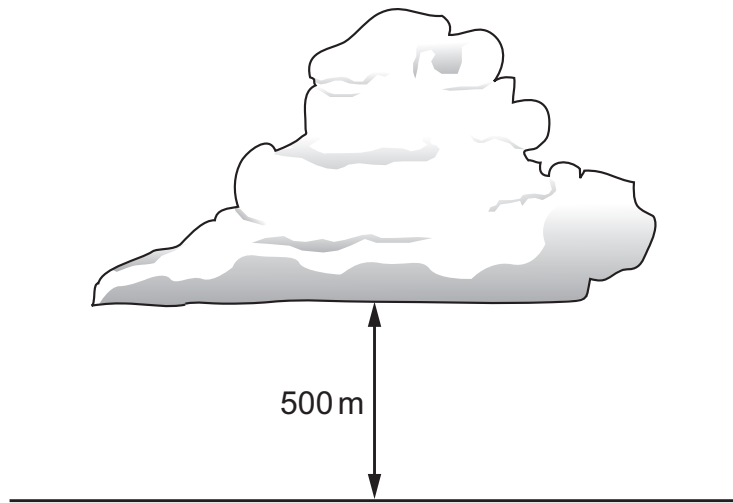
What could be the direction of the electric field and the sign of the charge, if any, on the particle?

	electric field direction	sign of charge
A	downwards	negative
B	downwards	positive
C	upwards	negative
D	upwards	no charge

- 30** Which diagram best represents the field lines in the electric field produced by a combination of one point positive charge and one point negative charge?

A**B****C****D**

- 31** The diagram shows a thundercloud whose base is 500 m above the ground.



The potential difference between the base of the cloud and the ground is 200 MV. A raindrop with a charge of $4.0 \times 10^{-12} \text{ C}$ is in the region between the cloud and the ground.

What is the electrical force on the raindrop?

- A** $1.6 \times 10^{-6} \text{ N}$ **B** $8.0 \times 10^{-4} \text{ N}$ **C** $1.6 \times 10^{-3} \text{ N}$ **D** 0.40 N

- 32** The current I in a metal wire is given by the equation

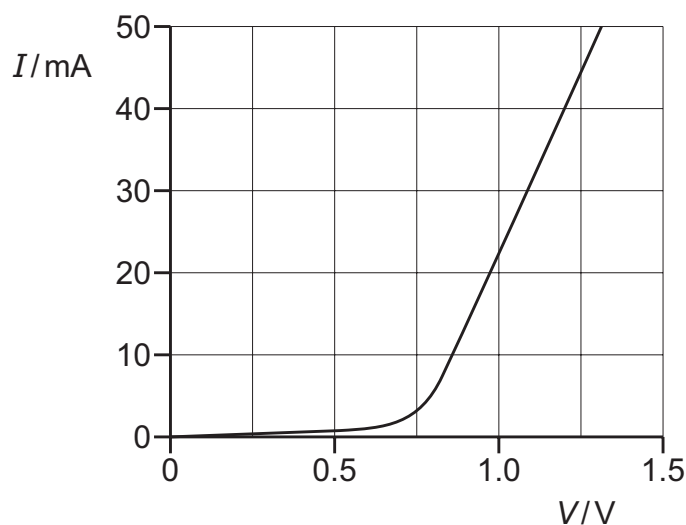
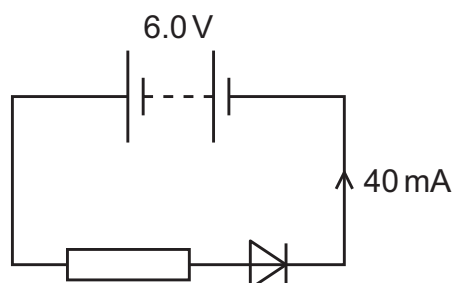
$$I = Anvq.$$

What does the symbol n represent?

- A** the number of charge carriers in the wire
B the number of charge carriers per unit cross-sectional area of the wire
C the number of charge carriers per unit length of the wire
D the number of charge carriers per unit volume of the wire

184. Question | 9702 Feb-March 2021 P1 V2 Q34

- 34** A fixed resistor and a diode are connected in series to a battery of electromotive force (e.m.f.) 6.0 V and negligible internal resistance. The graph shows the variation with potential difference (p.d.) V of the current I for the diode.



The current in the diode is 40 mA .

What is the resistance of the fixed resistor?

- A** $30\ \Omega$ **B** $120\ \Omega$ **C** $150\ \Omega$ **D** $180\ \Omega$

185. Question | 9702 Feb-March 2021 P1 V2 Q35

- 35** An electrical cable consists of seven strands of copper wire, each of diameter 0.30 mm , connected in parallel.

The resistivity of copper is $1.72 \times 10^{-8}\ \Omega\text{ m}$. The current in the cable is 13 A .

What is the potential difference (p.d.) between two points on the cable a distance of 1.0 m apart?

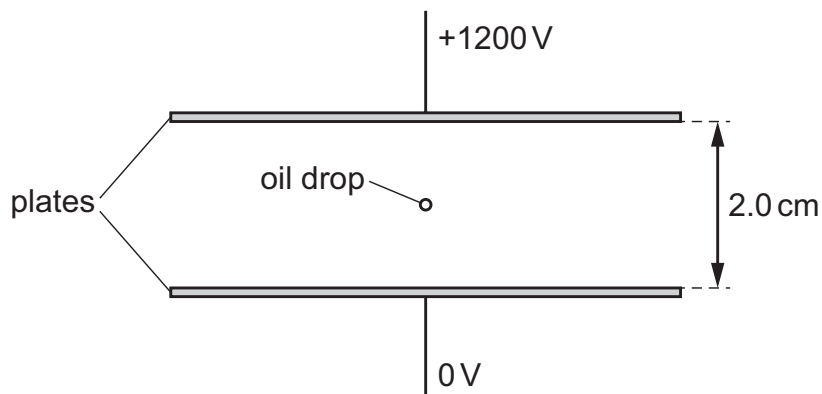
- A** 0.0045 V **B** 0.11 V **C** 0.45 V **D** 3.2 V

186. Question | 9702 May-June 2021 P1 V1 Q30

- 30** What is the electric field strength in a region where a proton accelerates at 2.00 ms^{-2} due to the field?
- A** 11.4 pVm^{-1} **B** 5.22 nVm^{-1} **C** 10.4 nVm^{-1} **D** 20.9 nVm^{-1}

187. Question | 9702 May-June 2021 P1 V1 Q31

- 31** An oil drop of mass $2.6 \times 10^{-15} \text{ kg}$ and with a charge of $-4.8 \times 10^{-19} \text{ C}$ is in a vacuum between two horizontal plates. The plates have a separation of 2.0 cm and a potential difference (p.d.) between them of 1200 V , as shown.

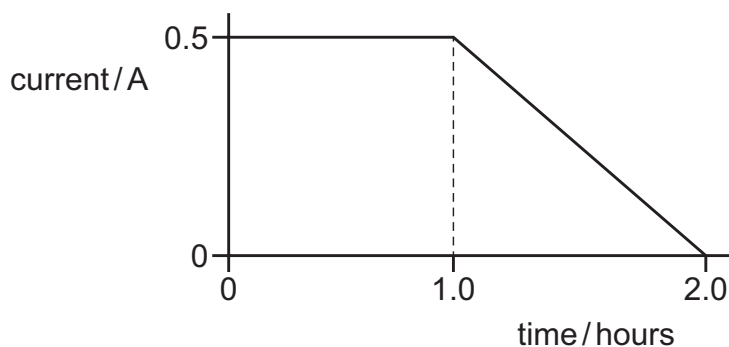


Which statement describes the motion of the oil drop?

- A** It is stationary.
- B** It has a downward acceleration of 9.7 ms^{-2} .
- C** It has an upward acceleration of 1.3 ms^{-2} .
- D** It has an upward acceleration of 11 ms^{-2} .

188. Question | 9702 May-June 2021 P1 V1 Q33

- 33** A mobile phone battery is charged by connecting it to a constant potential difference of 5.0 V . After a time of 1.0 hour, the initial current of 0.50 A slowly decreases to zero, as shown.



What is the best estimate of the energy transferred to the battery during the time of 2.0 hours shown in the graph?

- A** 2700 J **B** 9000 J **C** $14\,000\text{ J}$ **D** $18\,000\text{ J}$

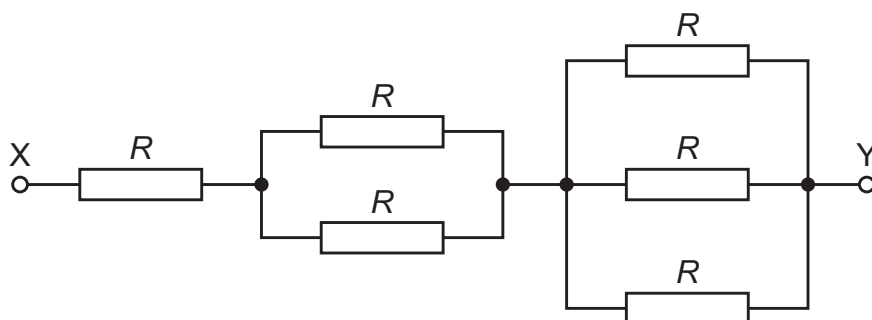
189. Question | 9702 May-June 2021 P1 V1 Q34

- 34** A length of wire is connected into an electric circuit. The current in the wire is measured.

Which change on its own could increase the current in the wire?

- A** an increase in the length of the wire
B an increase in the radius of the wire
C an increase in the resistance of the wire
D an increase in the resistivity of the wire

36 The diagram shows a network of resistors. Each resistor has resistance R .



What is the total resistance of the network between points X and Y?

A $\frac{R}{6}$

B $\frac{6R}{11}$

C $\frac{11R}{6}$

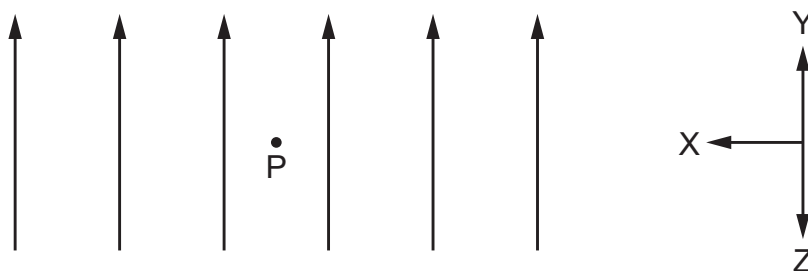
D $6R$

- 11** A charged particle is placed in a uniform field of force. The direction of the force on the particle is opposite to the direction of the field.

What is the field and what is the charge on the particle?

	field	charge on particle
A	electric	negative
B	electric	positive
C	gravitational	negative
D	gravitational	positive

30 A positively charged particle P is in an electric field, as shown.

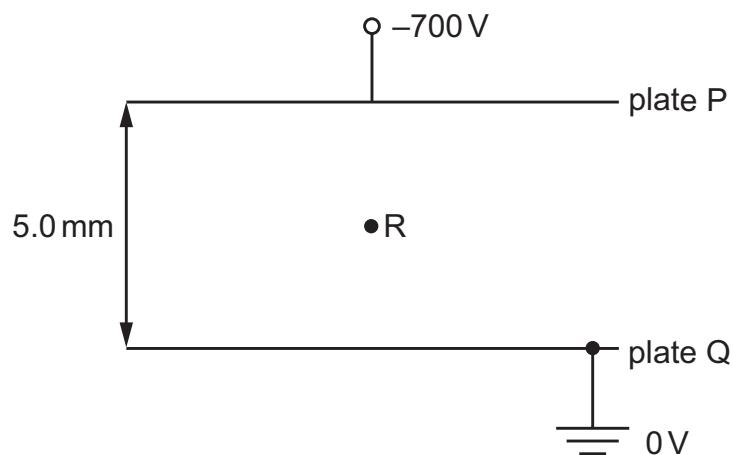


The field lines (lines of force) are evenly spaced and parallel.

Which statement is correct?

- A** Moving P a small distance in any direction will not change the electric force on P.
- B** Moving P a small distance in direction Y will increase the electric force on P.
- C** Moving P a small distance in direction Z will increase the electric force on P.
- D** Moving P a small distance in direction X will increase the electric force on P.

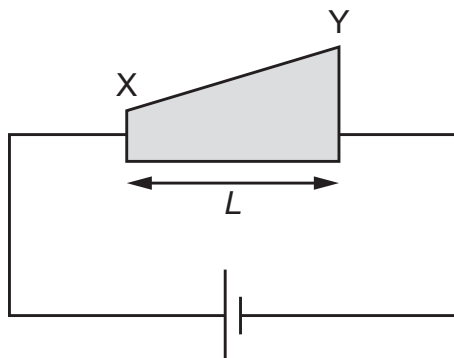
- 31** The diagram shows two parallel metal plates P and Q, separated by a distance of 5.0 mm. There is a potential difference of 700 V between the plates. Plate Q is earthed.



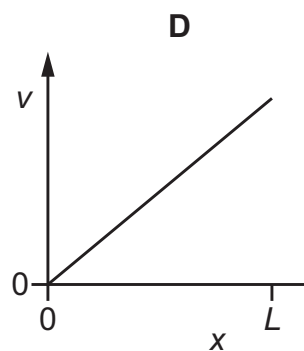
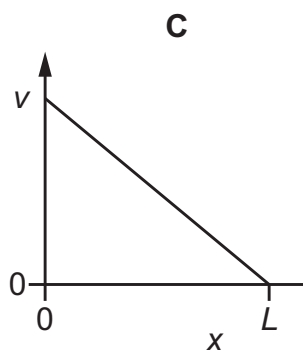
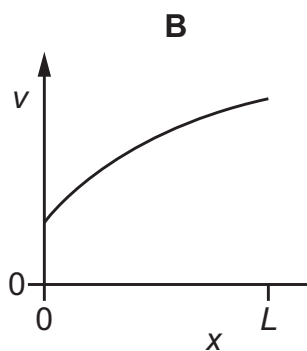
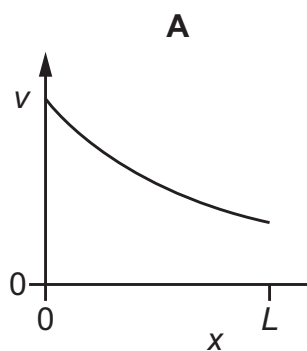
What is the magnitude and direction of the electric field at point R?

- A** $1.4 \times 10^2 \text{ NC}^{-1}$ from P towards Q
- B** $1.4 \times 10^2 \text{ NC}^{-1}$ from Q towards P
- C** $1.4 \times 10^5 \text{ NC}^{-1}$ from P towards Q
- D** $1.4 \times 10^5 \text{ NC}^{-1}$ from Q towards P

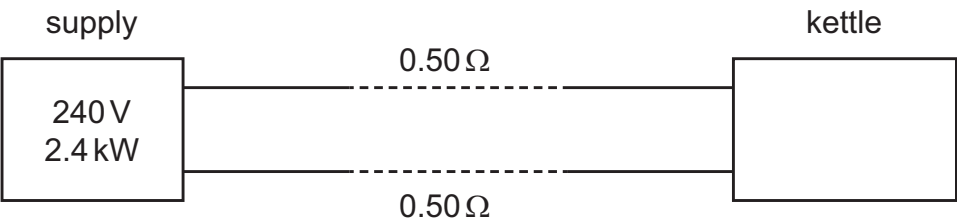
- 32** A wedge-shaped metal conductor of length L , varying width and uniform thickness is connected to a cell, as shown.



