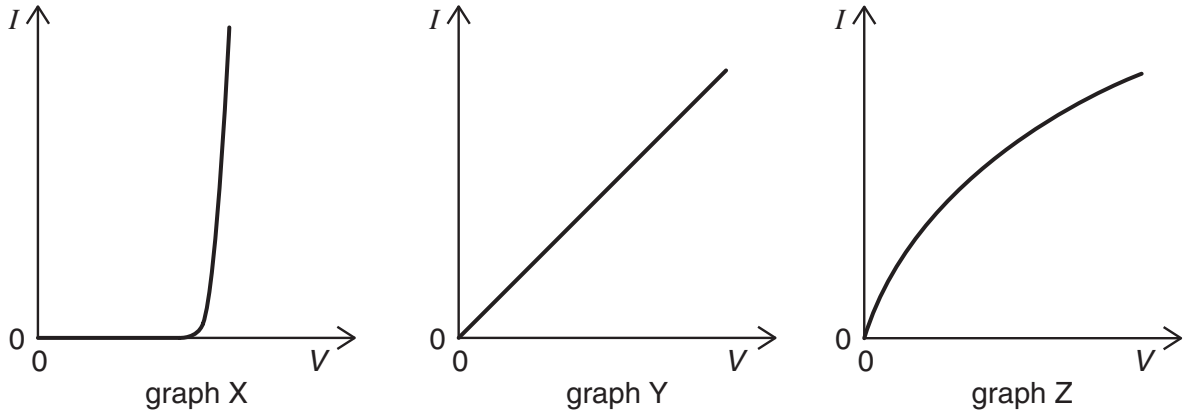
1 The graphs show the variation with potential difference V of the current I for three circuit elements.



The three circuit elements are a metal wire at constant temperature, a semiconductor diode and a filament lamp.

Which row of the table 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

2 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 this lamp at room temperature?

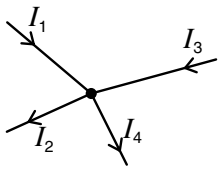
A 36 Ω **B** 580 Ω **C** 1.5 kΩ **D** 9.2 kΩ

3 The diagrams show connected wires which carry currents I_1, I_2, I_3 and I_4.

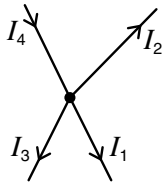
The currents are related by the equation $I_1 + I_2 = I_3 + I_4$.

To which diagram does this equation apply?

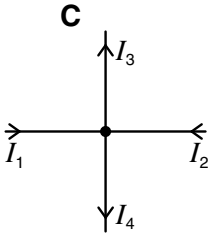
A



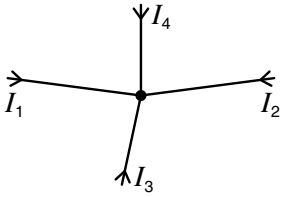
B



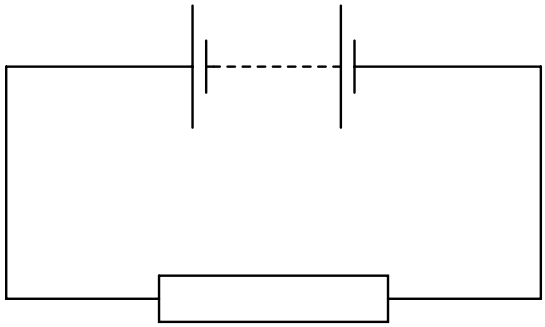
C



D



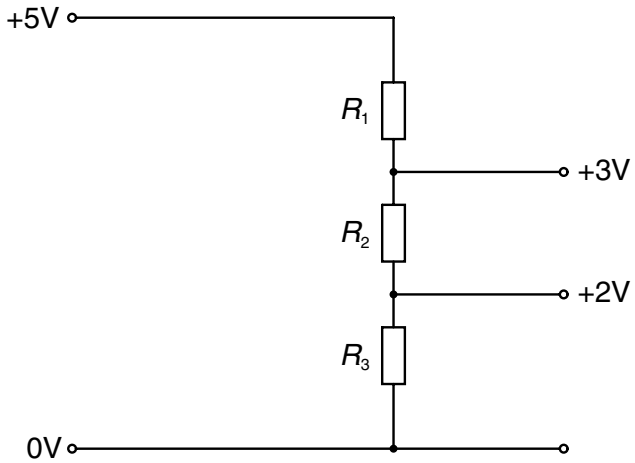
4 In the circuit below, the battery converts an amount E of chemical energy to electrical energy when charge Q passes through the resistor in time t.



Which expressions give the e.m.f. of the battery and the current in the resistor?

	e.m.f.	current
A	EQ	Q/t
B	EQ	Qt
C	E/Q	Q/t
D	E/Q	Qt

5 A potential divider is used to give outputs of 2 V and 3 V from a 5 V source, as shown.



What are possible values for the resistances R_1, R_2 and R_3?

	R_1/kΩ	R_2/kΩ	R_3/kΩ
A	2	1	5
B	3	2	2
C	4	2	4
D	4	6	10

6 When four identical lamps P, Q, R and S are connected as shown in diagram 1, they have normal brightness.

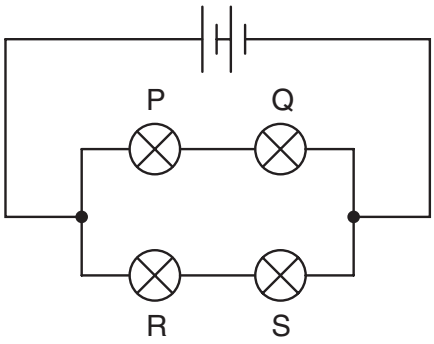


diagram 1

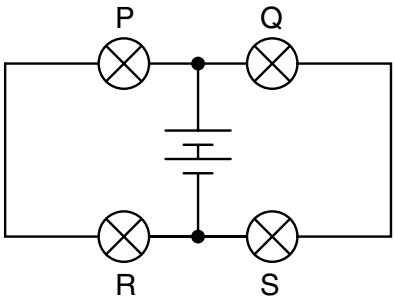


diagram 2

When the four lamps are connected as shown in diagram 2, which statement is correct?

A The lamps do not light.

B The lamps are less bright than normal.

C The lamps have normal brightness.

D The lamps are brighter than normal.

7 What physical quantity would result from a calculation in which a potential difference is multiplied by an electric charge?

A electric current

B electric energy

C electric field strength

D electric power

8 The current in a component is reduced uniformly from 100 mA to 20 mA over a period of 8.0 s.

What is the charge that flows during this time?

A 160 mC **B** 320 mC **C** 480 mC **D** 640 mC

9 The sum of the electrical currents into a point in a circuit is equal to the sum of the currents out of the point.

Which of the following is correct?

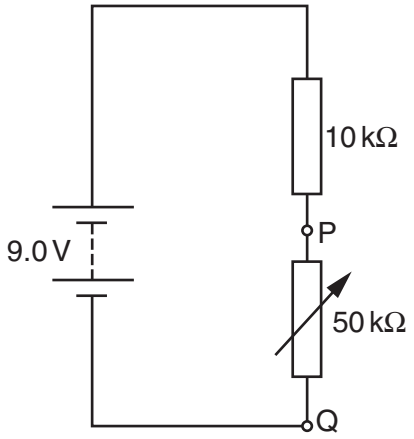
A This is Kirchhoff's first law, which results from the conservation of charge.

B This is Kirchhoff's first law, which results from the conservation of energy.

C This is Kirchhoff's second law, which results from the conservation of charge.

D This is Kirchhoff's second law, which results from the conservation of energy.

10 The diagram shows a potential divider connected to a 9.0 V supply of negligible internal resistance.



What range of voltages can be obtained between P and Q?

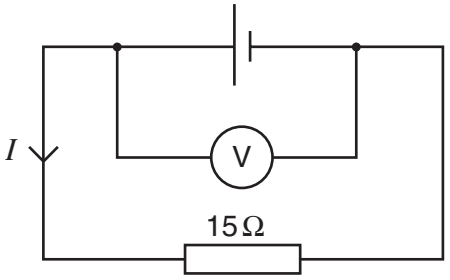
A zero to 1.5 V

B zero to 7.5 V

C 1.5 V to 7.5 V

D 1.5 V to 9.0 V

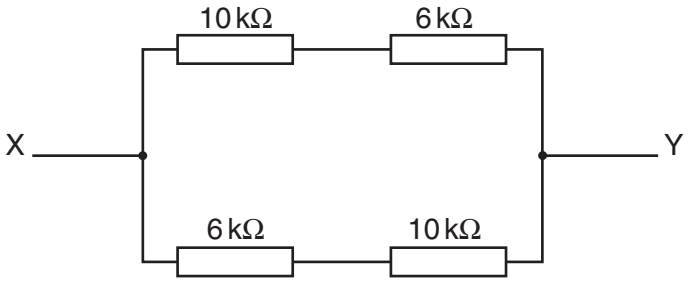
11 The e.m.f. of the cell in the following circuit is 9.0 V. The reading on the high-resistance voltmeter is 7.5 V.



What is the current I?

A 0.1 A **B** 0.5 A **C** 0.6 A **D** 2.0 A

12 The diagram shows an arrangement of four resistors.



What is the resistance between X and Y?

A 4 kΩ **B** 8 kΩ **C** 16 kΩ **D** 32 kΩ

13 The terminal voltage of a battery is observed to fall when the battery supplies a current to an external resistor.

What quantities are needed to calculate the fall in voltage?

A the battery's e.m.f. and its internal resistance

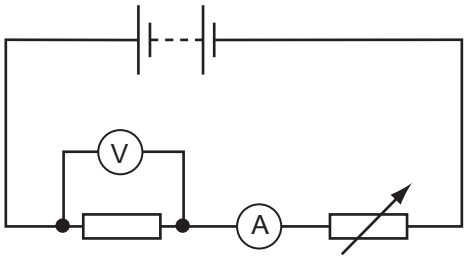
B the battery's e.m.f. and the current

C the current and the battery's internal resistance

D the current and the external resistance

14 The diagram shows a battery, a fixed resistor, an ammeter and a variable resistor connected in series.

A voltmeter is connected across the fixed resistor.



The value of the variable resistor is reduced.

Which correctly describes the changes in the readings of the ammeter and of the voltmeter?

	ammeter	voltmeter
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

15 A copper wire of cross-sectional area 2.0 mm^2 carries a current of 10 A.

How many electrons pass through a given cross-section of the wire in one second?

A 1.0×10^1 **B** 5.0×10^6 **C** 6.3×10^{19} **D** 3.1×10^{25}

16 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?

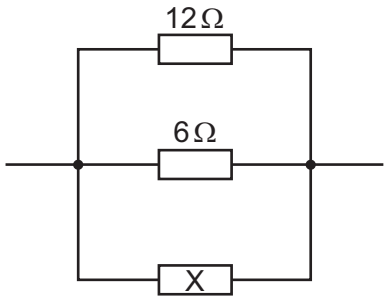
A $\frac{R}{2}$ **B** R **C** $2R$ **D** $4R$

17 Kirchhoff's two laws for electric circuits can be derived by using conservation laws.

On which conservation laws do Kirchhoff's laws depend?

	Kirchhoff's first law	Kirchhoff's second law
A	charge	current
B	charge	energy
C	current	mass
D	energy	current

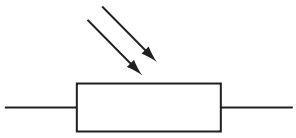
18 The diagram shows a parallel combination of three resistors. The total resistance of the combination is 3 Ω.



What is the resistance of resistor X?

A 2 Ω **B** 3 Ω **C** 6 Ω **D** 12 Ω

19 Which electrical component is represented by the following symbol?



A a diode

B a light-dependent resistor

C a resistor

D a thermistor

20 Which equation is used to define resistance?

A energy = $(\text{current})^2 \times \text{resistance} \times \text{time}$

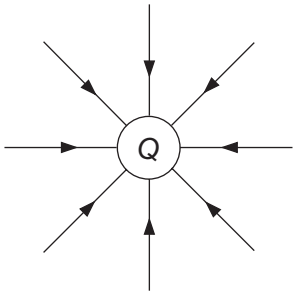
B potential difference = current × resistance

C power = $(\text{current})^2 \times \text{resistance}$

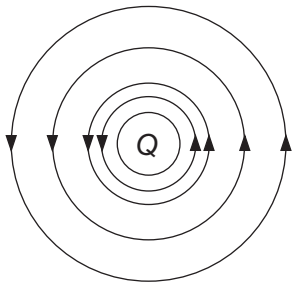
D resistivity = resistance × area ÷ length

21 Which diagram represents the electric field in the vicinity of a positive electric charge of magnitude *Q*?

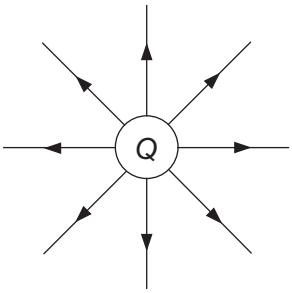
A



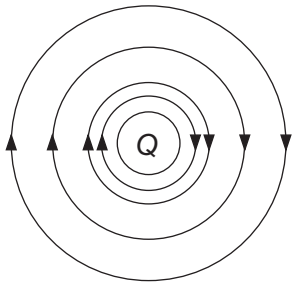
B



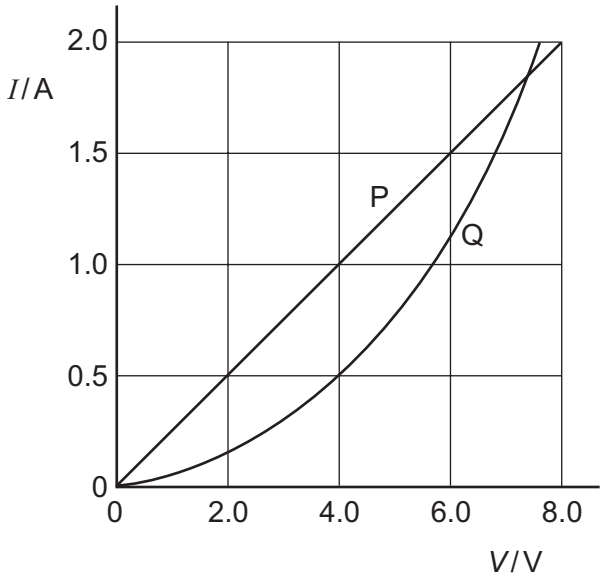
C



D



22 The *I*-*V* characteristics of two electrical components P and Q are shown below.



Which statement is correct?

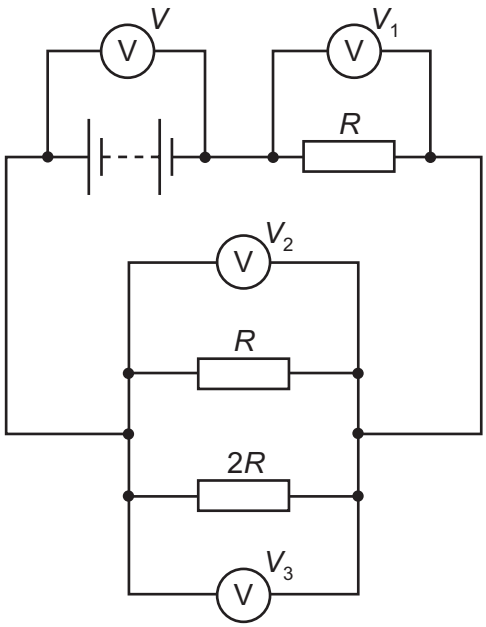
A P is a resistor and Q is a filament lamp.

B The resistance of Q increases as the current in it increases.

C At 1.9 A the resistance of Q is approximately half that of P.

D At 0.5 A the power dissipated in Q is double that in P.

23 The diagram shows a circuit with four voltmeter readings V, V_1, V_2 and V_3.



Which equation relating the voltmeter readings must be true?

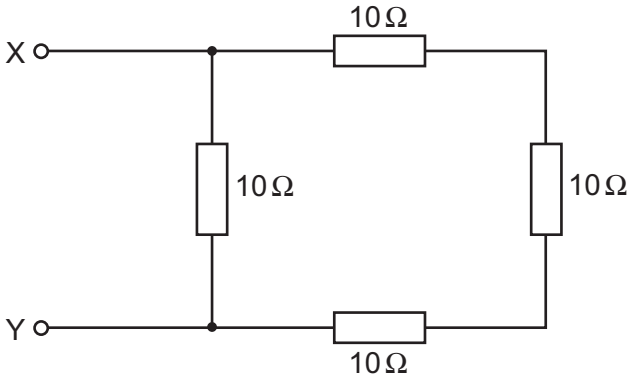
A $V = V_1 + V_2 + V_3$

B $V + V_1 = V_2 + V_3$

C $V_3 = 2(V_2)$

D $V - V_1 = V_3$

24 The diagram shows an arrangement of resistors.



What is the total electrical resistance between X and Y?

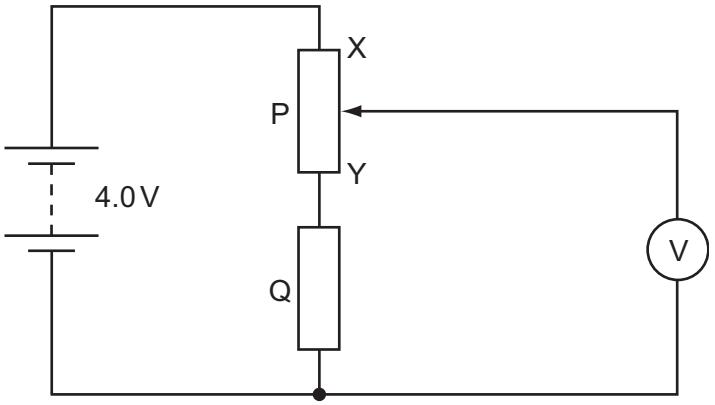
A less than 1 Ω

B between 1 Ω and 10 Ω

C between 10 Ω and 30 Ω

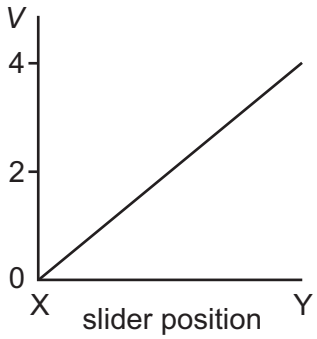
D 40 Ω

25 In the circuit below, P is a potentiometer of total resistance 10 Ω and Q is a fixed resistor of resistance 10 Ω. The battery has an e.m.f. of 4.0 V and negligible internal resistance. The voltmeter has a very high resistance. The slider on the potentiometer is moved from X to Y and a graph of voltmeter reading *V* is plotted against slider position.

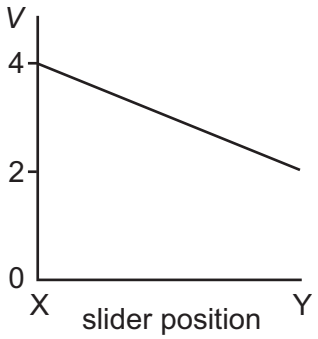


Which graph is obtained?