Which graph best shows how the average drift velocity v of electrons in the conductor varies with distance x from end X?



33 The power output of an electrical supply is 2.4 kW at a potential difference (p.d.) of 240 V. The two wires between the supply and a kettle each have a resistance of $0.50\,\Omega$, as shown.

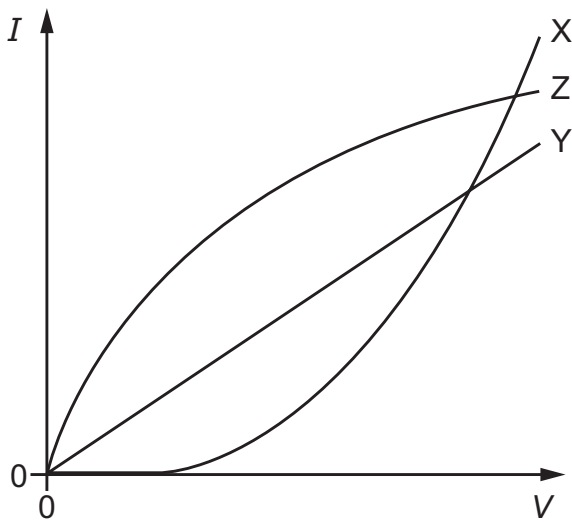


What is the power supplied to the kettle and what is the p.d. across the kettle?

	power / kW	p.d. / V
A	2.3	230
B	2.3	235
C	2.4	230
D	2.4	235

196. Question | 9702 May-June 2021 P1 V2 Q34

34 The graph shows the variation with potential difference V of the current I in components X, Y and Z.



Which row correctly identifies the components?

	metallic conductor at constant temperature	semiconductor diode	filament lamp
A	X	Z	Y
B	Y	X	Z
C	Y	Z	X
D	Z	Y	X

197. Question | 9702 May-June 2021 P1 V2 Q35

35 A wire of resistance $9.55\,\Omega$ has a diameter of $0.280\,\text{mm}$.

It is made of metal of resistivity $4.90 \times 10^{-7}\,\Omega\text{m}$.

What is the length of the wire?

- A** 1.20 m **B** 4.80 m **C** 19.0 m **D** 76.0 m

198. Question | 9702 May-June 2021 P1 V3 Q31

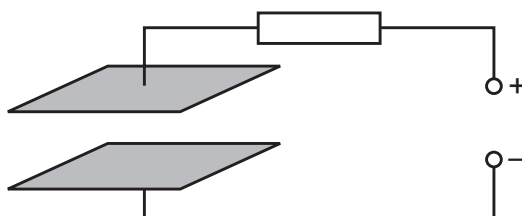
- 31** A particle has a charge of $+2.0 \text{ mC}$ and is in a vertical uniform electric field. An electric force of $1.0 \times 10^{-2} \text{ N}$ acts upwards on the particle.

What is the electric field strength?

- A** 0.20 V m^{-1} downwards
- B** 0.20 V m^{-1} upwards
- C** 5.0 V m^{-1} downwards
- D** 5.0 V m^{-1} upwards

199. Question | 9702 May-June 2021 P1 V3 Q32

- 32** The diagram shows two parallel metal plates connected to a d.c. power supply through a resistor.



There is a uniform electric field in the region between the plates.

Which change would cause a **decrease** in the strength of the electric field?

- A** a small increase in the distance between the plates
- B** a small increase in the potential difference between the plates
- C** a small increase in the resistance of the resistor
- D** a small increase to the area of both plates

200. Question | 9702 May-June 2021 P1 V3 Q33

- 33** A wire has a length of 12 cm and contains a total of 5.1×10^{22} free electrons.

When a potential difference is applied across the ends of the wire, the free electrons move with an average drift speed of $4.0 \times 10^{-6} \text{ m s}^{-1}$.

What is the current in the wire?

- A** 0.0027 A
- B** 0.0039 A
- C** 0.27 A
- D** 0.39 A

201. Question | 9702 May-June 2021 P1 V3 Q34

34 A battery is marked 9.0 V.

What does this mean?

- A** Each coulomb of charge from the battery supplies 9.0 J of electrical energy to the whole circuit.
- B** The battery supplies 9.0 J of electrical energy to an external circuit for each coulomb of charge.
- C** The potential difference across any component connected to the battery will be 9.0 V.
- D** There will always be a potential difference of 9.0 V across the battery terminals.

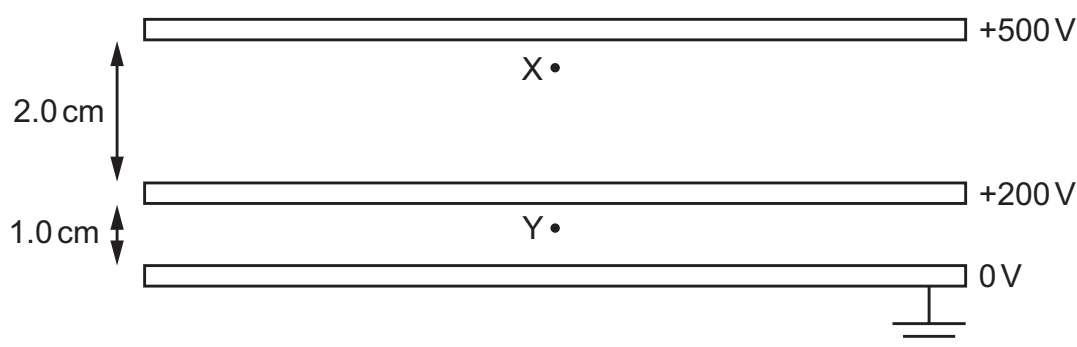
202. Question | 9702 Oct-Nov 2021 P1 V1 Q30

30 What is meant by electric field strength?

- A** force per unit charge acting on a small mass
- B** force per unit charge acting on a small positive charge
- C** force per unit mass acting on a small mass
- D** force per unit mass acting on a small positive charge

203. Question | 9702 Oct-Nov 2021 P1 V1 Q31

31 Three parallel metal plates of the same area are fixed with a separation of 2.0 cm between the top plate and the middle plate, and 1.0 cm between the middle plate and the bottom plate. The top plate is held at a potential of +500 V, the middle plate at +200 V and the bottom plate is earthed, as shown.



What is the value of the ratio $\frac{\text{magnitude of force on an electron at X}}{\text{magnitude of force on an electron at Y}}$?

- A** 0.75
- B** 1.00
- C** 1.25
- D** 1.50

32 The current I in a wire is given by the equation

$$I = nAvq$$

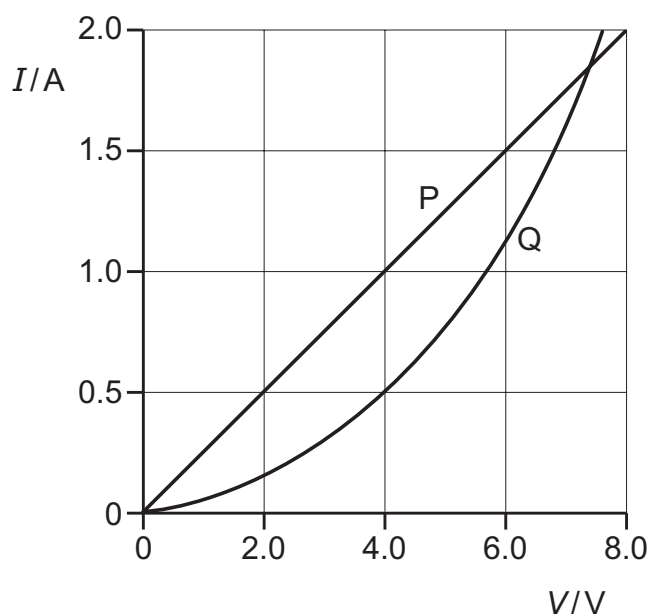
where n is the number density of the free electrons, A is the cross-sectional area of the wire, v is the average drift velocity of the free electrons and q is the charge of an electron.

Which relationship is **not** used in the derivation of this equation?

- A** charge = current $\times$ time
- B** distance = speed $\times$ time
- C** number = number density $\times$ area
- D** volume = length $\times$ area

205. Question | 9702 Oct-Nov 2021 P1 V1 Q34

34 The I – V characteristics of two electrical components P and Q are shown.



Which statement is correct?

- A** For a current of 0.5 A, the power dissipated in Q is double that in P.
- B** For a current of 1.9 A, the resistance of Q is approximately half that of P.
- C** The resistance of Q increases as the current in it increases.
- D** P is a fixed resistor and Q is a filament lamp.

206. Question | 9702 Oct-Nov 2021 P1 V1 Q35

35 Two copper wires S and T, of equal length, are connected in parallel. Wire S has a diameter of 3.0 mm. Wire T has a diameter of 1.5 mm.

A potential difference is applied across the ends of this parallel arrangement.

What is the value of the ratio $\frac{\text{current in S}}{\text{current in T}}$?

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

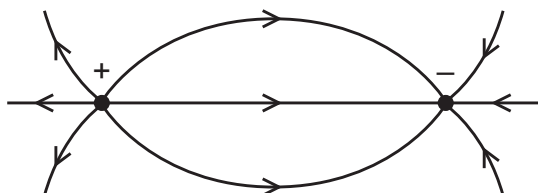
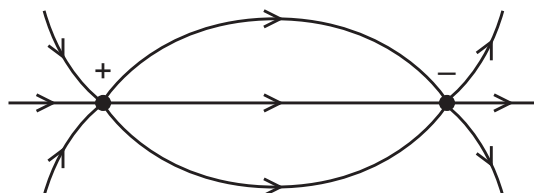
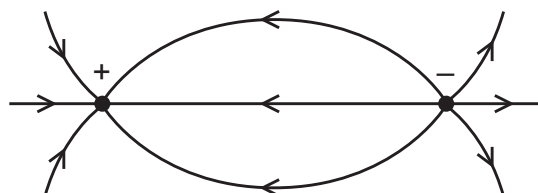
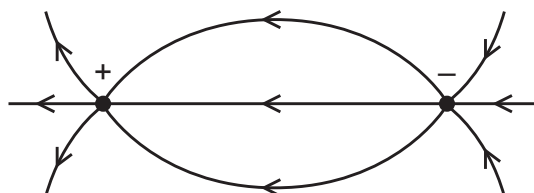
207. Question | 9702 Oct-Nov 2021 P1 V1 Q36

36 What is the circuit symbol for an oscilloscope?**A****B****C****D**

208. Question | 9702 Oct-Nov 2021 P1 V2 Q31

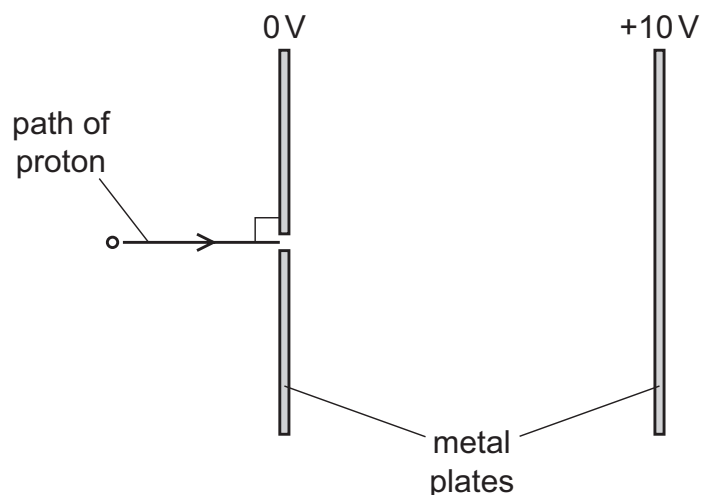
31 Four diagrams representing the electric field between two oppositely charged point charges are shown.

Which diagram correctly shows the electric field lines?

A**B****C****D**

32 A proton enters the uniform electric field between two parallel vertical metal plates in a vacuum.

One plate is at a potential of 0 V and the other plate is at a potential of +10 V, as shown.



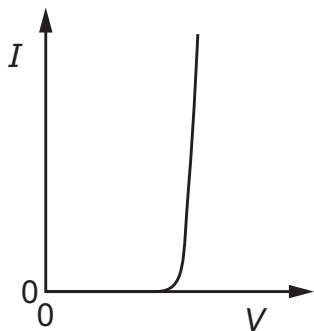
What is the initial change in the motion of the proton caused by the electric field, immediately after the proton enters the field?

- A** It begins to move downwards.
- B** It begins to move upwards.
- C** Its speed decreases.
- D** Its speed increases.

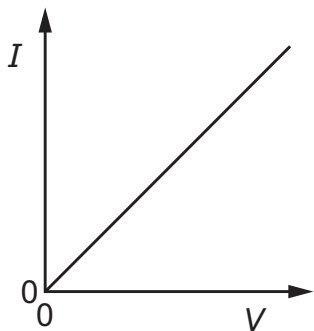
33 What is a description of the coulomb?

- A** the electric charge of one electron
- B** the electric charge transferred by a current of one ampere in one second
- C** the kinetic energy gained by an electron accelerated through a potential difference of one volt
- D** the kinetic energy of an electron moving at a speed of one metre per second

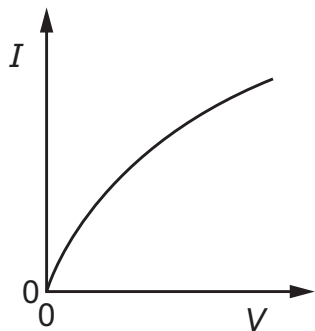
35 The graphs show the variation with potential difference V of the current I for three circuit components.



graph X



graph Y



graph Z

The components are a metal wire at constant temperature, a semiconductor diode and a filament lamp.

Which row correctly identifies these graphs?

	metal wire at constant temperature	semiconductor diode	filament lamp
A	X	Z	Y
B	Y	X	Z
C	Y	Z	X
D	Z	X	Y

- 36** The electromotive force (e.m.f.) of a cell is 6.0 V . It has negligible internal resistance and is connected across a resistor. The potential difference (p.d.) across the resistor is also 6.0 V .

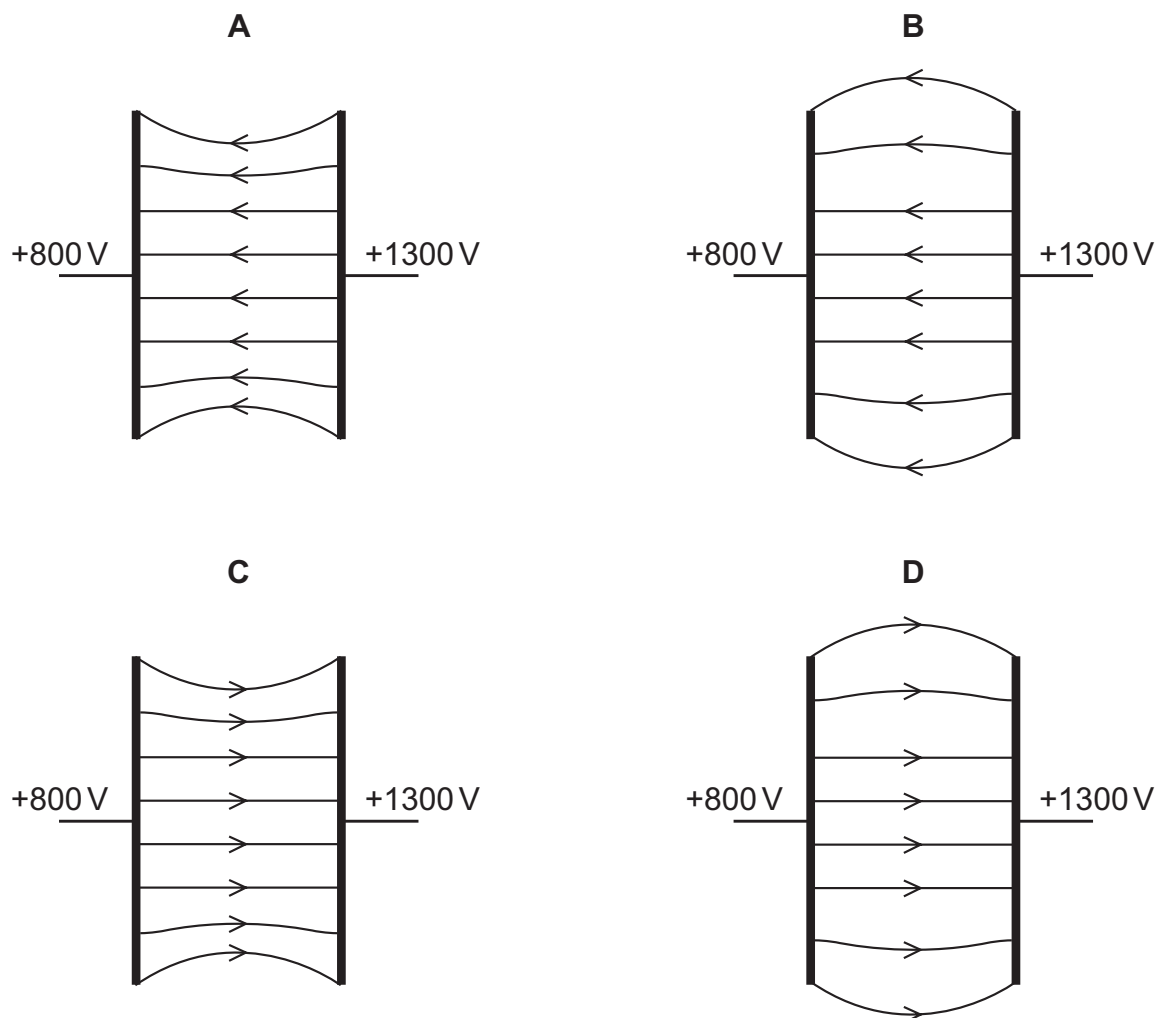
The e.m.f. and the p.d. have the same numerical value but represent different processes.

Which statement about the different processes is correct?

- A** The e.m.f. is the energy transferred from chemical energy to electrical energy in the cell and the p.d. is the energy transferred from electrical energy to thermal energy in the resistor.
- B** The p.d. is the energy transferred from chemical energy to electrical energy in the cell and the e.m.f. is the energy transferred from electrical energy to thermal energy in the resistor.
- C** The e.m.f. is the energy transferred per unit charge from chemical energy to electrical energy in the cell and the p.d. is the energy transferred per unit charge from electrical energy to thermal energy in the resistor.
- D** The p.d. is the energy transferred per unit charge from chemical energy to electrical energy in the cell and the e.m.f. is the energy transferred per unit charge from electrical energy to thermal energy in the resistor.

31 Two parallel metal plates are at electric potentials of +800 V and +1300 V.

Which diagram best represents the electric field between the metal plates?



32 An electron is in a uniform electric field of field strength 1500 V m^{-1} .

What is the acceleration of the electron due to the electric field?

- A** $8.5 \times 10^{-9} \text{ m s}^{-2}$
- B** $1.6 \times 10^{-5} \text{ m s}^{-2}$
- C** $1.4 \times 10^{11} \text{ m s}^{-2}$
- D** $2.6 \times 10^{14} \text{ m s}^{-2}$

215. Question | 9702 Oct-Nov 2021 P1 V3 Q33

- 33** A lightning strike transfers 1×10^{20} electrons past a point in a time of $30 \mu\text{s}$.

What is the average current during the lightning strike?

- A** 0.5 mA **B** 0.5 A **C** 500 A **D** 500 kA

216. Question | 9702 Oct-Nov 2021 P1 V3 Q35

- 35** A wire of uniform cross-section has resistance R .

A second wire is made of the same material but is twice as long and has twice the diameter of the first wire.

What is the resistance of the second wire?

- A** $\frac{R}{8}$ **B** $\frac{R}{2}$ **C** R **D** $8R$

217. Question | 9702 Feb-March 2022 P1 V2 Q29

- 29** For a current-carrying wire, the current can be calculated using the equation shown.

$$I = Anvq$$

What is the meaning of n ?

- A** the number of charge carriers in the wire
B the number of charge carriers multiplied by the volume of the wire
C the number of charge carriers per unit length of the wire
D the number of charge carriers per unit volume of the wire

30 The number of free electrons passing a point in a wire in 24 hours is 6.0×10^{23} .

What is the average current in the wire?

A 6.3 pA

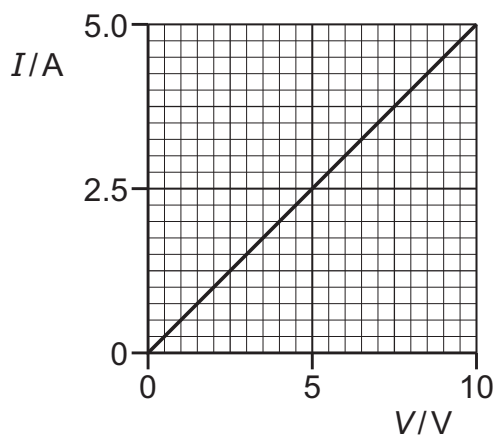
B 1.1 A

C 67 A

D 4.0 kA

219. Question | 9702 Feb-March 2022 P1 V2 Q32

- 32** A piece of wire has a length of 0.80 m and a diameter of 5.0×10^{-4} m. The I – V characteristic of the wire is shown.



What is the resistivity of the metal from which the wire is made?

- A** $1.2 \times 10^{-7} \Omega \text{ m}$
- B** $1.6 \times 10^{-7} \Omega \text{ m}$
- C** $4.9 \times 10^{-7} \Omega \text{ m}$
- D** $2.0 \times 10^{-6} \Omega \text{ m}$

220. Question | 9702 May-June 2022 P1 V1 Q31

- 31** A straight copper wire of diameter 0.42×10^{-3} m has a number density of free electrons of $8.5 \times 10^{28} \text{ m}^{-3}$. In a given time interval, a charge of 0.15 C moves through the wire.

What is the average displacement of the free electrons along the wire in this time interval?

- A** $3.3 \times 10^{-8} \text{ m}$ **B** $2.0 \times 10^{-5} \text{ m}$ **C** $8.0 \times 10^{-5} \text{ m}$ **D** $2.5 \times 10^{-4} \text{ m}$

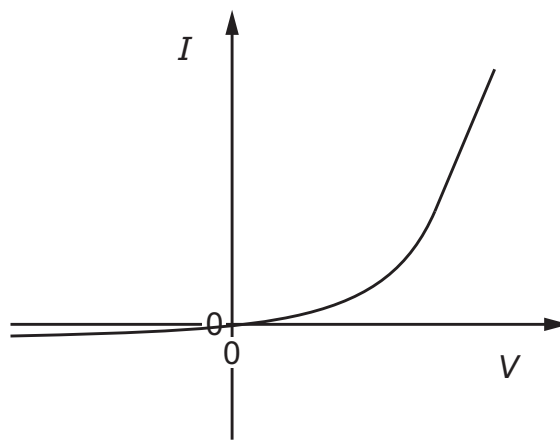
221. Question | 9702 May-June 2022 P1 V1 Q32

32 What is the definition of the potential difference (p.d.) across a component?

- A** the electrical power supplied to the component
- B** the energy transferred to the component per unit charge
- C** the product of the current in the component and its resistance
- D** the voltage across the component

222. Question | 9702 May-June 2022 P1 V1 Q33

33 The graph shows the I – V characteristic for a semiconductor diode.



Which statement can be deduced from the graph?

- A** Above a certain positive potential difference the diode obeys Ohm's law.
- B** Current is directly proportional to potential difference when the current in the diode is in one direction.
- C** The diode has zero resistance when the current in the diode is in one direction.
- D** The resistance of the diode depends upon the potential difference across it.

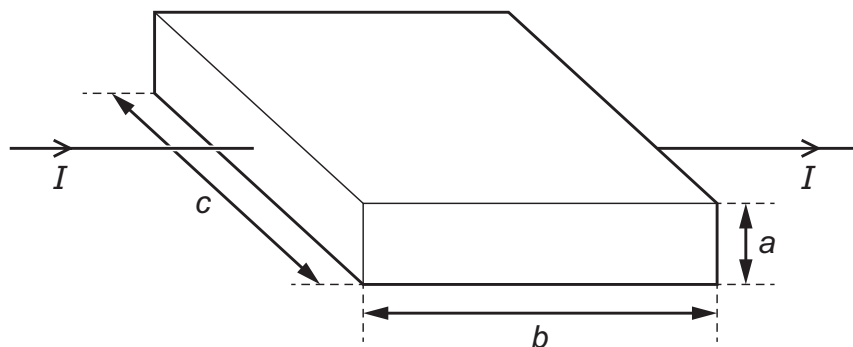
223. Question | 9702 May-June 2022 P1 V1 Q34

34 A wire has a resistance of $30\ \Omega$. A second wire is made from the same material, has the same mass and is three times as long as the first wire.

What is the resistance of the second wire?

- A** $10\ \Omega$
- B** $30\ \Omega$
- C** $90\ \Omega$
- D** $270\ \Omega$

31 The diagram shows a metal block.



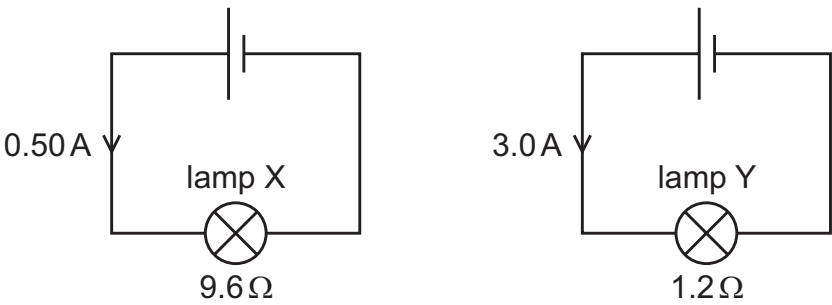
The block has sides of length a , b and c as shown, and its volume is V . Each charge carrier has a charge $-q$ and the number density of the charge carriers in the metal is n . It takes each charge carrier an average time of t to pass through the block.

What is an expression for the current I ?

- A** $I = nqabc$ **B** $I = \frac{nqV}{t}$ **C** $I = \frac{nqbc}{t}$ **D** $I = nqaV$

225. Question | 9702 May-June 2022 P1 V2 Q32

32 The circuit diagrams show two lamps X and Y each connected to a cell. The current in lamp X is 0.50 A and its resistance is $9.6\,\Omega$. The current in lamp Y is 3.0 A and its resistance is $1.2\,\Omega$.



What is the ratio $\frac{\text{power in lamp X}}{\text{power in lamp Y}}$?

A 0.22 **B** 0.75 **C** 1.3 **D** 4.5

226. Question | 9702 May-June 2022 P1 V2 Q33

33 The intensity of light incident on a light-dependent resistor (LDR) is increased. The temperature of a thermistor is increased. In each case, the current in the component is maintained at a constant value.

What happens to the potential difference across each component?

	LDR	thermistor
A	increases	increases
B	increases	decreases
C	decreases	increases
D	decreases	decreases

227. Question | 9702 May-June 2022 P1 V2 Q34

34 An iron wire has length 8.0 m and diameter 0.50 mm. The wire has resistance R .

A second iron wire has length 2.0 m and diameter 1.0 mm.

What is the resistance of the second wire?

A $\frac{R}{16}$ **B** $\frac{R}{8}$ **C** $\frac{R}{2}$ **D** R

228. Question | 9702 May-June 2022 P1 V3 Q32

32 Two wires, X and Y, are made from the same metal.

The diameter of wire Y is twice that of wire X.

Wire X, wire Y and a battery are connected in series.

What is the ratio $\frac{\text{average drift speed of free electrons in wire X}}{\text{average drift speed of free electrons in wire Y}}$?

A $\frac{1}{4}$

B $\frac{1}{2}$

C $\frac{2}{1}$

D $\frac{4}{1}$

229. Question | 9702 May-June 2022 P1 V3 Q33

33 A resistor has resistance R . When the potential difference (p.d.) across the resistor is V , the current in the resistor is I . The power dissipated in the resistor is P . Work W is done when charge Q flows through the resistor.

What is **not** a valid relationship between these variables?

A $I = \frac{P}{V}$

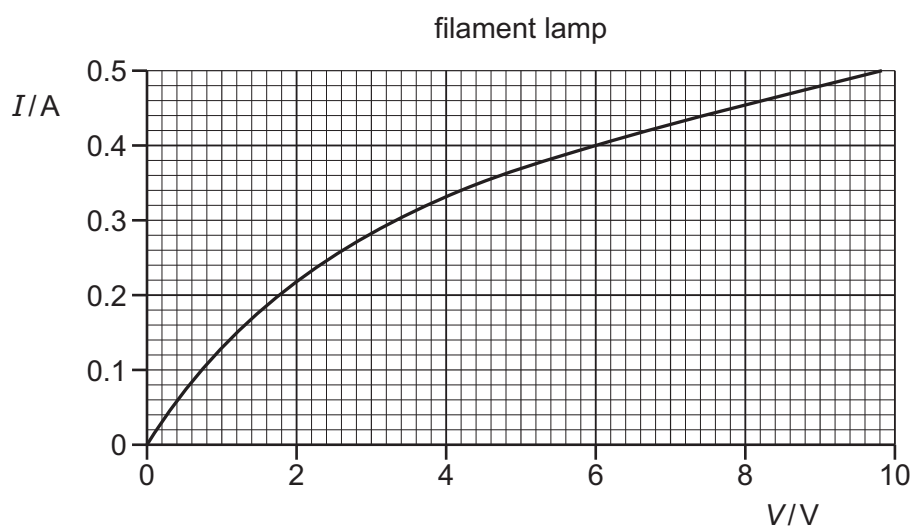
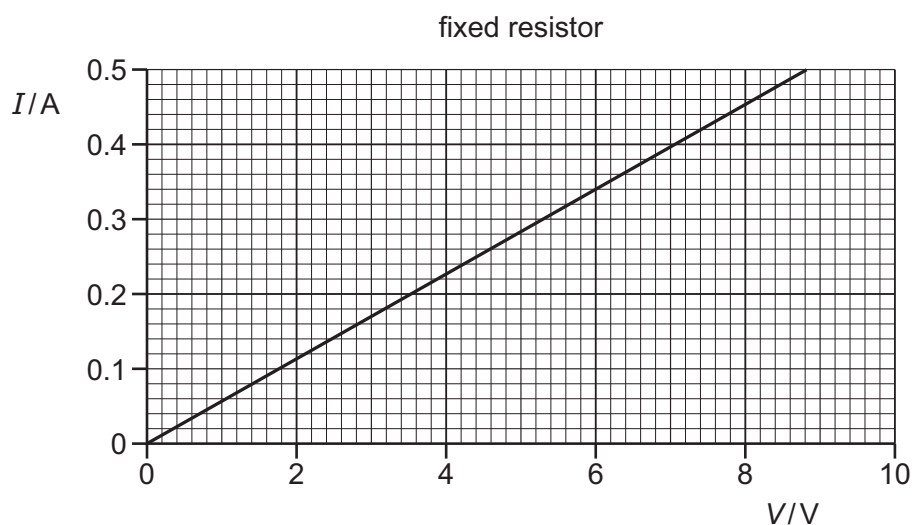
B $Q = \frac{W}{V}$

C $R = \frac{P}{I^2}$

D $R = \frac{V}{P}$

34 A fixed resistor and a filament lamp are connected in series to a power supply.

The I – V characteristics for the two components are shown.