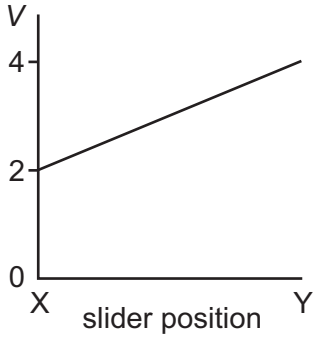
A



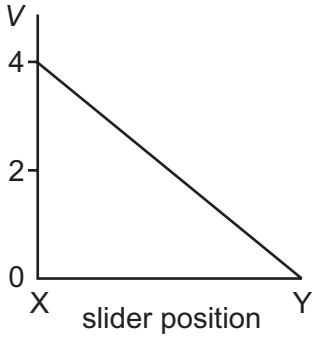
B



C



D

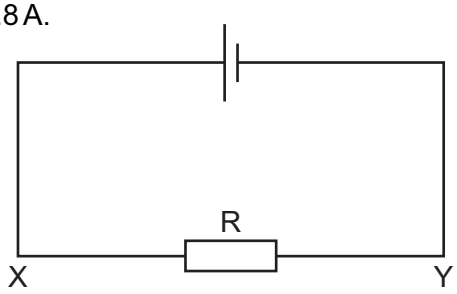


26 A total charge of 100 C flows through a 12 W light bulb in a time of 50 s.

What is the potential difference across the bulb during this time?

A 0.12 V **B** 2.0 V **C** 6.0 V **D** 24 V

27 The current in the circuit is 4.8 A.



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

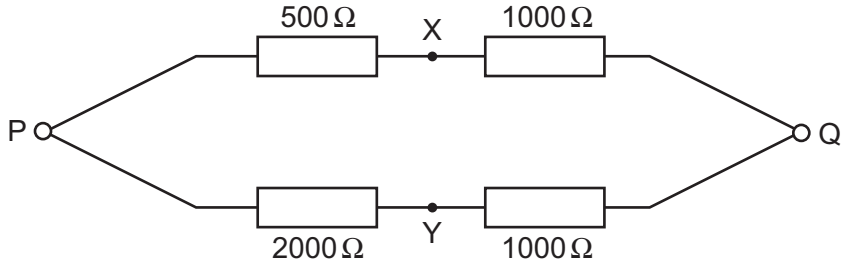
A $3.0 \times 10^{19}\,s^{-1}$ in direction X to Y

B $6.0 \times 10^{18}\,s^{-1}$ in direction X to Y

C $3.0 \times 10^{19}\,s^{-1}$ in direction Y to X

D $6.0 \times 10^{18}\,s^{-1}$ in direction Y to X

28 A p.d. of 12 V is connected between P and Q.



What is the p.d. between X and Y?

A 0 V **B** 4 V **C** 6 V **D** 8 V

29 The potential difference between point X and point Y is 20 V. The time taken for charge carriers to move from X to Y is 15 s, and, in this time, the energy of the charge carriers changes by 12 J.

What is the current between X and Y?

A 0.040 A **B** 0.11 A **C** 9.0 A **D** 25 A

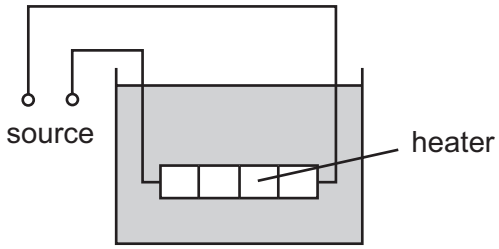
30 A power cable X has a resistance *R* and carries current I.

A second cable Y has a resistance 2*R* and carries current $\frac{1}{2}I$.

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

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

31 The diagram shows a low-voltage circuit for heating the water in a fish tank.



The heater has a resistance of 3.0 Ω. The voltage source has an e.m.f. of 12 V and an internal resistance of 1.0 Ω.

At what rate does the voltage source supply energy to the heater?

A 27 W **B** 36 W **C** 48 W **D** 64 W

32 Two wires made of the same material and of the same length are connected in parallel to the same voltage supply. Wire P has a diameter of 2 mm. Wire Q has a diameter of 1 mm.

What is the ratio $\frac{\text{current in P}}{\text{current in Q}}$?

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

33 What is a correct statement of Ohm's law?

A The potential difference across a component equals the current providing the resistance and other physical conditions stay constant.

B The potential difference across a component equals the current multiplied by the resistance.

C The potential difference across a component is proportional to its resistance.

D The potential difference across a component is proportional to the current in it providing physical conditions stay constant.

34 A potential difference V is applied between two parallel plates a small distance d apart, and produces an electric field of strength E between the plates.

What is the electric field strength between the plates when both V and d are doubled?

A $E/4$ **B** E **C** $2E$ **D** $4E$

35 When four identical lamps P, Q, R and S are connected as shown in diagram 1, they have normal brightness.

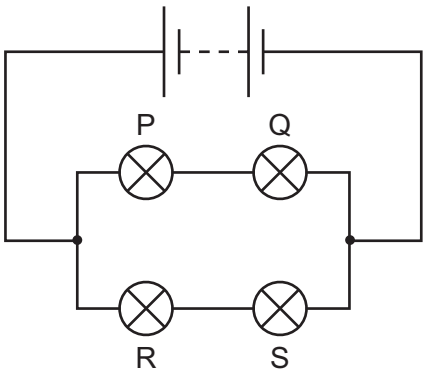


diagram 1

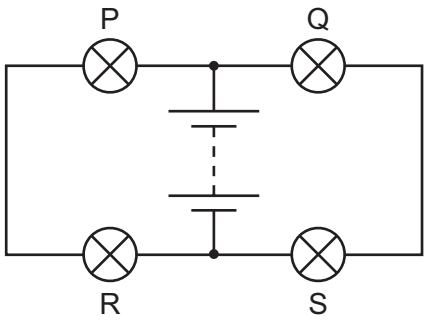


diagram 2

The four lamps and the battery are then connected as shown in diagram 2.

Which statement is correct?

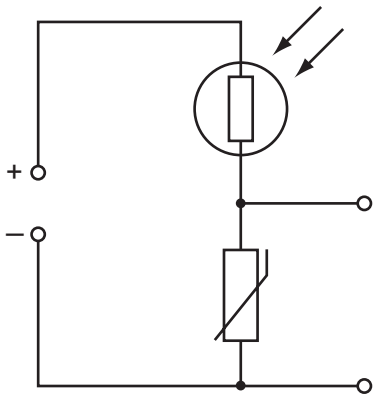
A The lamps do not light.

B The lamps are less bright than normal.

C The lamps have normal brightness.

D The lamps are brighter than normal.

36 The diagram shows a light-dependent resistor (LDR) and a thermistor forming a potential divider.



Under which set of conditions will the potential difference across the thermistor have the greatest value?

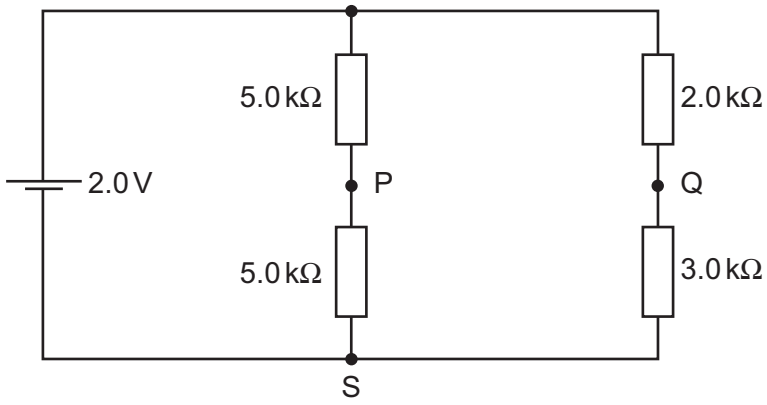
	illumination	temperature
A	low	low
B	high	low
C	low	high
D	high	high

37 The current in a resistor is 8.0 mA.

What charge flows through the resistor in 0.020 s?

A 0.16 mC **B** 1.6 mC **C** 4.0 mC **D** 0.40 C

38 A cell of e.m.f. 2.0 V and negligible internal resistance is connected to the network of resistors shown.

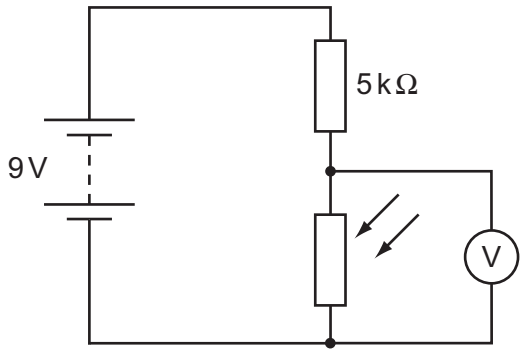


V_1 is the potential difference between S and P. V_2 is the potential difference between S and Q.

What is the value of $V_1 - V_2$?

A +0.50 V **B** +0.20 V **C** –0.20 V **D** –0.50 V

39 A circuit is set up with an LDR and a fixed resistor as shown.



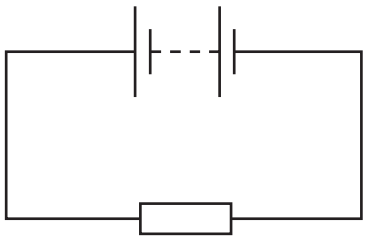
The voltmeter reads 4 V.

The light intensity is increased.

What is a possible voltmeter reading?

A 3 V **B** 4 V **C** 6 V **D** 8 V

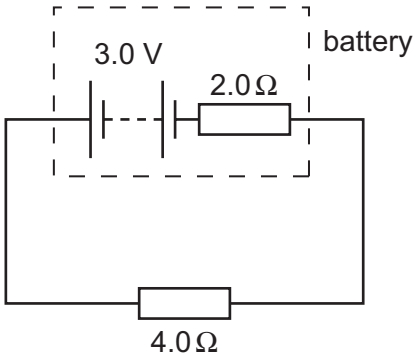
40 In the circuit below, the battery converts an amount E of chemical energy to electrical energy when charge Q passes through the resistor in time t.