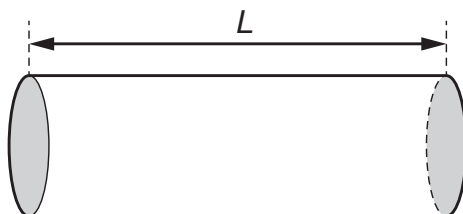
The current in the fixed resistor is 0.34 A.

What is the resistance of the filament lamp?

- A** $0.081\ \Omega$ **B** $12\ \Omega$ **C** $15\ \Omega$ **D** $18\ \Omega$

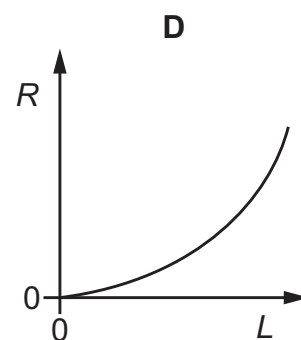
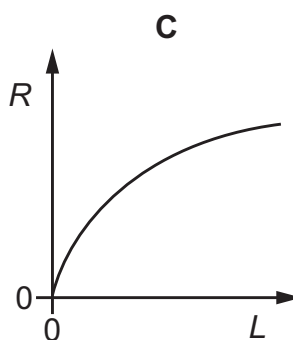
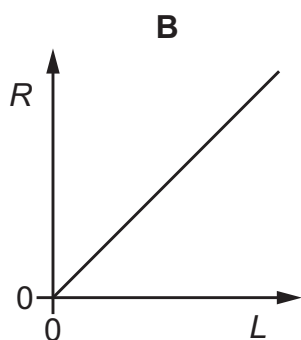
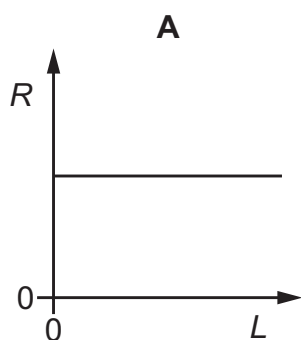
- 35** A piece of conducting putty (modelling clay) of constant resistivity is formed into a cylindrical shape.

The resistance R between its flat ends (shaded) is measured.



The same volume of putty is re-formed into cylinders of different lengths L , and the resistance R between the flat ends is measured for each value of L .

Which graph best shows the variation of R with L ?



36 The diagram shows the symbol for a component that may be used in an electrical circuit.



Which component is represented by this circuit symbol?

- A** buzzer
- B** electric bell
- C** loudspeaker
- D** microphone

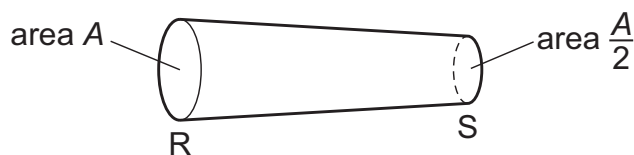
2 A voltmeter connected across a resistor in a circuit reads 3.6 V.

What could be the current in the resistor and the resistance of the resistor?

	current	resistance
A	150 mA	0.24 k Ω
B	15 mA	2.4 k Ω
C	1.5 mA	0.24 M Ω
D	15 μ A	240 k Ω

234. Question | 9702 Oct-Nov 2022 P1 V1 Q31

- 31** A length of wire RS has a circular cross-section.



At end R of the wire, the cross-sectional area is A .

At end S of the wire, the cross-sectional area is $\frac{A}{2}$.

Charge Q takes time t to pass through end R of the wire. There is a constant electric current in the wire.

How much charge will pass through end S in a time interval of $\frac{t}{4}$?

- A** $\frac{Q}{8}$ **B** $\frac{Q}{4}$ **C** $\frac{Q}{2}$ **D** Q

235. Question | 9702 Oct-Nov 2022 P1 V1 Q32

- 32** A power supply is connected to a component by connecting wires of total resistance $4.9\,\Omega$.

The power supply has an output power of $3.6\,\text{W}$ and a terminal potential difference of $12\,\text{V}$.

How much thermal energy is dissipated in the connecting wires in a time of 1.0 hour?

- A** $0.44\,\text{J}$ **B** $29\,\text{J}$ **C** $1.6\,\text{kJ}$ **D** $11\,\text{kJ}$

236. Question | 9702 Oct-Nov 2022 P1 V2 Q31

- 31** A nichrome wire has a resistance of $15\,\Omega$ and a diameter of $3.0\,\text{mm}$. The number density of the free electrons in nichrome is $9.0 \times 10^{28}\,\text{m}^{-3}$.

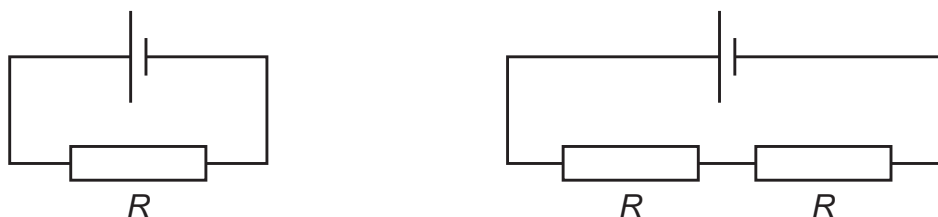
A potential difference (p.d.) of $6.0\,\text{V}$ is applied between the ends of the wire.

What is the average drift speed of the free electrons in the wire?

- A** $9.8 \times 10^{-7}\,\text{m s}^{-1}$
B $3.9 \times 10^{-6}\,\text{m s}^{-1}$
C $6.1 \times 10^{-6}\,\text{m s}^{-1}$
D $2.5 \times 10^{-5}\,\text{m s}^{-1}$

237. Question | 9702 Oct-Nov 2022 P1 V2 Q32

32 The diagrams show two different circuits.



The cells in each circuit have the same electromotive force (e.m.f.) and negligible internal resistance. The three resistors each have the same resistance R .

In the circuit on the left, the power dissipated in the resistor is P .

What is the total power dissipated in the circuit on the right?

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

238. Question | 9702 Oct-Nov 2022 P1 V2 Q33

33 The potential difference (p.d.) across a filament lamp is increased.

Which statement is correct?

- A** The resistance of the lamp decreases because the temperature decreases.
B The resistance of the lamp decreases because the temperature increases.
C The resistance of the lamp increases because the temperature decreases.
D The resistance of the lamp increases because the temperature increases.

239. Question | 9702 Oct-Nov 2022 P1 V2 Q34

34 A metal wire has resistance R .

The wire is stretched so that its diameter decreases to 94.0% of the original diameter.

The volume of the wire is unchanged.

What is the resistance of the stretched wire?

- A** $1.06R$ **B** $1.13R$ **C** $1.20R$ **D** $1.28R$

240. Question | 9702 Oct-Nov 2022 P1 V3 Q30

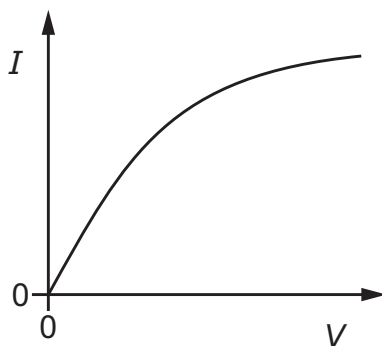
30 There is an electric current in a copper wire.

Which statement describing the average drift speed of the charge carriers in the wire is correct?

- A** It is nearly $3 \times 10^8 \text{ m s}^{-1}$.
- B** It is proportional to the cross-sectional area of the wire.
- C** It is proportional to the length of the wire.
- D** It is proportional to the magnitude of the current.

241. Question | 9702 Oct-Nov 2022 P1 V3 Q32

32 Which component has the I – V graph shown?



- A** filament lamp
- B** metallic conductor at constant temperature
- C** resistor of fixed resistance
- D** semiconductor diode

- 33** Two wires, P and Q, have the same resistance. Wire Q is made of material that has twice the resistivity of the material used to make wire P. The diameter of wire Q is twice the diameter of wire P.

What is the ratio $\frac{\text{length of wire P}}{\text{length of wire Q}}$?

A $\frac{1}{8}$

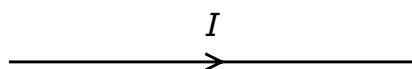
B $\frac{1}{4}$

C $\frac{1}{2}$

D $\frac{2}{1}$

243. Question | 9702 Specimen 2022 P1 Q29

29 The diagram shows the symbol for a wire carrying a current I .



What does this current represent?

- A** the charge flowing past a point in the wire per unit time
- B** the number of electrons flowing past a point in the wire per unit time
- C** the number of positive nuclei flowing past a point in the wire per unit time
- D** the number of protons flowing past a point in the wire per unit time

244. Question | 9702 Specimen 2022 P1 Q30

30 An electric current I is given by the formula $I = Anvq$.

What do each of the symbols represent for an electric current in a metal wire?

	A	n	v	q
A	area of cross-section	number of free electrons	voltage	charge of each nucleus
B	area of cross-section	number of free electrons per unit volume	average drift speed of free electrons	charge of each electron
C	current	number of free electrons	average drift speed of free electrons	charge of each nucleus
D	current	number of free electrons per unit volume	voltage	charge of each electron

245. Question | 9702 Specimen 2022 P1 Q31

- 31** Which values of current and resistance will produce a rate of energy transfer of 16 J s^{-1} ?

	current/A	resistance/ Ω
A	1	4
B	2	2
C	2	8
D	4	1

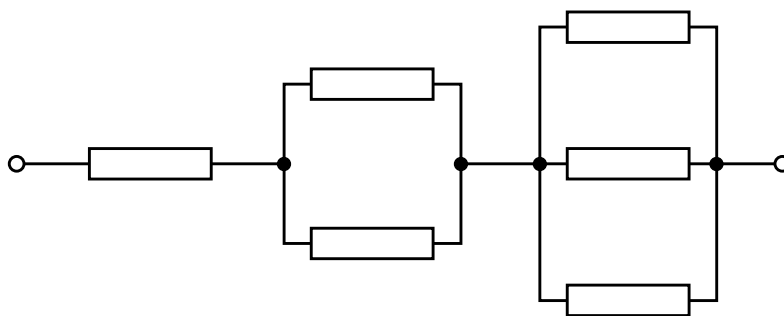
246. Question | 9702 Specimen 2022 P1 Q32

- 32** A coil contains N turns of insulated copper wire wound on to a cylinder of diameter D . The copper wire has diameter d . The resistivity of copper is ρ . Diameter D is much greater than diameter d .

What is the total resistance between the two ends of the coil of copper wire?

- A** $\frac{4N\rho D}{d^2}$ **B** $\frac{4N\rho d}{D^2}$ **C** $\frac{8N\rho D}{d^2}$ **D** $\frac{8N\rho d}{D^2}$

35 Six resistors, each of resistance R , are connected as shown.



The combined resistance is $66\text{ k}\Omega$.

What is the value of R ?

- A** $11\text{ k}\Omega$ **B** $18\text{ k}\Omega$ **C** $22\text{ k}\Omega$ **D** $36\text{ k}\Omega$

30 A wire carries a current of $0.10\text{ }\mu\text{A}$. The potential difference across the wire is 10 mV .

How much energy is dissipated by the wire in a time of 10 s ?

- A** 1.0 pJ **B** 10 pJ **C** 1.0 nJ **D** 10 nJ

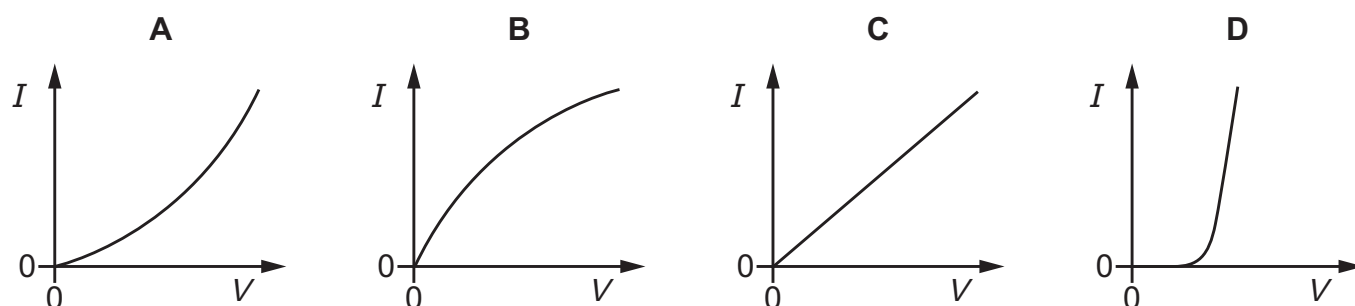
249. Question | 9702 Feb-March 2023 P1 V2 Q31

31 What is the definition of the potential difference across an electrical component?

- A** energy transferred per unit charge
- B** energy transferred per unit current
- C** energy transferred per unit resistance
- D** energy transferred per unit time

250. Question | 9702 Feb-March 2023 P1 V2 Q32

32 Which graph represents the way the current I through a filament lamp varies with the potential difference V across it?



251. Question | 9702 Feb-March 2023 P1 V2 Q33

33 The table shows the properties of two different wires, P and Q.

	length	resistance	resistivity of material
wire P	l	R	ρ
wire Q	$2l$	$\frac{1}{4}R$	$\frac{1}{3}\rho$

Wire P has a cross-section of diameter d .

What is the diameter of the cross-section of wire Q?

- A** $0.41d$
- B** $1.6d$
- C** $2.7d$
- D** $7.1d$

252. Question | 9702 May-June 2023 P1 V1 Q30

30 The electric current in a metal wire is 4.0 mA.

How many electrons pass a fixed point in the wire in a time of 10 hours?