Which expressions give the e.m.f. of the battery and the current in the resistor?

	e.m.f.	current
A	EQ	Q/t
B	EQ	Qt
C	E/Q	Q/t
D	E/Q	Qt

41 A battery has an e.m.f. of 3.0 V and an internal resistance of 2.0 Ω.

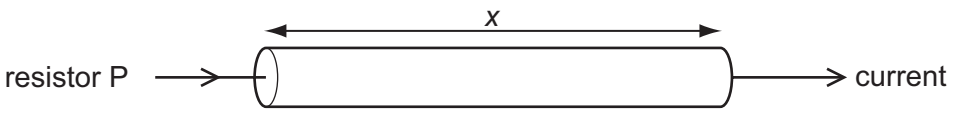


The battery is connected to a load of 4.0 Ω.

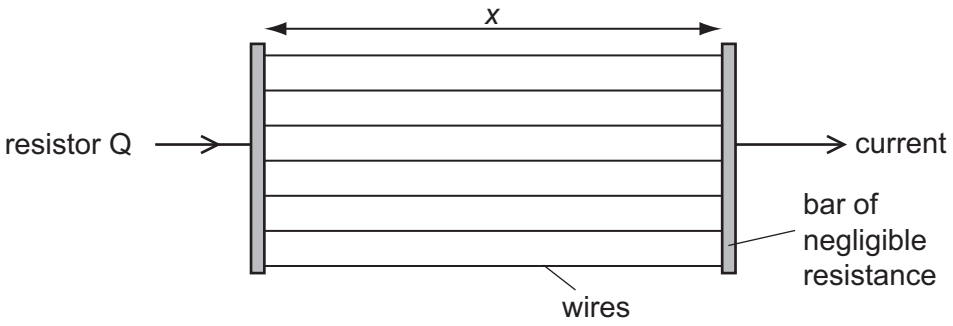
What are the terminal potential difference V and output power P?

	V/V	P/W
A	1.0	0.50
B	1.0	1.5
C	2.0	1.0
D	2.0	1.5

42 A researcher has two pieces of copper of the same volume. All of the first piece is made into a cylindrical resistor P of length *x*.



All of the second piece is made into uniform wires each of the same length *x* which he connects between two bars of negligible resistance to form a resistor Q.



How do the electrical resistances of P and Q compare?

A P has a larger resistance than Q.

B Q has a larger resistance than P.

C P and Q have equal resistance.

D Q may have a larger or smaller resistance than P, depending on the number of wires made.

43 Which equation is used to define resistance?

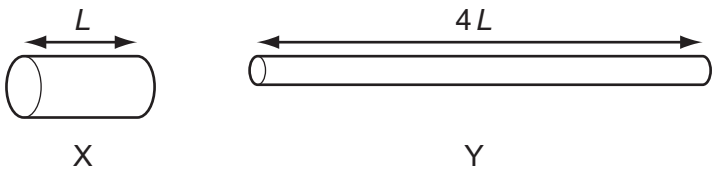
A power = $(\text{current})^2 \times$ resistance

B resistivity = resistance $\times$ area $\div$ length

C potential difference = current $\times$ resistance

D energy = $(\text{current})^2 \times$ resistance $\times$ time

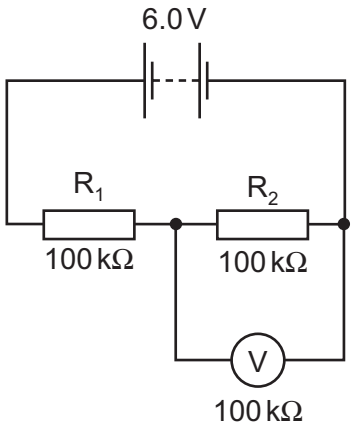
44 Two copper wires X and Y have the same volume. Wire Y is four times as long as wire X.



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

A 4 **B** 8 **C** 16 **D** 64

45 In the circuit shown, the 6.0 V battery has negligible internal resistance. Resistors R_1 and R_2 and the voltmeter have resistance 100 kΩ.



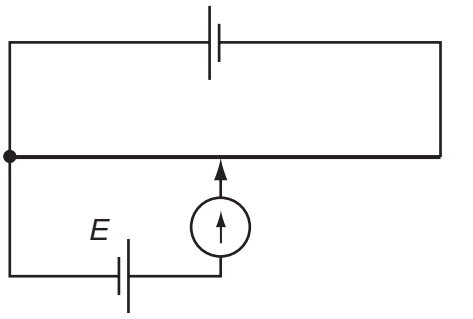
What is the current in the resistor R_2?

A 20 μA **B** 30 μA **C** 40 μA **D** 60 μA

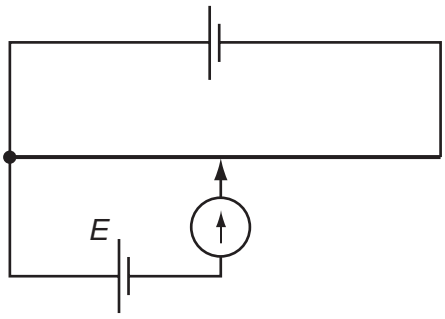
46 The unknown e.m.f. *E* of a cell is to be determined using a potentiometer circuit. The balance length is to be measured when the galvanometer records a null reading.

What is the correct circuit to use?

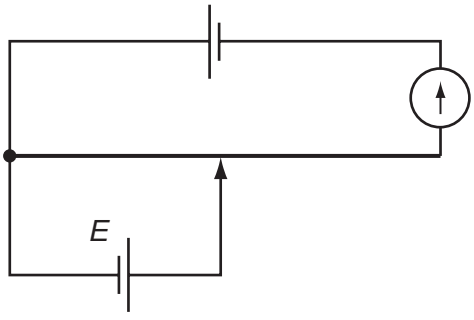
A



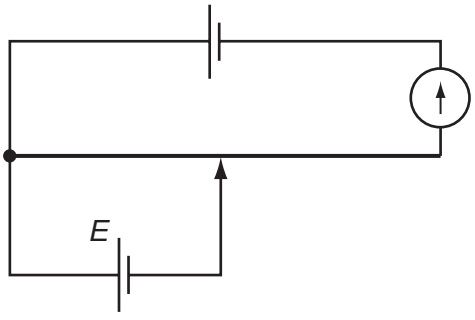
B



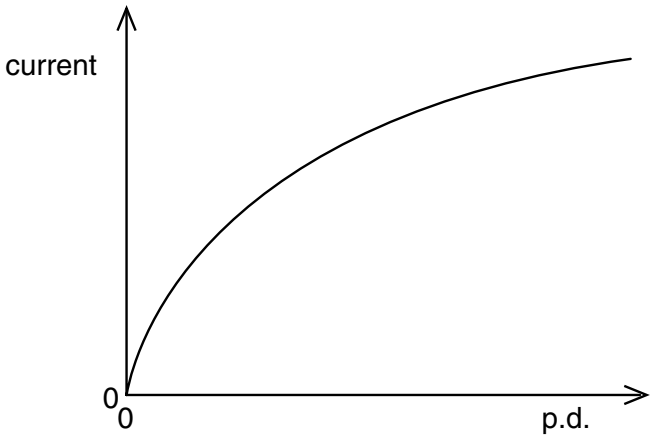
C



D



47 The graph shows how the current through a lamp filament varies with the potential difference across it.



Which statement explains the shape of this graph?

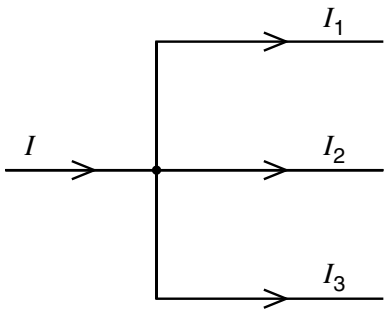
A As the filament temperature rises, electrons can pass more easily through the filament.

B It takes time for the filament to reach its working temperature.

C The power output of the filament is proportional to the square of the current through it.

D The resistance of the filament increases with a rise in temperature.

48 At a circuit junction, a current I divides into currents I_1, I_2 and I_3.



These currents are related by the equation

$$I = I_1 + I_2 + I_3.$$

Which law does this statement illustrate and on what principle is the law based?

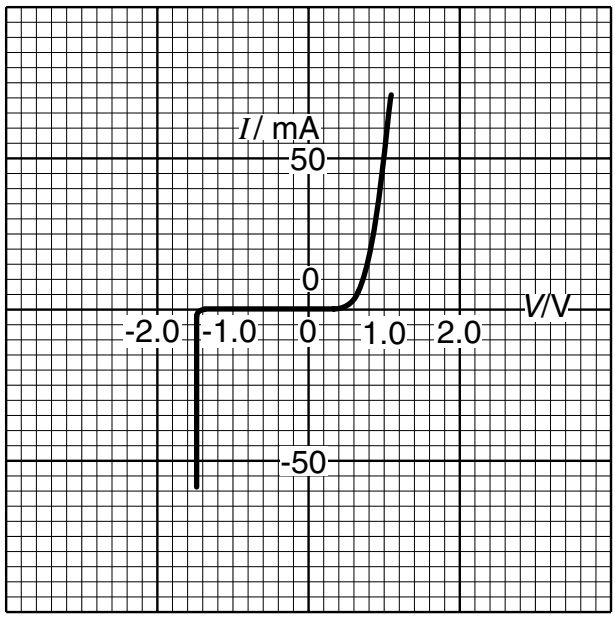
A Kirchhoff's first law based on conservation of charge

B Kirchhoff's first law based on conservation of energy

C Kirchhoff's second law based on conservation of charge

D Kirchhoff's second law based on conservation of energy

49 The variation with potential difference V of the current I in a semiconductor diode is shown below.



What is the resistance of the diode for applied potential differences of +1.0 V and –1.0 V?

	resistance	
	at +1.0 V	at –1.0 V
A	20 Ω	infinite
B	20 Ω	zero
C	0.05 Ω	infinite
D	0.05 Ω	zero

50 The combined resistance R_T of two resistors of resistances R_1 and R_2 connected in parallel is given by the formula

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$

Which statement is used in the derivation of this formula?

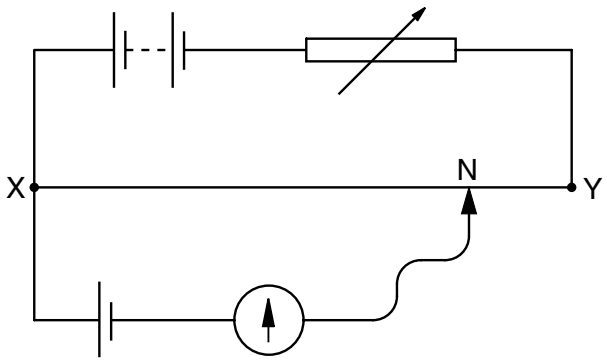
A The currents through the two resistors are equal.

B The potential difference across each resistor is the same.

C The supply current is split between the two resistors in the same ratio as the ratio of their resistances.

D The total power dissipated is the sum of the powers dissipated in the two resistors separately.

51 In the potentiometer circuit below, the moveable contact is placed at N on the bare wire XY, such that the galvanometer shows zero deflection.

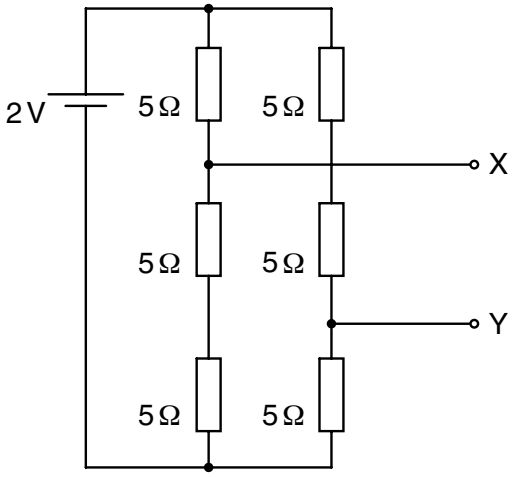


The resistance of the variable resistor is now increased.

What is the effect of this increase on the potential difference across the wire XY and on the position of the moveable contact for zero deflection?

	potential difference across XY	position of moveable contact
A	increases	nearer to X
B	increases	nearer to Y
C	decreases	nearer to X
D	decreases	nearer to Y

52 Six resistors, each of resistance 5 Ω, are connected to a 2 V cell of negligible internal resistance.



What is the potential difference between terminals X and Y?

A $\frac{2}{3}$ V **B** $\frac{8}{9}$ V **C** $\frac{4}{3}$ V **D** 2 V

53 Which electrical quantity would be the result of a calculation in which energy is divided by charge?

A current

B potential difference

C power

D resistance

54 A wire carries a current of 2.0 amperes for 1.0 hour.

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

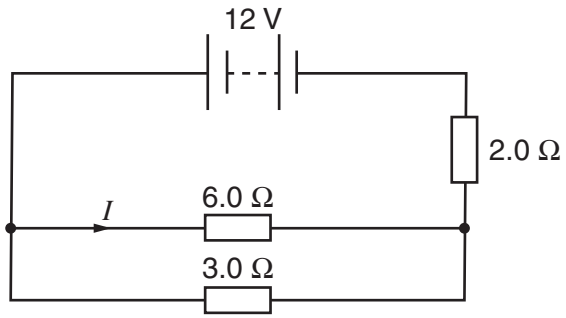
A 1.2×10^{-15}

B 7.2×10^{3}

C 1.3×10^{19}

D 4.5×10^{22}

55 The diagram shows a circuit in which the battery has negligible internal resistance.

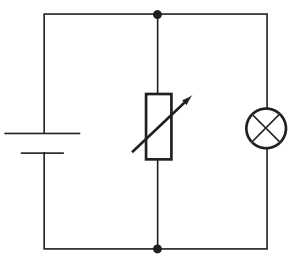


What is the value of the current I?

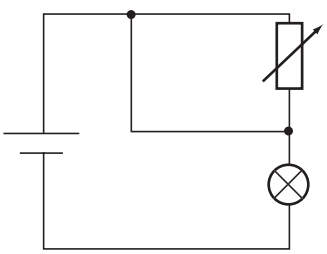
A 1.0 A **B** 1.6 A **C** 2.0 A **D** 3.0 A

56 Which diagram shows a potential divider circuit that can vary the voltage across the lamp?

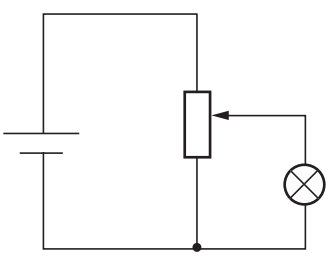
A



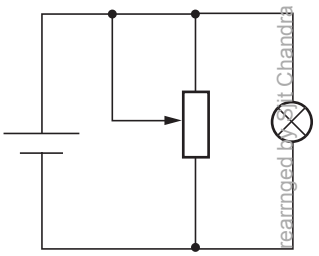
B



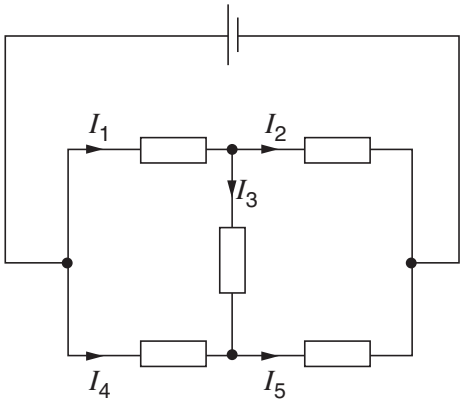
C



D



57 The diagram shows currents I_1, I_2, I_3, I_4 and I_5 in different branches of a circuit.



Which one of the following is correct?

A $I_1 = I_2 + I_3$

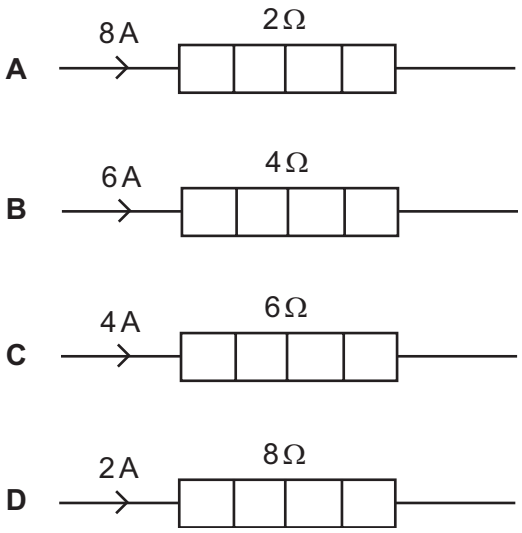
B $I_2 = I_1 + I_3$

C $I_3 = I_4 + I_5$

D $I_4 = I_5 + I_3$

58 The diagram shows four heaters and the current in each.

Which heater has the greatest power dissipation?

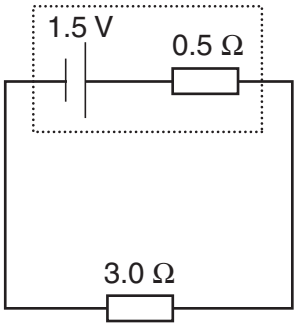


59 When a potential difference V is applied between the ends of a wire of diameter d and length l, the current in the wire is I.

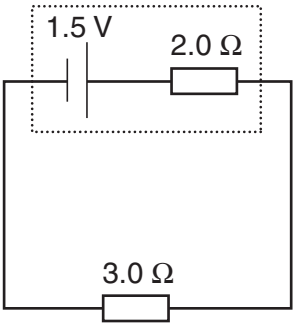
What is the current when a potential difference of $2V$ is applied between the ends of a wire of the same material of diameter $2d$ and the length $2l$? Assume that the temperature of the wire remains constant.

A I **B** $2I$ **C** $4I$ **D** $8I$

60 The diagram shows two circuits. In these circuits, only the internal resistances differ.



circuit **X**



circuit **Y**

Which line in the table is correct?

	potential difference across 3.0 Ω resistor	power dissipated in 3.0 Ω resistor
A	greater in X than in Y	less in X than in Y
B	greater in X than in Y	greater in X than in Y
C	less in X than in Y	less in X than in Y
D	less in X than in Y	greater in X than in Y

61 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.

62 Which of the following 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

63 Two heating coils X and Y, of resistance R_X and R_Y respectively, deliver the same power when 12 V is applied across X and 6 V is applied across Y.

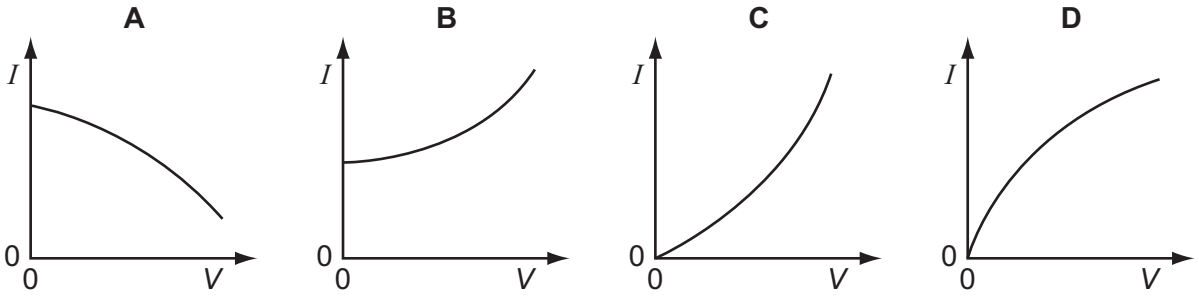
What is the ratio R_X / R_Y?