- A** 2.5×10^{17}
- B** 2.5×10^{20}
- C** 9.0×10^{20}
- D** 9.0×10^{23}

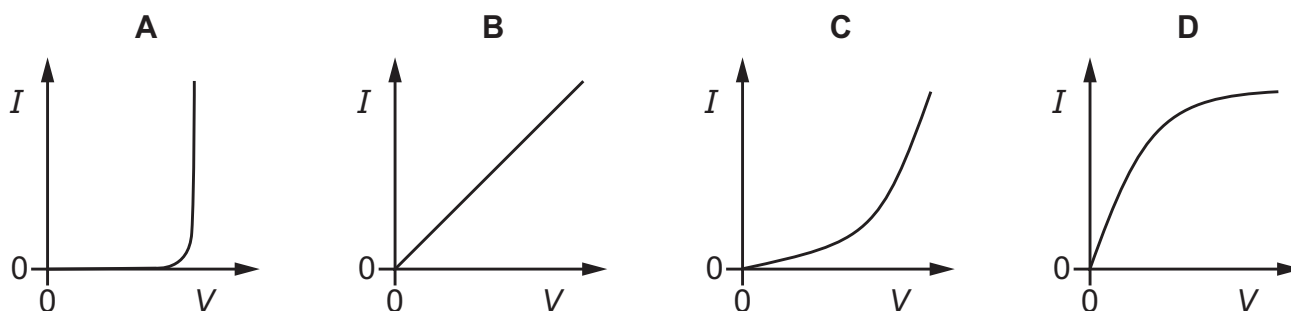
253. Question | 9702 May-June 2023 P1 V1 Q31

31 What is the definition of the potential difference across an electrical component?

- A** the charge per unit time passing through the component
- B** the energy transferred per unit charge
- C** the force per unit charge
- D** the resistance per unit current

254. Question | 9702 May-June 2023 P1 V1 Q32

32 Which graph shows the I – V characteristic of a filament lamp?



255. Question | 9702 May-June 2023 P1 V1 Q33

33 A metal wire has a length of 2.50 m and a cross-sectional area of $4.50 \times 10^{-6} \text{ m}^2$. The resistivity of the metal is $3.50 \times 10^{-7} \Omega \text{ m}$.

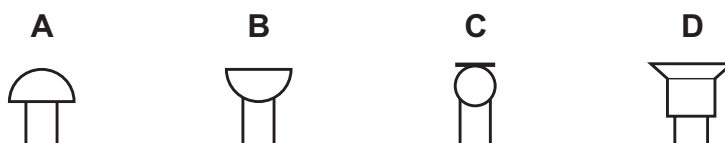
The wire is stretched so that its length increases to 2.65 m. The wire remains cylindrical and the **volume** of the wire remains constant.

What is the change in the resistance of the wire?

- A** 0.012Ω
- B** 0.024Ω
- C** 0.19Ω
- D** 0.22Ω

256. Question | 9702 May-June 2023 P1 V1 Q34

34 Which circuit symbol represents a microphone?



257. Question | 9702 May-June 2023 P1 V2 Q30

30 Which charge can be carried by a charge carrier?

- A** $1.1 \times 10^{-19} \text{ C}$
- B** $4.0 \times 10^{-19} \text{ C}$
- C** $4.8 \times 10^{-19} \text{ C}$
- D** $9.1 \times 10^{-19} \text{ C}$

258. Question | 9702 May-June 2023 P1 V2 Q31

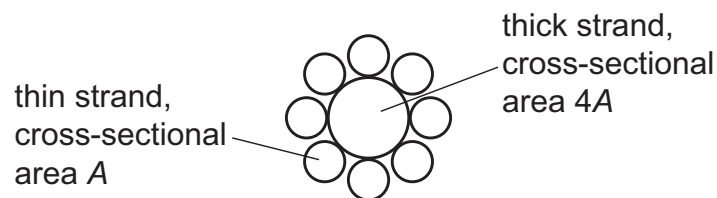
31 A resistor of resistance R is connected across a cell of electromotive force (e.m.f.) E and negligible internal resistance.

Which single change to the circuit would lead to the largest increase in the power dissipated in the resistor?

- A** doubling the value of E
- B** doubling the value of R
- C** halving the value of E
- D** halving the value of R

- 32** An electrical cable is made up of one thick strand of copper wire that is surrounded by eight thin strands of copper wire. All nine strands of wire are connected in parallel with each other.

A cross-section of the cable is shown.



Each thin strand of wire has cross-sectional area A and length L .

The thick strand of wire has cross-sectional area $4A$ and length L .

The cable has total resistance R .

Which expression gives the resistivity of copper?

A $\frac{4A}{33RL}$

B $\frac{12A}{RL}$

C $\frac{4AR}{L}$

D $\frac{12AR}{L}$

260. Question | 9702 May-June 2023 P1 V2 Q33

33 A car has sensors for detecting the light intensity and temperature of its environment.

The sensors make use of a light-dependent resistor (LDR) and a thermistor.

The car moves from a warm and dark environment into a cold and bright environment.

What are the changes to the resistances of the LDR and thermistor?

	resistance of LDR	resistance of thermistor
A	increases	increases
B	increases	decreases
C	decreases	increases
D	decreases	decreases

261. Question | 9702 May-June 2023 P1 V2 Q35

35 Kirchhoff's first law is a consequence of the conservation of which quantity?

- A** charge
- B** energy
- C** momentum
- D** potential difference

262. Question | 9702 May-June 2023 P1 V3 Q30

30 A metal wire is connected between the terminals of a cell so that there is a current in the wire.

Which statement is correct?

- A** Negatively charged electrons in the wire move from the negative terminal to the positive terminal.
- B** Negatively charged nuclei in the wire move from the negative terminal to the positive terminal.
- C** Positively charged electrons in the wire move from the positive terminal to the negative terminal.
- D** Positively charged nuclei in the wire move from the positive terminal to the negative terminal.

263. Question | 9702 May-June 2023 P1 V3 Q32

32 A wire has a length of 3.0 m and is made of metal of resistivity $4.9 \times 10^{-7} \Omega \text{ m}$.

A potential difference (p.d.) of 12 V is applied across the wire so that it has a current of 1.4 A.

What is the cross-sectional area of the wire?

- A** $1.2 \times 10^{-7} \text{ m}^2$
- B** $1.7 \times 10^{-7} \text{ m}^2$
- C** $1.1 \times 10^{-6} \text{ m}^2$
- D** $1.3 \times 10^{-5} \text{ m}^2$

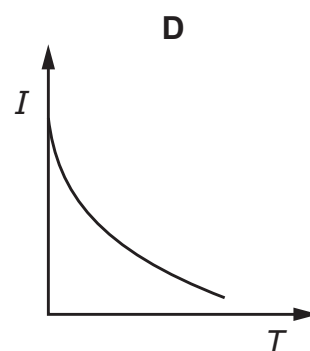
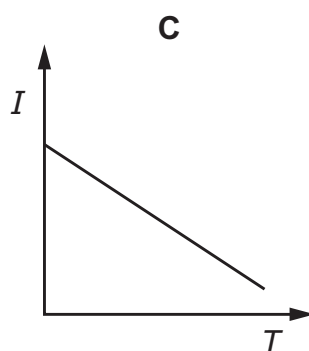
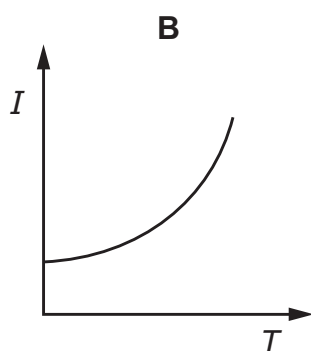
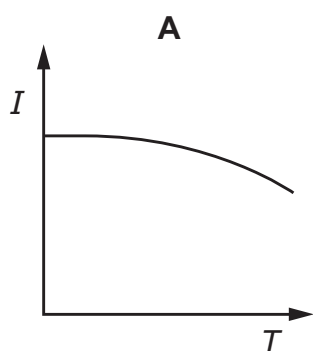
264. Question | 9702 May-June 2023 P1 V3 Q33

33 A cell of negligible internal resistance is connected in series with a thermistor, a fixed resistor and an ammeter.

The thermistor is placed in a beaker of water and the temperature of the water is slowly increased.

A graph of current I against the temperature T of the thermistor is plotted.

Which graph could show the variation of I with T ?



265. Question | 9702 May-June 2023 P1 V3 Q35

- 35** Kirchhoff's first law states that the sum of the currents entering a junction in a circuit is equal to the sum of the currents leaving it.

The law is based on the conservation of a physical quantity.

What is this physical quantity?

- A** charge
- B** energy
- C** mass
- D** momentum

266. Question | 9702 May-June 2023 P1 V3 Q36

- 36** Two resistors have a combined resistance of $34\ \Omega$ when connected in series. The same resistors have a combined resistance of $7.4\ \Omega$ when connected in parallel.

What is the resistance of one of the resistors?

- A** $15\ \Omega$
- B** $17\ \Omega$
- C** $23\ \Omega$
- D** $27\ \Omega$

267. Question | 9702 Oct-Nov 2023 P1 V1 Q30

- 30** The current I in a conductor is given by the equation shown.

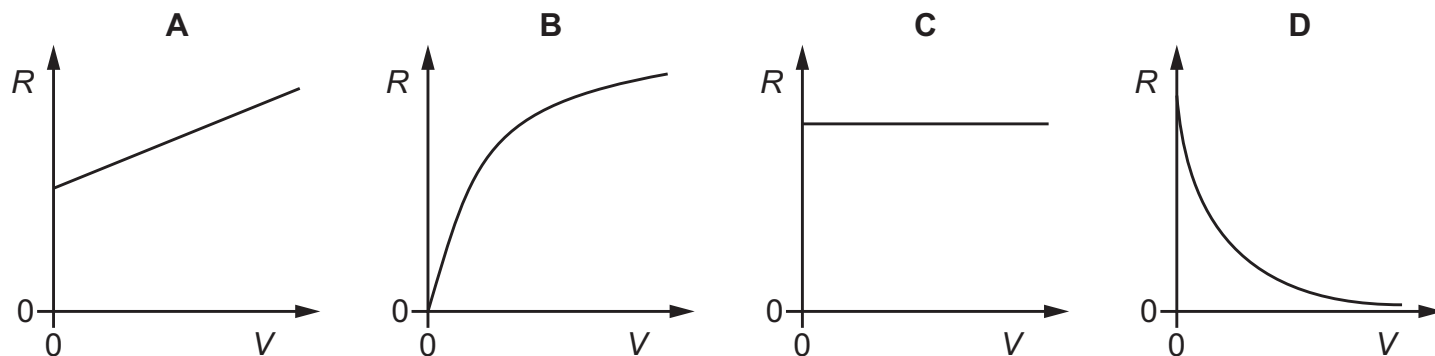
$$I = Anvq$$

What does the letter n represent in this equation?

- A** charge carried per charge carrier
- B** number of charge carriers per unit area
- C** number of charge carriers per unit volume
- D** total mass of charge carriers per unit volume

268. Question | 9702 Oct-Nov 2023 P1 V1 Q32

- 32** Which graph could show how the resistance R of a filament lamp varies with the applied potential difference (p.d.) V , as V is increased to the normal operating p.d.?



269. Question | 9702 Oct-Nov 2023 P1 V1 Q33

- 33** A piece of conducting putty is in the shape of a cylinder of length 60 mm and diameter 20 mm. The resistance between the ends of the cylinder is $20\ \Omega$.

What is the resistivity of the putty?

- A** $0.033\ \Omega\text{m}$ **B** $0.10\ \Omega\text{m}$ **C** $0.42\ \Omega\text{m}$ **D** $5.2\ \Omega\text{m}$

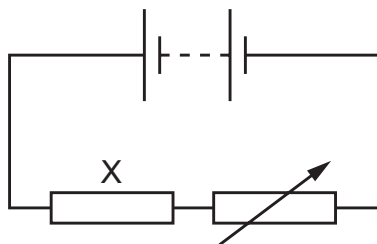
270. Question | 9702 Oct-Nov 2023 P1 V1 Q35

- 35** Kirchhoff's first and second laws are a consequence of the conservation of which quantities?

- A** charge and energy
B charge and resistance
C mass and energy
D mass and resistance

271. Question | 9702 Oct-Nov 2023 P1 V2 Q31

- 31** In the circuit shown, a fixed resistor X is connected in series with a battery and a variable resistor.



The power dissipated in resistor X is 7.2 W when a current of 3.0 A passes through it.

The variable resistor is adjusted so that the power dissipated in X increases by 50% .

What is the new current in the circuit?

- A** 2.4 A **B** 3.7 A **C** 4.5 A **D** 14 A

272. Question | 9702 Oct-Nov 2023 P1 V2 Q32

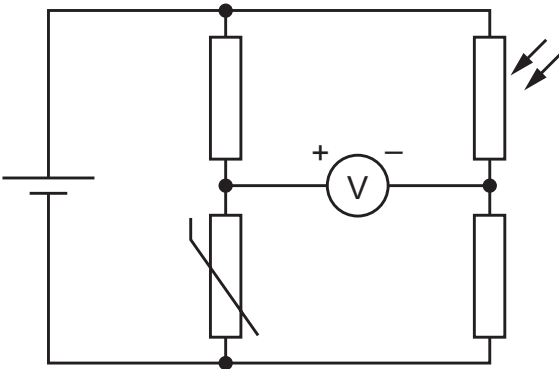
- 32** The potential difference across a metal wire is kept constant. The length l and the diameter d of the wire are both varied. The type of metal is kept the same.

How is the current in the wire related to l and d ?

- A** It is directly proportional to l and inversely proportional to d .
B It is directly proportional to l and inversely proportional to d^2 .
C It is inversely proportional to l and directly proportional to d .
D It is inversely proportional to l and directly proportional to d^2 .

273. Question | 9702 Oct-Nov 2023 P1 V2 Q33

33 A student sets up a circuit. The circuit diagram shows how the positive and negative terminals of a voltmeter are connected to the circuit. The voltmeter has an initial reading that is positive.



Which changes, if any, in temperature and light intensity would cause the voltmeter reading to **decrease**?

	temperature	light intensity
A	increase	increase
B	no change	decrease
C	decrease	no change
D	decrease	decrease

274. Question | 9702 Oct-Nov 2023 P1 V3 Q30

30 What could **not** be used to create an electric current?

- A** alpha-particles
- B** beta-particles
- C** neutrons
- D** protons

275. Question | 9702 Oct-Nov 2023 P1 V3 Q31

31 What is the definition of the potential difference (p.d.) across a component?

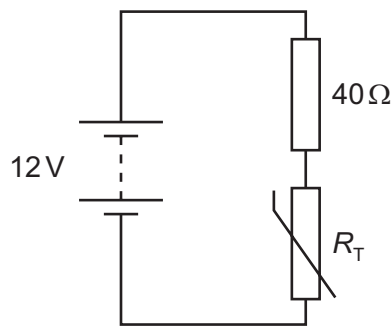
- A** the energy transferred per unit charge
- B** the energy transferred per unit current
- C** the power transferred per unit charge
- D** the power transferred per unit current

32 The resistance of a filament lamp increases as the current in it increases.

What is the reason for this?

- A** The charge of each charge carrier increases.
- B** The potential difference across the filament decreases.
- C** The power dissipated by the filament decreases.
- D** The temperature of the filament increases.

33 A battery of electromotive force (e.m.f.) 12 V and negligible internal resistance is connected to a fixed resistor of resistance $40\ \Omega$ and a thermistor of resistance R_T , as shown.