A ¼ **B** ½ **C** 2 **D** 4

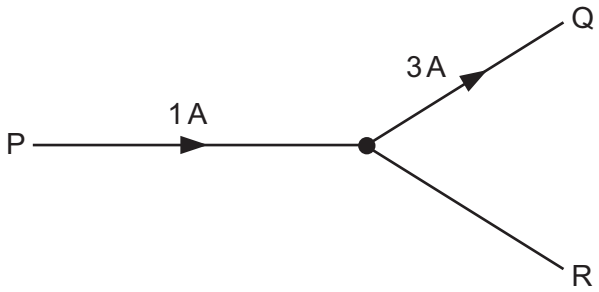
64 The resistance of a thermistor decreases significantly as its temperature increases.

The thermistor is kept in air. The air is at room temperature.

Which graph best represents the way in which the current I in the thermistor depends upon the potential difference V across it?



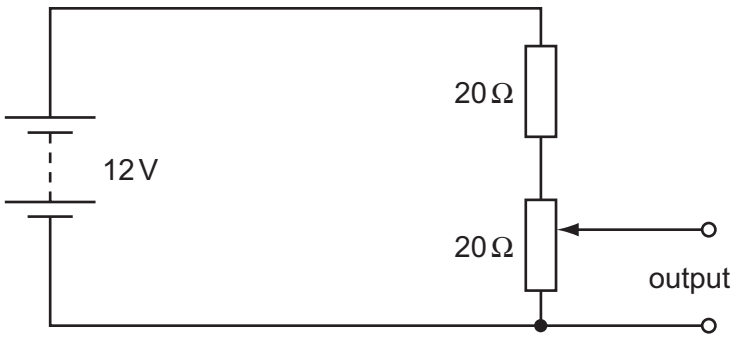
65 The diagram shows a junction in a circuit where three wires P, Q and R meet. The currents in P and Q are 1 A and 3 A respectively, in the directions shown.



How many coulombs of charge pass a given point in wire R in 5 seconds?

A 0.4 **B** 0.8 **C** 2 **D** 10

66 The diagram shows a potentiometer and a fixed resistor connected across a 12 V battery of negligible internal resistance.

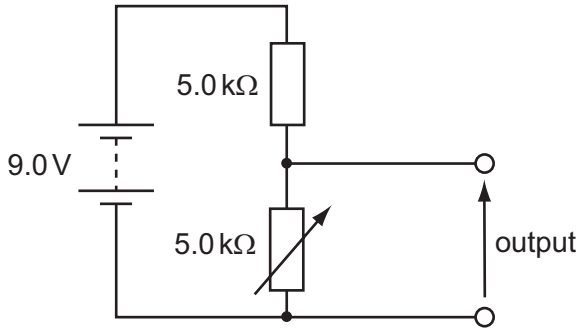


The fixed resistor and the potentiometer each have resistance 20 Ω. The circuit is designed to provide a variable output voltage.

What is the range of output voltages?

A 0 – 6 V **B** 0 – 12 V **C** 6 – 12 V **D** 12 – 20 V

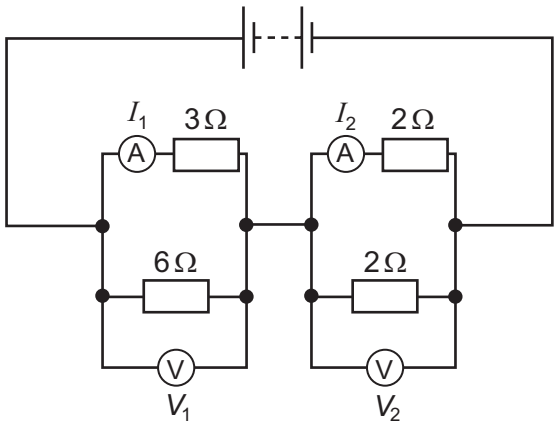
67 The diagram shows a potential divider circuit designed to provide a variable output p.d.



Which gives the available range of output p.d?

	maximum output	minimum output
A	3.0 V	0
B	4.5 V	0
C	9.0 V	0
D	9.0 V	4.5 V

68 In the circuit shown, the ammeters have negligible resistance and the voltmeters have infinite resistance.



The readings on the meters are I_1, I_2, V_1 and V_2, as labelled on the diagram.

Which is correct?

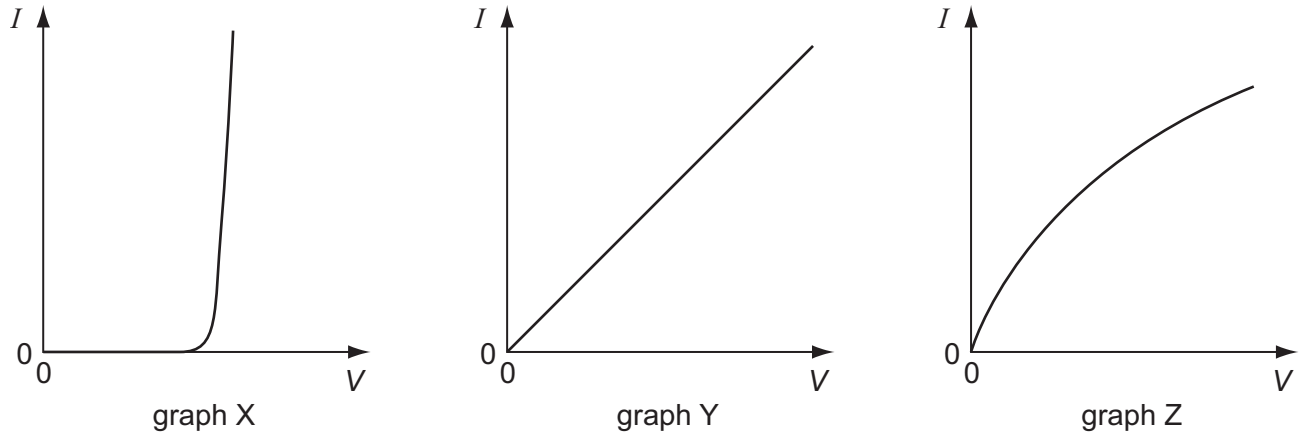
A $I_1 > I_2$ and $V_1 > V_2$

B $I_1 > I_2$ and $V_1 < V_2$

C $I_1 < I_2$ and $V_1 > V_2$

D $I_1 < I_2$ and $V_1 < V_2$

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



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

Which row of the table 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

70 The resistance of a device is designed to change with temperature.

What is the device?

A a light-dependent resistor

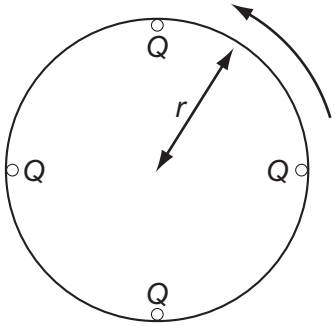
B a potential divider

C a semiconductor diode

D a thermistor

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

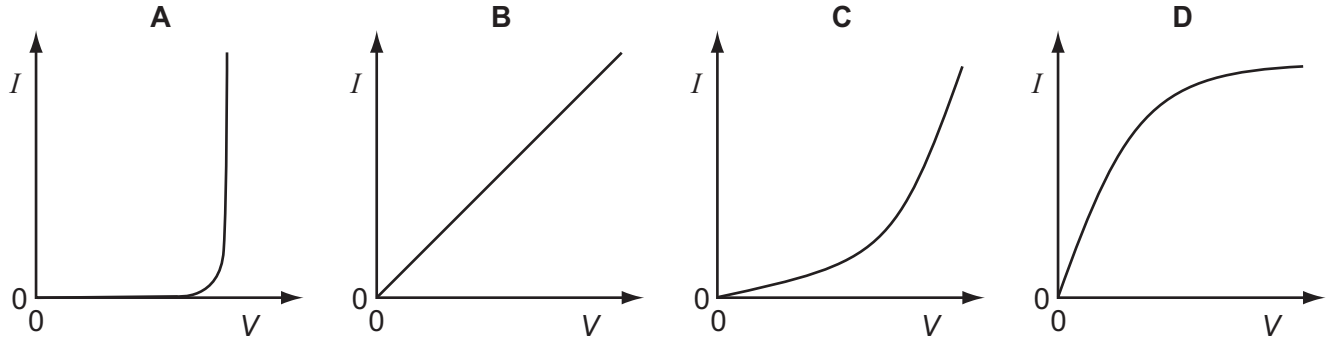
The frequency of rotation of the disc is f.



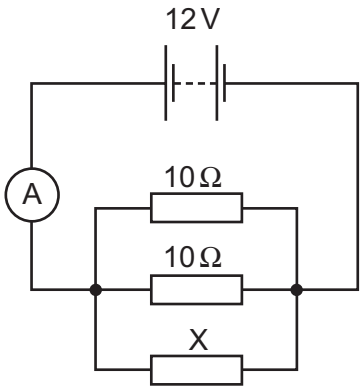
What is the equivalent electric current at the edge of the disc?

A $4Qf$ **B** $\frac{4Q}{f}$ **C** $8\pi rQf$ **D** $\frac{2Qf}{\pi r}$

72 Which graph shows the $I - V$ characteristic of a filament lamp?



73 The diagram shows a circuit containing three resistors in parallel.

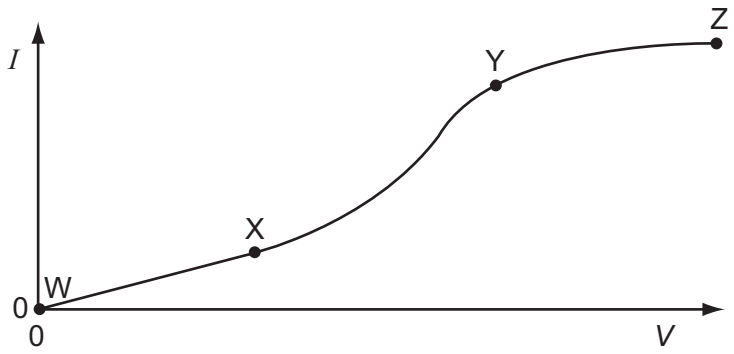


The battery has e.m.f. 12 V and negligible internal resistance. The ammeter reading is 3.2 A.