Initially, the temperature of the thermistor is $15\ ^\circ\text{C}$ and the current in the circuit is 0.10 A .
The temperature of the thermistor then changes, which causes the current to increase to 0.12 A .
How does the temperature of the thermistor change and what is R_T at the new temperature?

	temperature of thermistor	R_T at new temperature / Ω
A	increases	60
B	decreases	60
C	increases	100
D	decreases	100

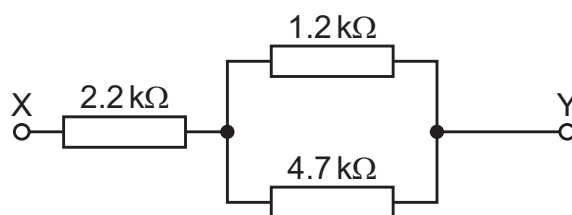
278. Question | 9702 Feb-March 2024 P1 V2 Q32

- 32** What are the definitions of potential difference (p.d.) and electromotive force (e.m.f.), in terms of energy transfer W and charge q ?

	p.d.	e.m.f.
A	$\frac{W}{q}$	$\frac{W}{q}$
B	$\frac{W}{q}$	Wq
C	Wq	$\frac{W}{q}$
D	Wq	Wq

279. Question | 9702 Feb-March 2024 P1 V2 Q33

- 33** The diagram shows a network consisting of three resistors.



What is the combined resistance of the network between terminal X and terminal Y?

- A** $0.67\text{ k}\Omega$ **B** $1.6\text{ k}\Omega$ **C** $3.2\text{ k}\Omega$ **D** $8.1\text{ k}\Omega$

280. Question | 9702 Feb-March 2024 P1 V2 Q34

- 34** A resistor dissipates 25 W of power when there is a potential difference (p.d.) of 4.0 V across it.

What is the resistance of the resistor?

- A** $0.16\text{ }\Omega$ **B** $0.64\text{ }\Omega$ **C** $100\text{ }\Omega$ **D** $400\text{ }\Omega$

281. Question | 9702 Feb-March 2024 P1 V2 Q36

- 36** A radioactive source produces a beam of α -particles in a vacuum. The average current caused by the α -particles in the beam is 1.5×10^{-9} A.

The beam is incident on a metal target.

What is the average number of α -particles hitting the metal target in a time of 3.0 s?

- A** 4.7×10^9 **B** 9.4×10^9 **C** 1.4×10^{10} **D** 2.8×10^{10}

282. Question | 9702 Feb-March 2024 P1 V2 Q37

- 37** The charge carriers in a metal wire are free electrons.

Which statement about the charge of each free electron is correct?

- A** The magnitude of the charge increases with the potential difference across the wire.
B The magnitude of the charge is zero unless there is a potential difference across the wire.
C The sign and magnitude of the charge do **not** depend on the potential difference across the wire.
D The sign of the charge depends on the potential difference across the wire.

283. Question | 9702 May-June 2024 P1 V1 Q31

- 31** What is the unit of resistivity?

- A** $\Omega \text{ m}^{-2}$ **B** $\Omega \text{ m}^{-1}$ **C** Ω **D** $\Omega \text{ m}$

284. Question | 9702 May-June 2024 P1 V1 Q32

32 A kettle is connected to a 250 V mains supply.

What are possible values for the power of the kettle and the current in the kettle?

	power / W	current / A
A	500	0.5
B	500	5.0
C	2500	0.1
D	2500	10

285. Question | 9702 May-June 2024 P1 V2 Q29

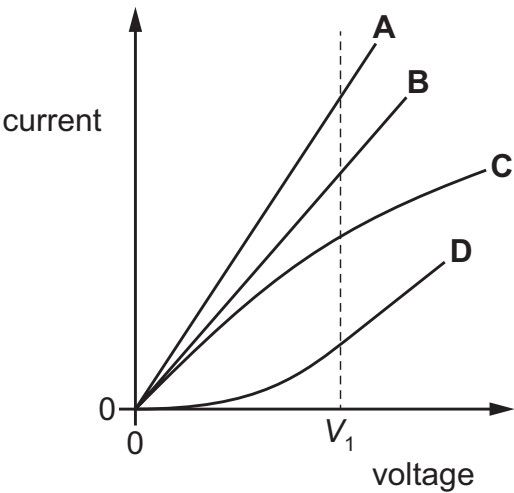
29 What is the definition of potential difference across a component?

- A** energy transferred per unit charge
- B** energy transferred per unit current
- C** energy transferred per unit distance
- D** energy transferred per unit time

286. Question | 9702 May-June 2024 P1 V2 Q31

31 The I – V characteristics for four components, **A**, **B**, **C** and **D**, are shown.

Which component has the greatest resistance when the potential difference across it is V_1 ?



287. Question | 9702 May-June 2024 P1 V2 Q32

- 32** A cylindrical wire has cross-sectional area A and number density of free electrons n . The wire has current I and the free electrons have average drift speed v .

A second cylindrical wire has cross-sectional area $0.5A$ and number density of free electrons $2n$. In this wire, the free electrons have average drift speed $2v$.

What is the current in the second wire?

- A** $0.5I$ **B** I **C** $2I$ **D** $4I$

288. Question | 9702 May-June 2024 P1 V2 Q33

- 33** An electric current is formed by moving charge carriers.

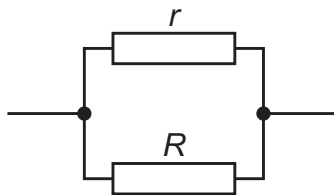
What is **not** a possible charge on a charge carrier?

- A** $-4.8 \times 10^{-19} \text{ C}$
B $-2.4 \times 10^{-19} \text{ C}$
C $+1.6 \times 10^{-19} \text{ C}$
D $+3.2 \times 10^{-19} \text{ C}$

289. Question | 9702 May-June 2024 P1 V2 Q35

- 35** Two resistors of resistances r and R are connected in parallel.

The value of r is less than that of R .



Which statement about the combined resistance of the two resistors is correct?

- A** It is between r and R .
B It is equal to $(r + R)$.
C It is greater than $(r + R)$.
D It is less than r .

290. Question | 9702 May-June 2024 P1 V3 Q30

30 Which quantity is given by the product of charge and electric potential difference?

- A** current
- B** energy transferred
- C** power dissipated
- D** resistance

291. Question | 9702 May-June 2024 P1 V3 Q31

31 The current in a filament lamp is increased.

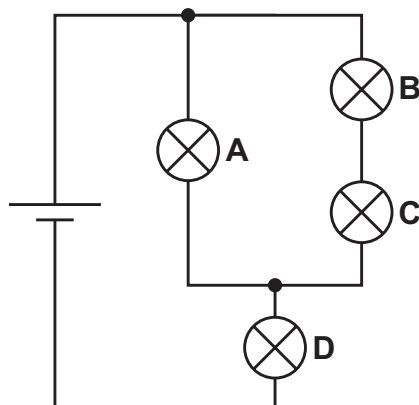
Which statement about the lamp is correct?

- A** The brightness of the lamp decreases.
- B** The potential difference across the filament decreases.
- C** The resistance of the filament decreases.
- D** The temperature of the filament increases.

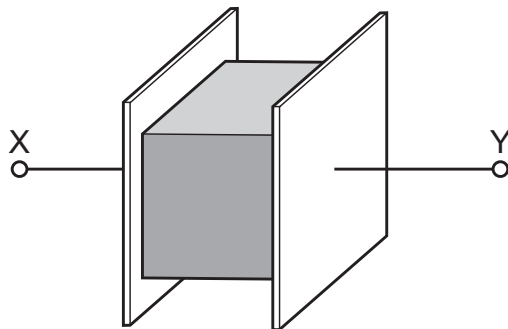
292. Question | 9702 May-June 2024 P1 V3 Q32

32 A student builds the circuit shown. All the lamps are identical.

Which lamp dissipates the most power?



- 33** The resistance of a metal cube is measured by placing it between two parallel plates, as shown.



The cube has volume V and is made of a material with resistivity ρ . The connections to the cube have negligible resistance.

Which expression gives the electrical resistance of the metal cube between X and Y?

A $\rho V^{\frac{1}{3}}$

B $\rho V^{\frac{2}{3}}$

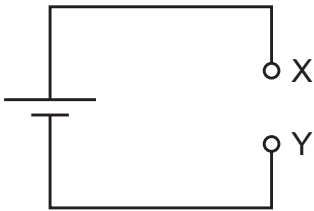
C $\frac{\rho}{V^{\frac{1}{3}}}$

D $\frac{\rho}{V^{\frac{2}{3}}}$

294. Question | 9702 May-June 2024 P1 V3 Q34

34 A circuit needs to be completed by connecting two resistors between points X and Y, as shown.

The resistors can be connected in series or in parallel with each other.



Which combination of resistors produces the least resistance between X and Y?

	resistances of resistors / Ω	type of combination
A	20 and 40	parallel
B	40 and 100	parallel
C	20 and 40	series
D	40 and 100	series

295. Question | 9702 Oct-Nov 2024 P1 V1 Q33

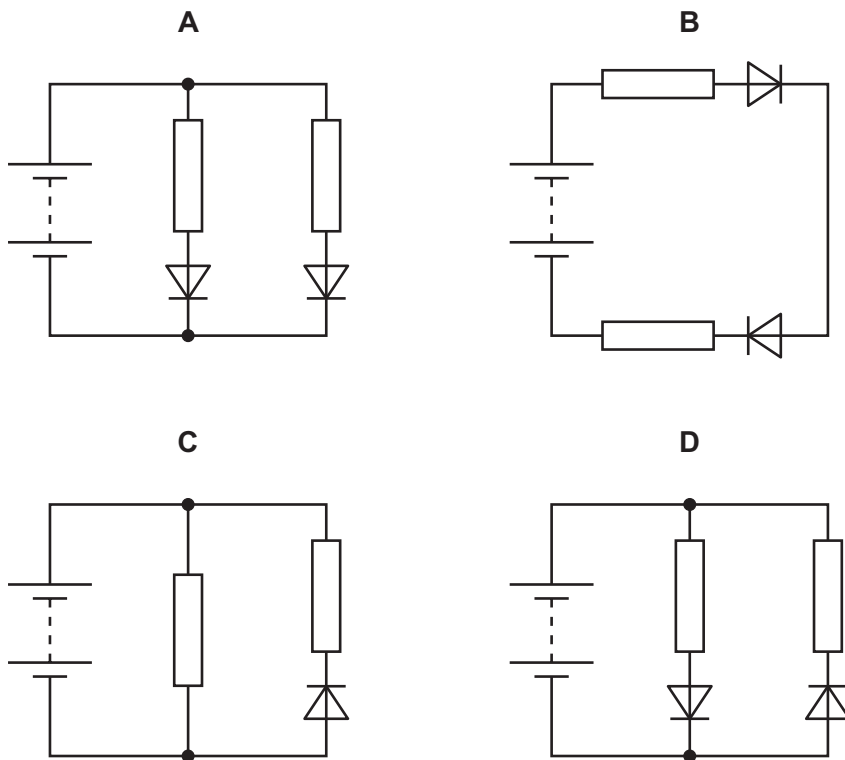
33 A torch uses three lamps connected in parallel and is powered by a cell of electromotive force (e.m.f.) 3.0 V and negligible internal resistance. Each lamp dissipates 0.60 W of power.

What is the current in the cell?

- A** 0.067 A **B** 0.20 A **C** 0.60 A **D** 0.83 A

- 36** In the circuits shown, the batteries are identical and all have negligible internal resistance. All of the resistors have the same resistance. The diodes have zero resistance when conducting and infinite resistance when not conducting.

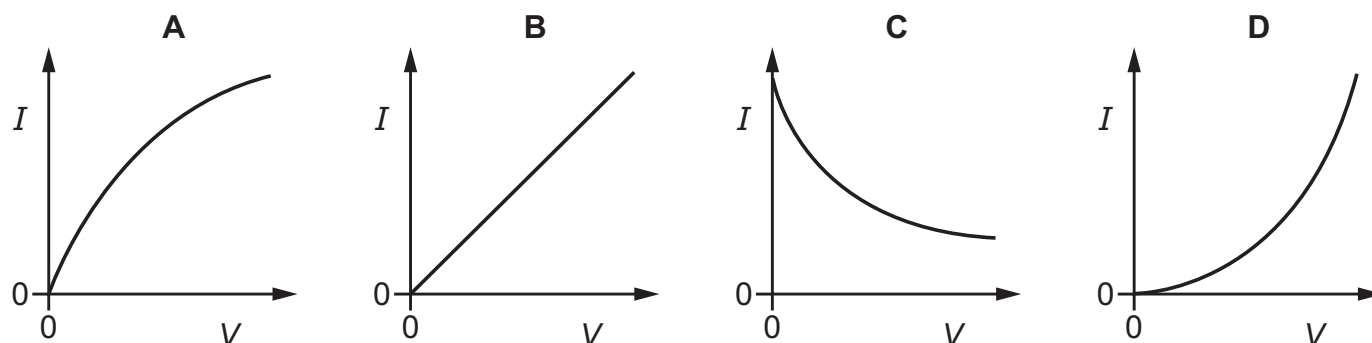
In which circuit is the current in the battery greatest?



297. Question | 9702 Oct-Nov 2024 P1 V2 Q33

- 33** The potential difference V across a filament lamp is slowly raised from zero to its normal operating value.

Which graph represents the variation with V of the current I in the lamp?



298. Question | 9702 Oct-Nov 2024 P1 V2 Q34

- 34** An electric current of 12 A is in a wire of length 0.35 m .

The average drift speed of the free electrons (charge carriers) in the wire is $5.0 \times 10^{-4}\text{ ms}^{-1}$.

How many free electrons are in the wire?

- A** 1.3×10^{16} **B** 5.3×10^{22} **C** 1.5×10^{23} **D** 4.3×10^{23}

299. Question | 9702 Oct-Nov 2024 P1 V3 Q31

31 What is an electric current?

- A** a flow of charge carriers
- B** a flow of energy
- C** an electron
- D** the charge on a particle

300. Question | 9702 Oct-Nov 2024 P1 V3 Q32

32 A wire of diameter d is connected into an electric circuit. There is a current I in the wire and the charge carriers have an average drift speed v .

The wire is replaced with a new wire of the same material but with a diameter $0.5d$.

The current is adjusted so that the charge carriers in the new wire have an average drift speed $3v$.

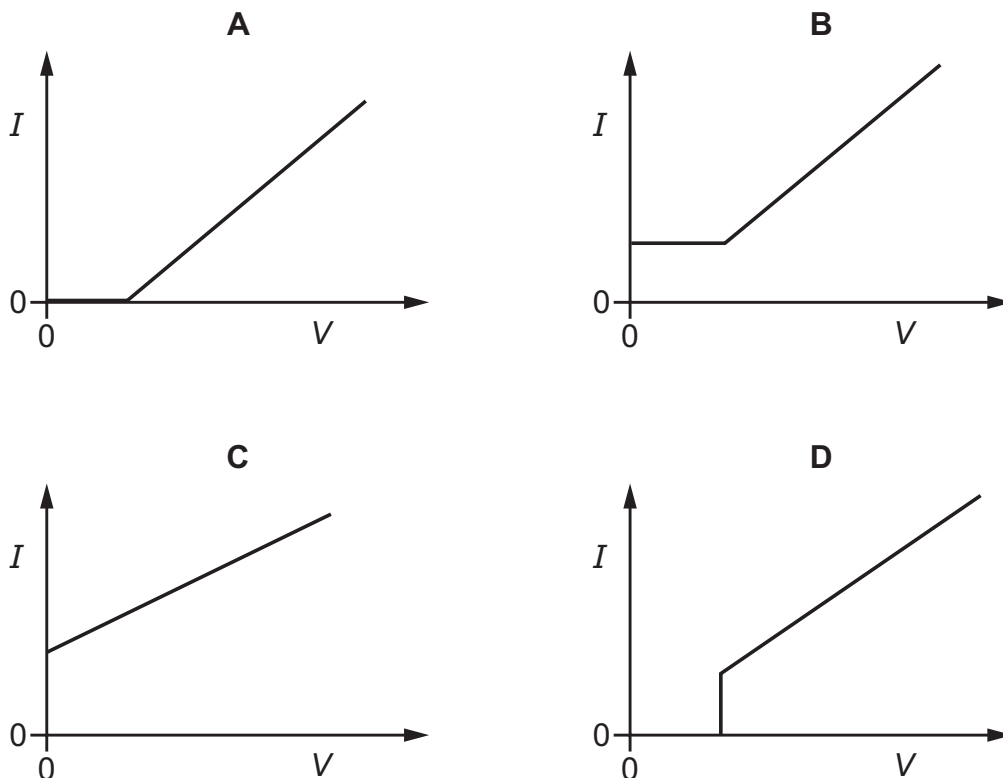
What is the current in the new wire?

- A** $0.75I$
- B** $1.5I$
- C** $6I$
- D** $12I$

301. Question | 9702 Oct-Nov 2024 P1 V3 Q33

- 33** A fixed resistor and a diode are combined by connecting them in series. The total potential difference V across the combination is varied and the corresponding current I is measured.

Which graph could represent the variation of I with V ?



302. Question | 9702 Oct-Nov 2024 P1 V3 Q34

- 34** The potential difference (p.d.) across a fixed resistor is V . The power dissipated in the resistor is 5.0 W .

The p.d. across the resistor then changes to a new value. With the new p.d. the energy transferred to the resistor in a time of 2.25 s is 45.0 J .

What is the new p.d. across the resistor?

- A** $\frac{1}{2}V$ **B** $2V$ **C** $3V$ **D** $4V$

303. Question | 9702 Feb-March 2025 P1 V2 Q30

30 Two cylindrical conductors, X and Y, are made from the same material. The conductors have equal lengths, but Y has a smaller diameter than X.

X and Y are connected in series to a cell.

Which row compares the number of charge carriers per unit time passing through X and through Y and compares the average drift speed of the charge carriers in X and in Y?

	number of charge carriers per unit time	average drift speed of charge carriers
A	Y greater than X	Y greater than X
B	Y same as X	Y same as X
C	Y greater than X	Y same as X
D	Y same as X	Y greater than X

304. Question | 9702 Feb-March 2025 P1 V2 Q31

31 A copper wire is 6.4 m long and has a resistance of $0.92\,\Omega$.

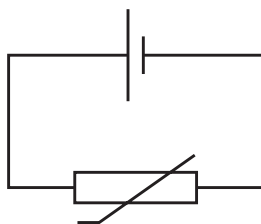
The resistivity of copper is $1.8 \times 10^{-8}\,\Omega\text{m}$.

What is the diameter of the wire?

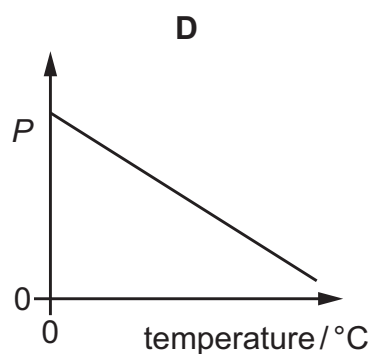
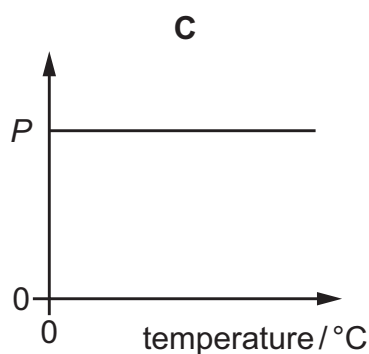
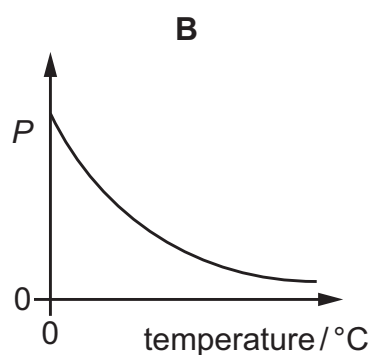
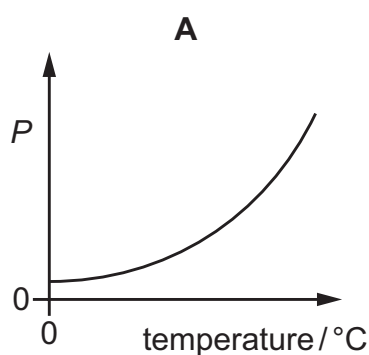
- A** $5.7 \times 10^{-5}\text{m}$ **B** $1.0 \times 10^{-4}\text{m}$ **C** $4.0 \times 10^{-4}\text{m}$ **D** $7.1 \times 10^{-4}\text{m}$

305. Question | 9702 Feb-March 2025 P1 V2 Q32

- 32** A thermistor is connected to a cell with negligible internal resistance.



Which graph shows the variation with temperature of power, P , dissipated in the thermistor?



306. Question | 9702 Feb-March 2025 P1 V2 Q33

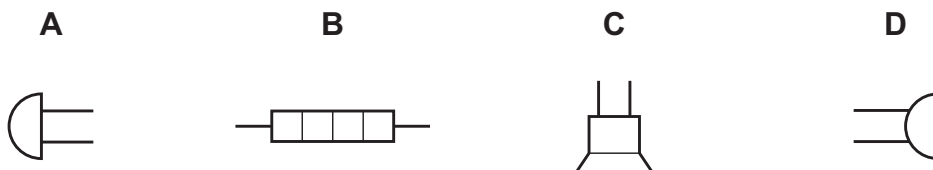
- 33** A metal electrical conductor has a resistance of $5.6 \text{ k}\Omega$. A potential difference (p.d.) of 9.0 V is applied across its ends.

How many electrons pass a point in the conductor in one minute?

- A** 6.0×10^{20} **B** 1.0×10^{19} **C** 6.0×10^{17} **D** 1.0×10^{16}

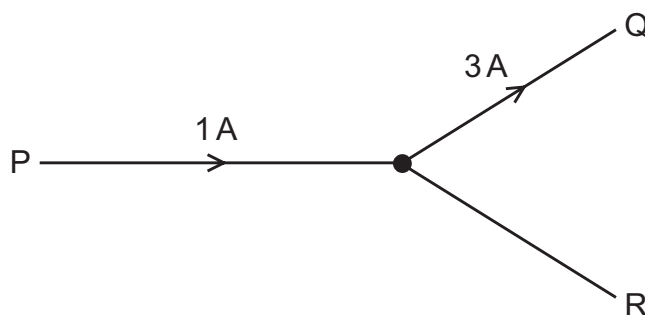
307. Question | 9702 Feb-March 2025 P1 V2 Q34

- 34** Which circuit symbol does **not** represent an electric component that is designed to emit sound waves?



308. Question | 9702 Feb-March 2025 P1 V2 Q35

- 35** The diagram shows a junction in a circuit where three wires, P, Q and R, meet. The currents in P and Q are 1 A and 3 A respectively, in the directions shown.



How much charge passes a given point in wire R in a time of 5 s?

- A** 0.4 C **B** 2 C **C** 10 C **D** 20 C

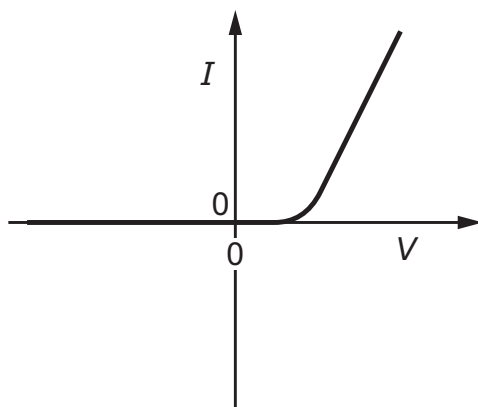
309. Question | 9702 May-June 2025 P1 V1 Q32

- 32** Which expression gives the definition of resistance?

- A** current divided by potential difference
B current multiplied by potential difference
C potential difference divided by current
D resistivity multiplied by length

310. Question | 9702 May-June 2025 P1 V1 Q33

33 The graph shows the I - V characteristic of an electrical component.



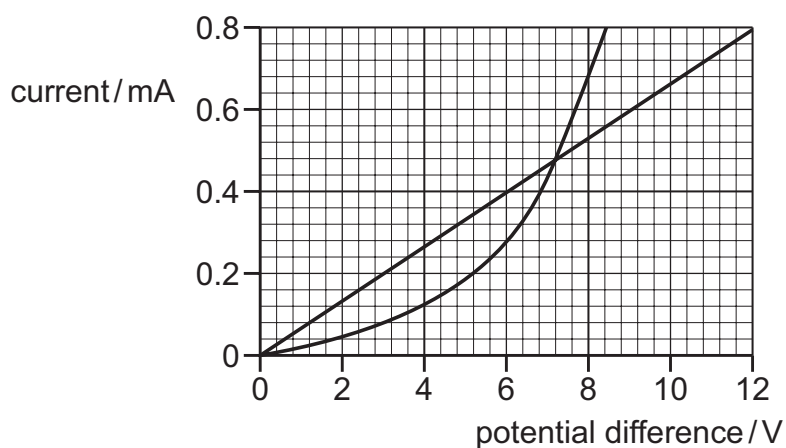
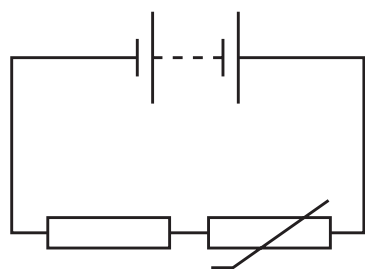
What is the component?

- A** a filament lamp
- B** a metallic conductor at constant temperature
- C** a resistor
- D** a semiconductor diode

311. Question | 9702 May-June 2025 P1 V1 Q35

35 The diagram shows a circuit containing a thermistor, a fixed resistor and a battery.

The graph shows the I - V characteristics of both components.



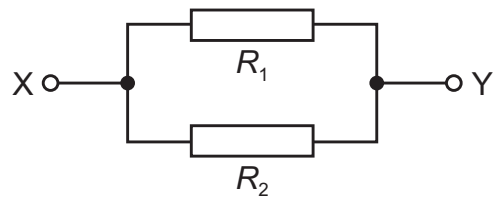
The battery has an e.m.f. of 12 V and negligible internal resistance.

What is the current in the fixed resistor?

- A** 0.36 mA
- B** 0.40 mA
- C** 0.48 mA
- D** 0.80 mA

312. Question | 9702 May-June 2025 P1 V1 Q36

36 Two resistors of resistances R_1 and R_2 are connected in parallel.



What is the combined resistance between X and Y?

- A** $R_1 + R_2$ **B** $\frac{R_1 R_2}{R_1 + R_2}$ **C** $\frac{R_1 + R_2}{R_1 R_2}$ **D** $\frac{R_1}{R_2}$

313. Question | 9702 May-June 2025 P1 V2 Q32

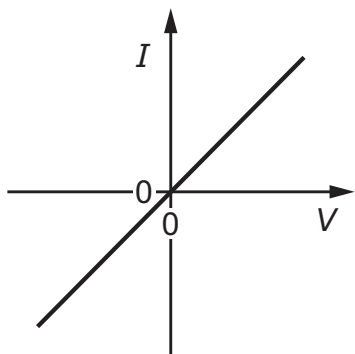
32 A wire is made from a metal of constant resistivity. There is a constant current in the wire.

Which statement about the potential difference across the wire is correct?

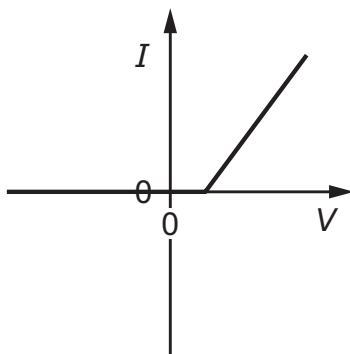
- A** It is directly proportional to the length of the wire.
B It is inversely proportional to the length of the wire.
C It is directly proportional to the diameter of the wire.
D It is inversely proportional to the diameter of the wire.

314. Question | 9702 May-June 2025 P1 V2 Q33

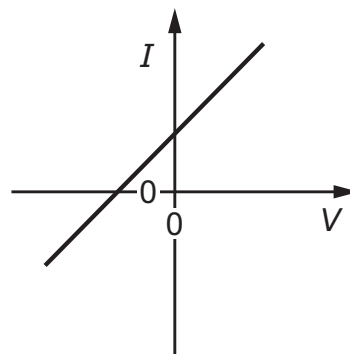
33 The I – V characteristics for three electrical components are shown.



1



2



3

Which components obey Ohm's law?

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

315. Question | 9702 May-June 2025 P1 V2 Q34

34 A resistor of resistance $200\ \Omega$ is connected to a supply that has a p.d. of $4.00\ \text{V}$.

How many electrons enter the resistor in $4.00\ \text{s}$?

- A** 3.13×10^{16} **B** 1.25×10^{17} **C** 5.00×10^{17} **D** 1.25×10^{21}

316. Question | 9702 May-June 2025 P1 V3 Q2

2 What is a reasonable estimate of the current in an electric kettle that is in use?

- A** $8\ \mu\text{A}$ **B** $8\ \text{mA}$ **C** $8\ \text{A}$ **D** $8\ \text{kA}$

317. Question | 9702 May-June 2025 P1 V3 Q32

32 The current I in a metallic conductor of cross-sectional area A is given by

$$I = Anve$$

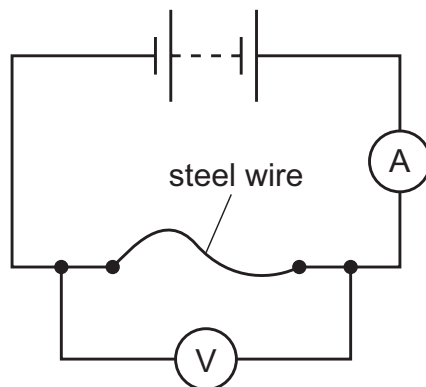
where e is the elementary charge and v is the mean drift velocity of the conduction electrons.

What is represented by the letter n in the equation?

- A** density of conduction electrons
B number of conduction electrons per unit time
C number of conduction electrons per unit volume
D volume of conduction electrons

318. Question | 9702 May-June 2025 P1 V3 Q34

34 A steel wire with a length of 2.20 m is connected to a battery as shown.



The reading on the voltmeter is 1.50 V and the reading on the ammeter is 4.90 A.