What is the resistance of X?

A 2.1 Ω **B** 4.6 Ω **C** 6.0 Ω **D** 15 Ω

74 An electrical component has a potential difference V across it and a current I through it. A graph of I against V is drawn and is marked in three sections WX, XY and YZ.

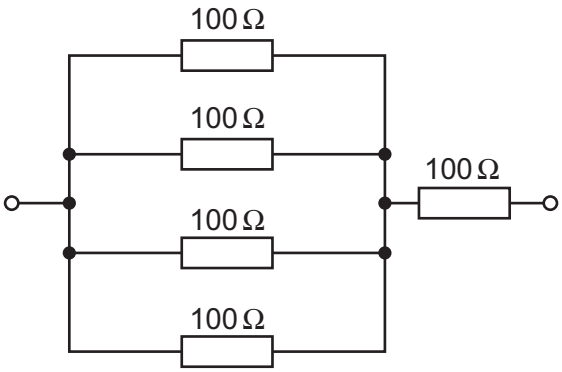


In which ways does the resistance of the component vary within each of the three sections?

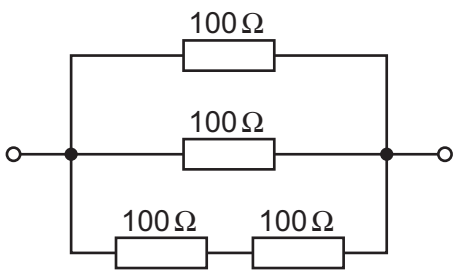
	WX	XY	YZ
A	constant	decreases	increases
B	constant	increases	increases
C	increases	decreases	constant
D	increases	increases	decreases

75 Which circuit has a resistance of 40 Ω between the terminals?

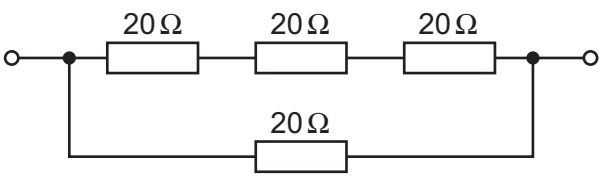
A



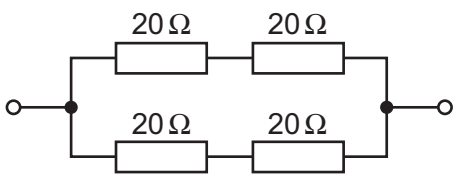
B



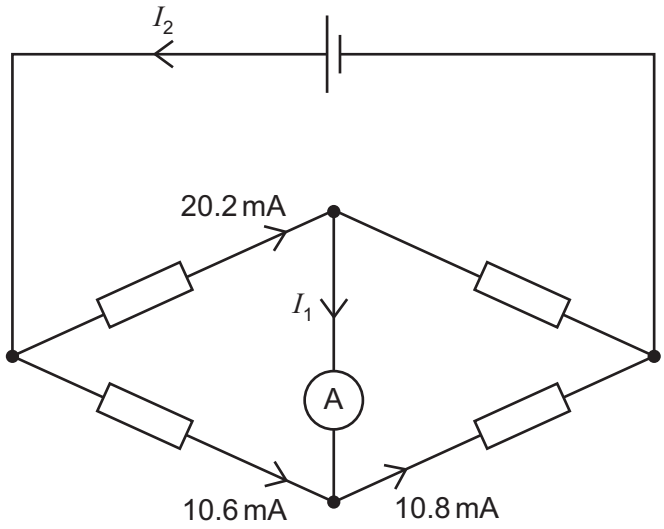
C



D



76 The diagram represents a circuit.

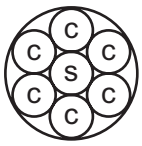


Some currents have been shown on the diagram.

What are the currents I_1 and I_2?

	I_1	I_2
A	0.2 mA	10.8 mA
B	0.2 mA	30.8 mA
C	–0.2 mA	20.0 mA
D	–0.2 mA	30.8 mA

77 An electric power cable consists of six copper wires c surrounding a steel core s.

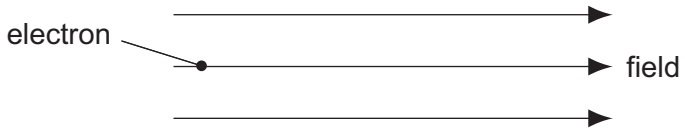


1.0 km of one of the copper wires has a resistance of 10 Ω and 1.0 km of the steel core has a resistance of 100 Ω.

What is the approximate resistance of a 1.0 km length of the power cable?

A 0.61 Ω **B** 1.6 Ω **C** 160 Ω **D** 610 Ω

78 An electron is situated in a uniform electric field as shown in the diagram.



What is the direction of the electric force acting on the electron?

A downwards into the paper

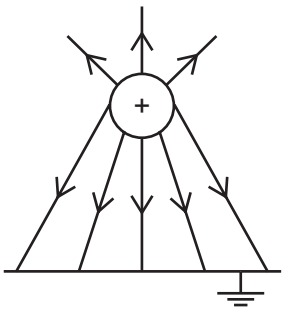
B upwards out of the paper

C to the left

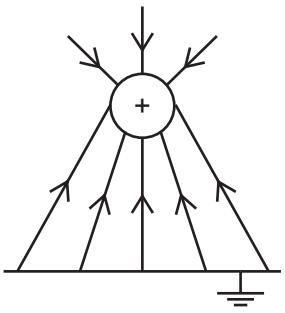
D to the right

79 Which diagram shows the electric field between a positively charged metal sphere and an earthed metal plate?

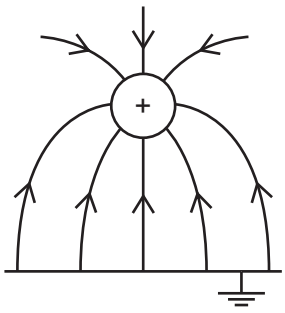
A



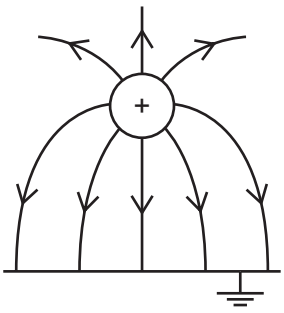
B



C



D



80 Which electrical quantity would be the result of a calculation in which energy transfer is divided by charge?

A current

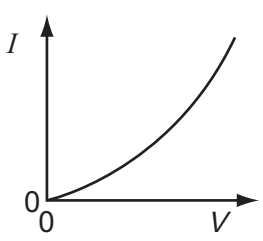
B potential difference

C power

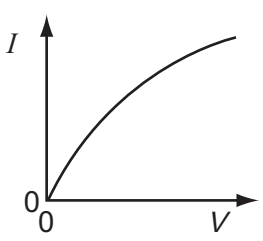
D resistance

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

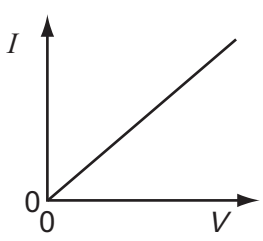
A



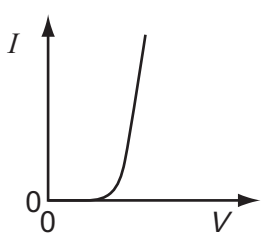
B



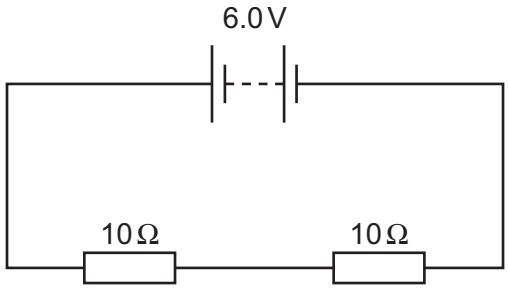
C



D



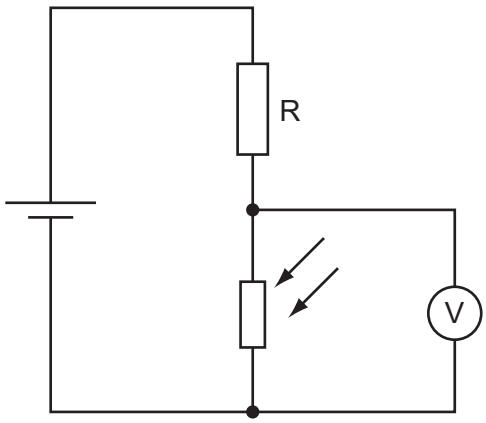
90 A battery of negligible internal resistance is connected to two 10 Ω resistors in series.



What charge flows through each of the 10 Ω resistors in 1 minute?

A 0.30 C **B** 0.60 C **C** 3.0 C **D** 18 C

91 A potential divider consists of a fixed resistor R and a light-dependent resistor (LDR).



What happens to the voltmeter reading, and why does it happen, when the intensity of light on the LDR increases?

A The voltmeter reading decreases because the LDR resistance decreases.

B The voltmeter reading decreases because the LDR resistance increases.

C The voltmeter reading increases because the LDR resistance decreases.

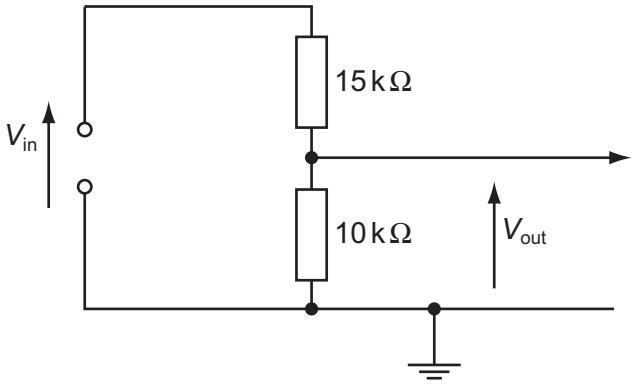
D The voltmeter reading increases because the LDR resistance increases.

92 Two wires P and Q have resistances R_P and R_Q respectively. Wire P is twice as long as wire Q and has twice the diameter of wire Q. The wires are made of the same material.

What is the ratio $\frac{R_P}{R_Q}$?

A 0.5 **B** 1 **C** 2 **D** 4

93 The circuit is designed to trigger an alarm system when the input voltage exceeds some preset value. It does this by comparing V_{out} with a fixed reference voltage, which is set at 4.8 V.

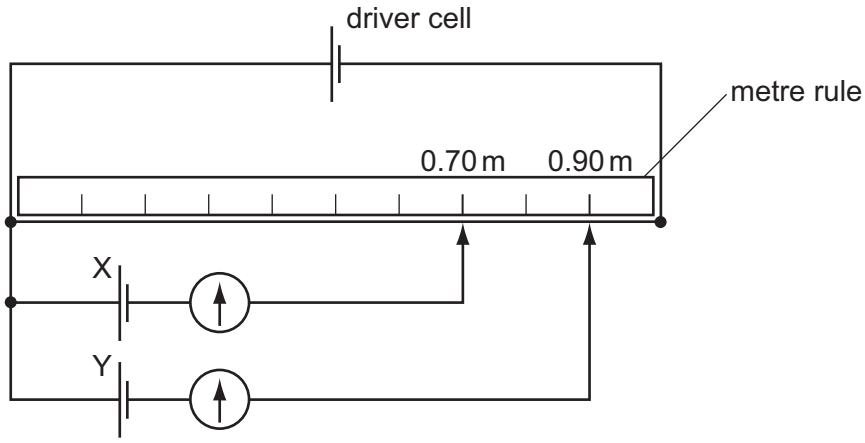


V_{out} is equal to 4.8 V.

What is the input voltage V_{in}?

A 4.8 V **B** 7.2 V **C** 9.6 V **D** 12 V

94 A potentiometer is used as shown to compare the e.m.f.s of two cells.



The balance points for cells X and Y are 0.70 m and 0.90 m respectively.

If the e.m.f. of cell X is 1.1 V, what is the e.m.f. of cell Y?

A 0.69 V **B** 0.86 V **C** 0.99 V **D** 1.4 V

95 Two wires P and Q made of the same material and of the same length are connected in parallel to the same voltage supply. Wire P has diameter 2 mm and wire Q has diameter 1 mm.

What is the ratio $\frac{\text{current in P}}{\text{current in Q}}$?

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

96 When four identical resistors are connected as shown in diagram 1, the ammeter reads 1.0 A and the voltmeter reads zero.

diagram 1

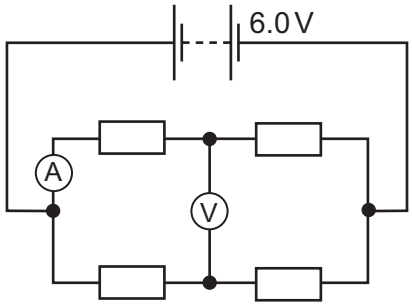
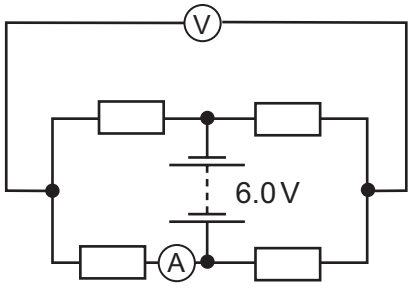


diagram 2



The resistors and meters are reconnected to the supply as shown in diagram 2.

What are the meter readings in diagram 2?

	voltmeter reading / V	ammeter reading / A
A	0	1.0
B	3.0	0.5
C	3.0	1.0
D	6.0	0

97 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

98 A particle has a charge of 4.8×10^{-19} C. The particle remains at rest between a pair of horizontal, parallel plates having a separation of 15 mm. The potential difference between the plates is 660 V.

What is the weight of the particle?

A 2.1×10^{-14} N

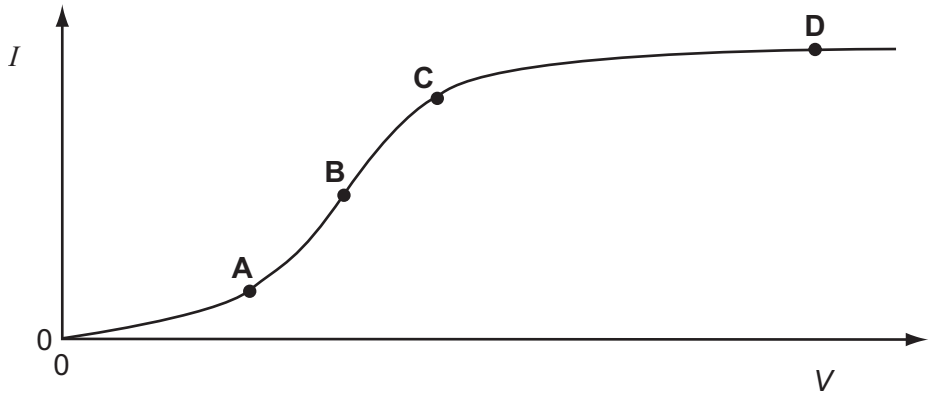
B 2.1×10^{-15} N

C 2.1×10^{-17} N

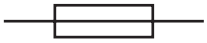
D 1.1×10^{-23} N

99 The graph shows how the electric current I through a conducting liquid varies with the potential difference V across it.

At which point on the graph does the liquid have the smallest resistance?



100 An electrical component has the following circuit symbol.



What does this symbol represent?

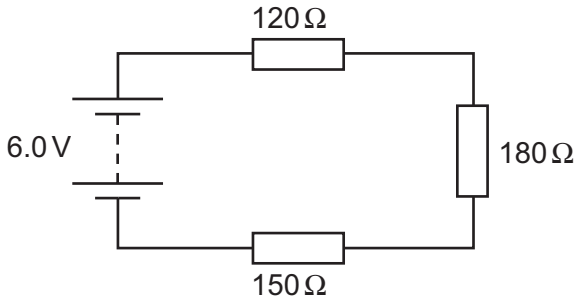
A variable resistor (rheostat)

B fuse

C light-dependent resistor

D thermistor

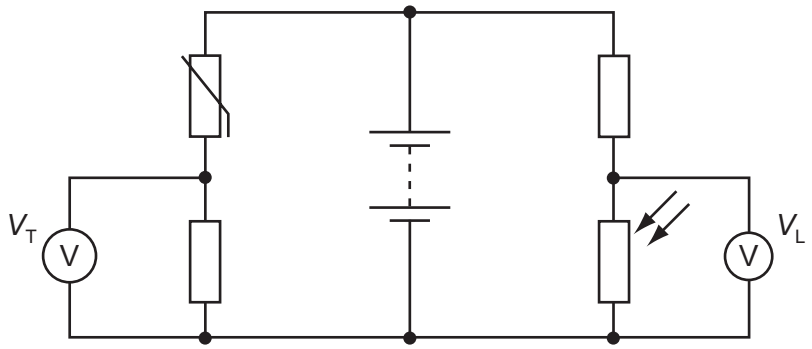
101 Three resistors are connected in series with a battery as shown in the diagram. The battery has negligible internal resistance.



What is the potential difference across the 180 Ω resistor?

A 1.6 V **B** 2.4 V **C** 3.6 V **D** 6.0 V

102 In the circuit below, the reading V_T on the voltmeter changes from high to low as the temperature of the thermistor changes. The reading V_L on the voltmeter changes from high to low as the level of light on the light-dependent resistor (LDR) changes.

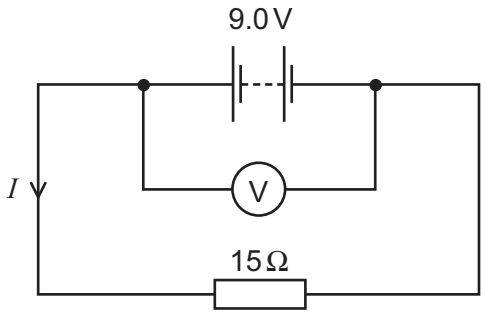


The readings on V_T and V_L are both high.

What are the conditions of temperature and light level?

	temperature	light level
A	low	low
B	low	high
C	high	low
D	high	high

103 The e.m.f. of the battery is 9.0 V. The reading on the high-resistance voltmeter is 7.5 V.



What is the current I?

A 0.10 A **B** 0.50 A **C** 0.60 A **D** 2.0 A

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

4.0 C passes through the resistor.

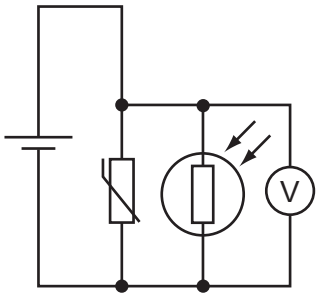
What is the energy transferred and the time taken?

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

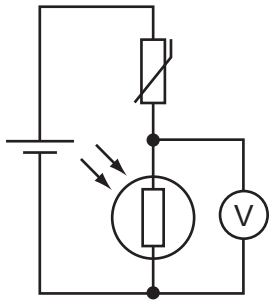
105 A thermistor and another component are connected to a constant voltage supply. A voltmeter is connected across one of the components. The temperature of the thermistor is then reduced but no other changes are made.

In which circuit will the voltmeter reading increase?

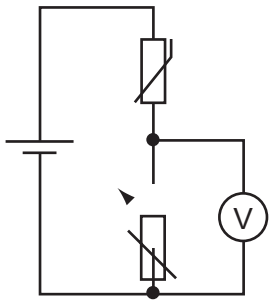
A



B



C



D