The resistivity of steel is $6.90 \times 10^{-7} \Omega \text{ m}$.

What is the diameter of the steel wire?

- A** $1.76 \times 10^{-4} \text{ m}$ **B** $3.52 \times 10^{-4} \text{ m}$ **C** $1.26 \times 10^{-3} \text{ m}$ **D** $2.51 \times 10^{-3} \text{ m}$

319. Question | 9702 May-June 2025 P1 V4 Q29

29 The resistance of a lamp is 10Ω and the potential difference across it is 6.0 V.

How many electrons pass through the lamp in a time of 24 hours?

- A** 5.2×10^4 **B** 9.0×10^{19} **C** 5.4×10^{21} **D** 3.2×10^{23}

320. Question | 9702 May-June 2025 P1 V4 Q30

30 What is equivalent to one volt?

- A** one coulomb per second
B one joule per coulomb
C one joule per second
D one joule second per coulomb squared

321. Question | 9702 May-June 2025 P1 V4 Q31

31 The resistance of some electrical components may change with changing conditions.

Which component's resistance increases?

- A** a filament lamp as the potential difference (p.d.) across it increases
- B** a light-dependent resistor (LDR) as the intensity of the light incident on it increases
- C** a metallic conductor at constant temperature as the current through it increases
- D** a thermistor as its temperature increases

322. Question | 9702 May-June 2025 P1 V4 Q32

32 Gold is sometimes used to make very small connecting wires in electronic circuits.

A particular gold wire has length $2.50 \times 10^{-3} \text{ m}$ and cross-sectional area $6.25 \times 10^{-8} \text{ m}^2$. Gold has resistivity $2.3 \times 10^{-8} \Omega \text{ m}$.

What is the resistance of the wire?

- A** $3.6 \times 10^{-18} \Omega$
- B** $5.8 \times 10^{-13} \Omega$
- C** $9.2 \times 10^{-4} \Omega$
- D** $6.8 \times 10^{-3} \Omega$

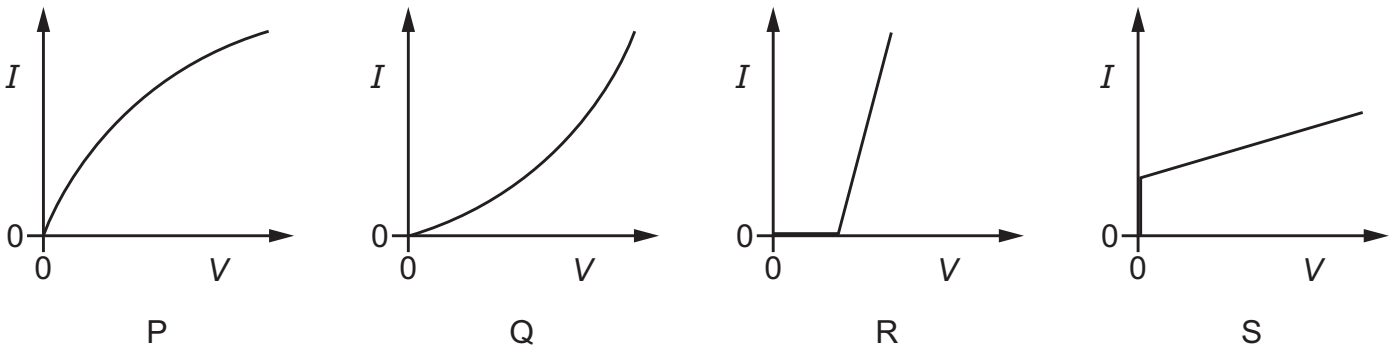
323. Question | 9702 Oct-Nov 2025 P1 V1 Q31

31 There is a potential difference V across a resistor of resistance R . The current in the resistor is I .

Which equation gives the power P dissipated by the resistor?

- A** $P = V^2 I$ **B** $P = \frac{V^2}{I}$ **C** $P = V^2 R$ **D** $P = \frac{V^2}{R}$

33 The graphs show possible current–voltage (I – V) characteristics for a filament lamp and for a semiconductor diode.

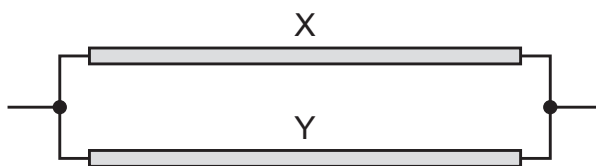


Which row identifies the I – V graphs for the lamp and for the diode?

	filament lamp	semiconductor diode
A	P	R
B	P	S
C	Q	R
D	Q	S

325. Question | 9702 Oct-Nov 2025 P1 V1 Q36

- 36** Two identical wires X and Y, each of length L and radius r , are connected in parallel as shown.



The total resistance of this combination is R_1 .

Wire X is replaced with a wire of the same material with length L and radius $2r$.

The total resistance of the new combination is R_2 .

What is the ratio $\frac{R_1}{R_2}$?

A $\frac{2}{5}$

B $\frac{2}{3}$

C $\frac{3}{2}$

D $\frac{5}{2}$

326. Question | 9702 Oct-Nov 2025 P1 V2 Q32

- 32** The current in a resistor of constant resistance is 8.0 mA. The power dissipated by the resistor is P .

The current in the resistor is increased to 12.0 mA.

What is the new power dissipated by the resistor?

A $0.44P$

B $0.67P$

C $1.5P$

D $2.3P$

327. Question | 9702 Oct-Nov 2025 P1 V2 Q33

- 33** A piece of wire X has resistivity ρ , length L and cross-sectional area A . Wire X has a resistance R .

A second piece of wire Y is made of a different metal. It has the same resistance as X but has twice the length of X.

Which row gives possible values for the resistivity and the cross-sectional area of Y?

	resistivity	cross-sectional area
A	$\frac{1}{2}\rho$	$\frac{1}{2}A$
B	$\frac{1}{2}\rho$	A
C	ρ	$\frac{1}{2}A$
D	2ρ	A

328. Question | 9702 Oct-Nov 2025 P1 V2 Q34

- 34** A cell of electromotive force (e.m.f.) E delivers a charge Q to an external circuit.

Which statement is correct?

- A** The energy dissipated in the external circuit is EQ .
- B** The energy dissipated within the cell is EQ .
- C** The external resistance is EQ .
- D** The total energy dissipated in the cell and the external circuit is EQ .

329. Question | 9702 Oct-Nov 2025 P1 V3 Q31

- 31** There is a potential difference V across a resistor of resistance R . The current in the resistor is I .

Which equation gives the power P dissipated by the resistor?

- A** $P = V^2 I$ **B** $P = \frac{V^2}{I}$ **C** $P = V^2 R$ **D** $P = \frac{V^2}{R}$

32 What is a possible charge on a particle?

A $6.40 \times 10^{-20} \text{ C}$

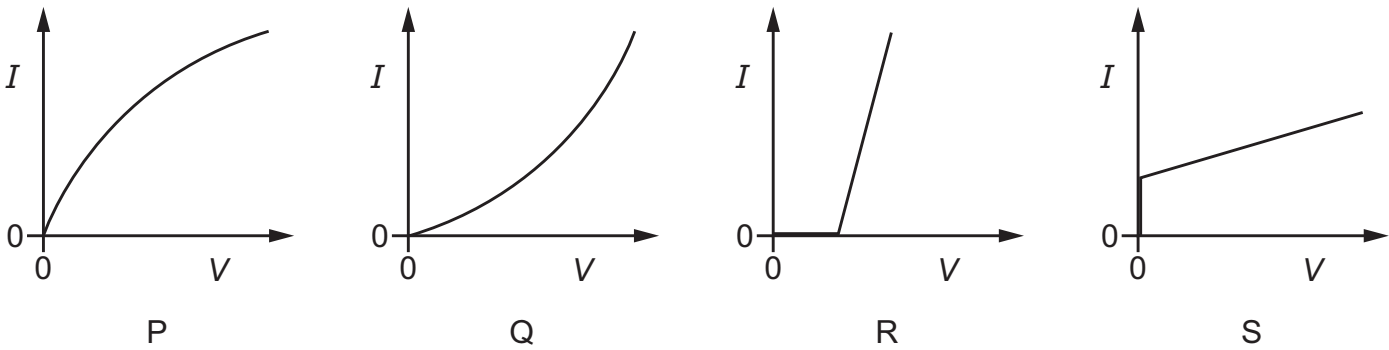
B $4.00 \times 10^{-19} \text{ C}$

C $1.12 \times 10^{-18} \text{ C}$

D $9.11 \times 10^{-18} \text{ C}$

331. Question | 9702 Oct-Nov 2025 P1 V3 Q33

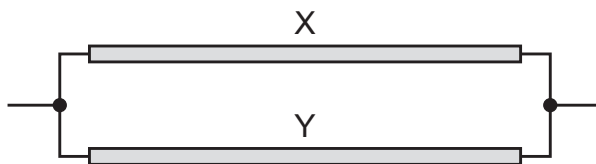
33 The graphs show possible current–voltage (I – V) characteristics for a filament lamp and for a semiconductor diode.



Which row identifies the I – V graphs for the lamp and for the diode?

	filament lamp	semiconductor diode
A	P	R
B	P	S
C	Q	R
D	Q	S

- 36** Two identical wires X and Y, each of length L and radius r , are connected in parallel as shown.



The total resistance of this combination is R_1 .

Wire X is replaced with a wire of the same material with length L and radius $2r$.

The total resistance of the new combination is R_2 .

What is the ratio $\frac{R_1}{R_2}$?

A $\frac{2}{5}$

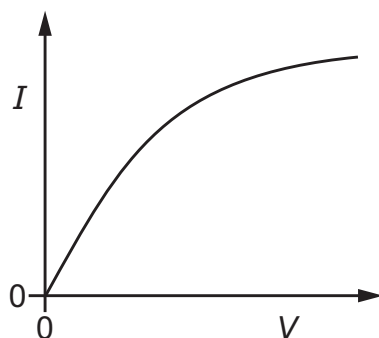
B $\frac{2}{3}$

C $\frac{3}{2}$

D $\frac{5}{2}$

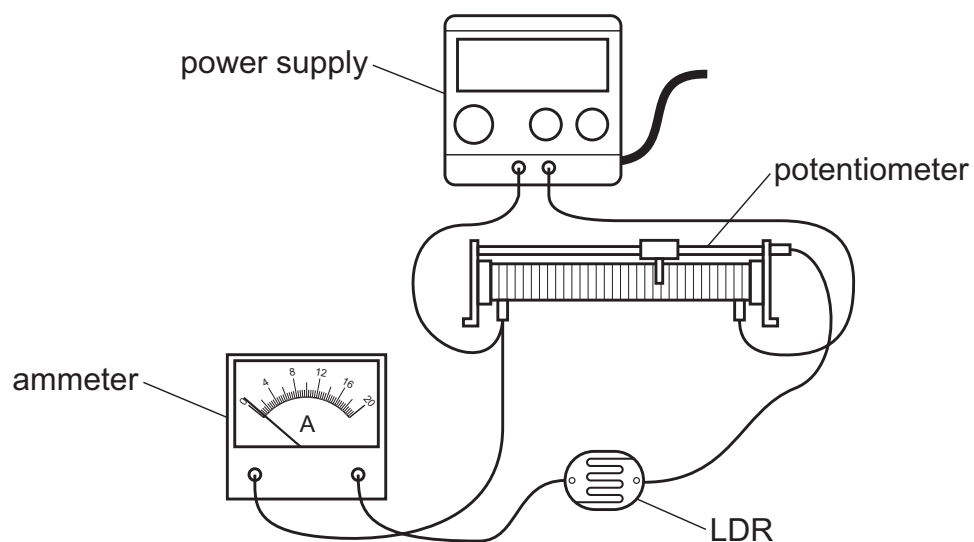
333. Question | 9702 Oct-Nov 2025 P1 V4 Q32

32 Which component has the I – V graph shown?

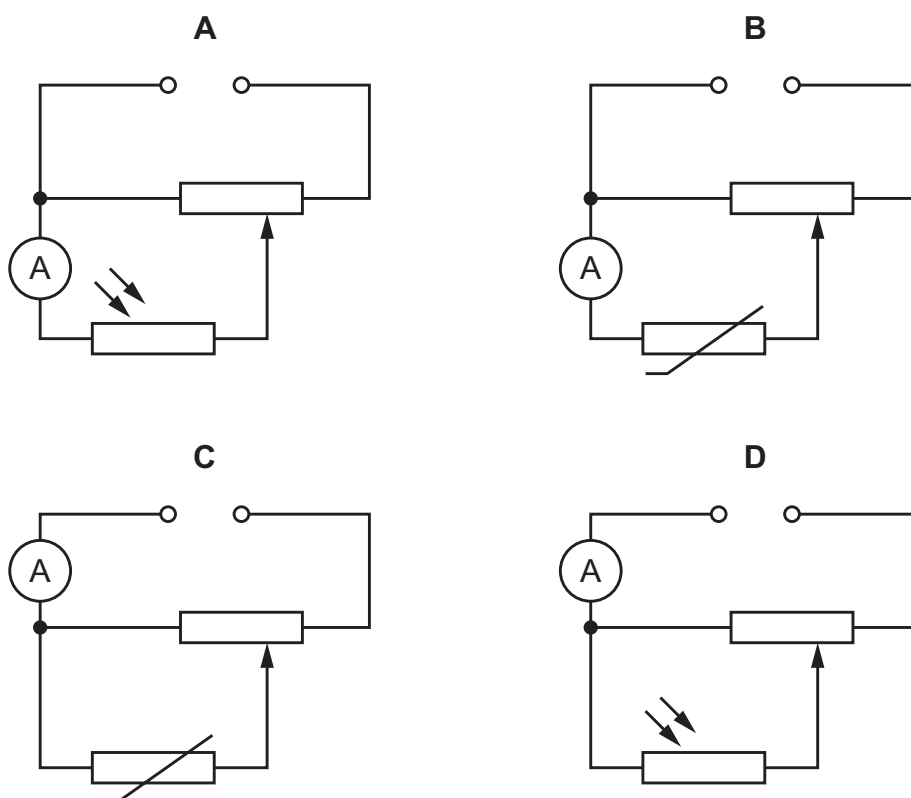


- A** filament lamp
- B** metallic conductor at constant temperature
- C** resistor of fixed resistance
- D** semiconductor diode

33 The diagram shows an electrical circuit containing a light-dependent resistor (LDR).



What is the circuit diagram for this circuit?



335. Question | 9702 Oct-Nov 2025 P1 V4 Q34

- 34** A copper wire of length 2 m has a circular cross-section. There is a constant current in the wire when it is connected to a mobile phone in order to charge the battery.

The wire has a fault. A 1 m length of the wire has half the diameter of the other 1 m length.

The power dissipated in the thicker length of wire is P .

What is the power dissipated in the thinner length of wire?

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

336. Question | 9702 Oct-Nov 2025 P1 V4 Q35

- 35** A wire carries a current of 5.6 A.

What is the number of conduction electrons that pass a point on the wire in a time of 20 s?

- A** 1.8×10^{18} **B** 2.2×10^{19} **C** 3.5×10^{19} **D** 7.0×10^{20}