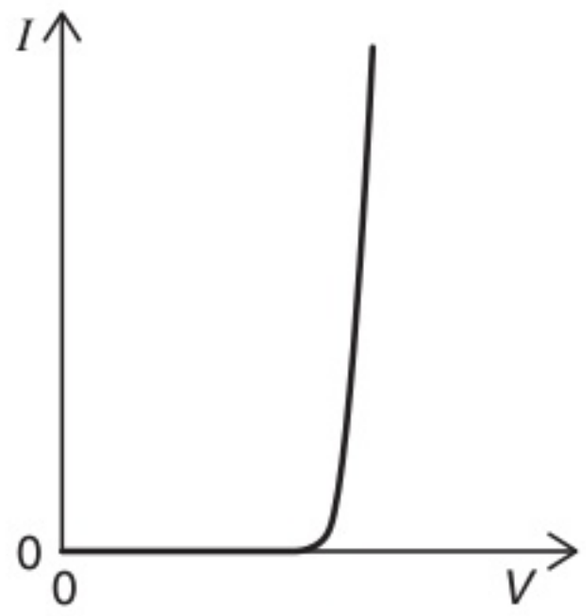
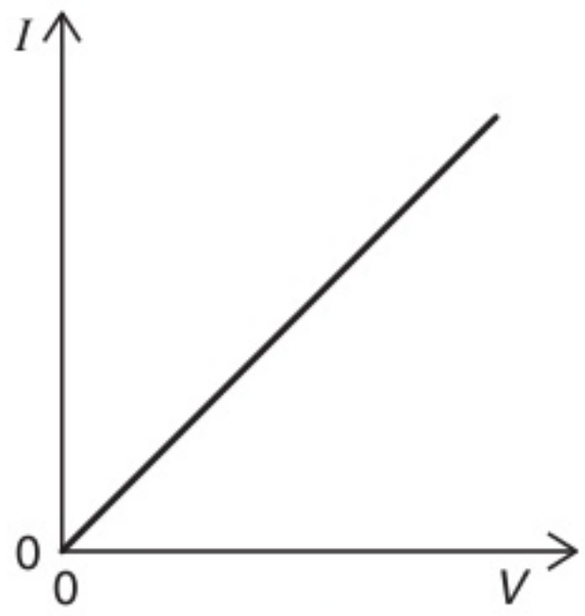
30 The graphs show the variation with potential difference V of the current I for three circuit elements.

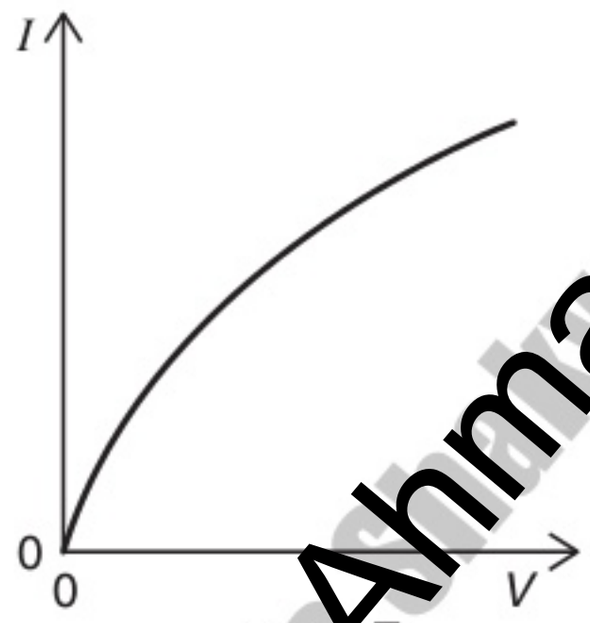
9702/1/M/J/02



graph X



graph Y



graph Z

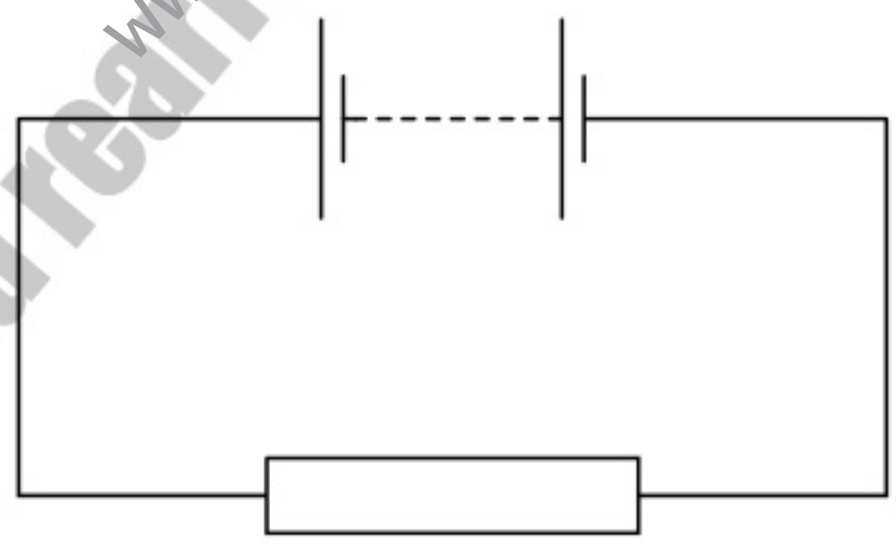
The three circuit elements are a metal wire at constant temperature, a semiconductor diode and a filament lamp.

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

31 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.

9702/1/M/J/02



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

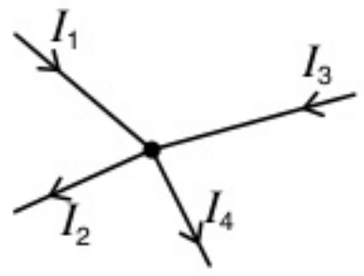
	e.m.f.	current
A	EQ	Q/t
B	EQ	Qt
C	E/Q	Q/t
D	E/Q	Qt

33 The diagrams show connected wires which carry currents I_1, I_2, I_3 and I_4. 9702/1/M/J/02

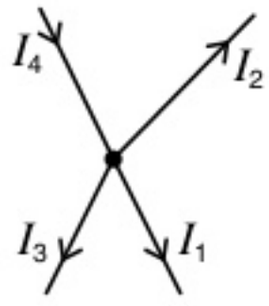
The currents are related by the equation $I_1 + I_2 = I_3 + I_4$.

To which diagram does this equation apply?

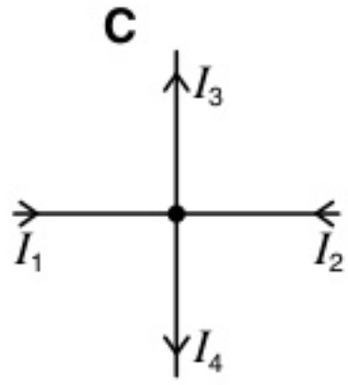
A



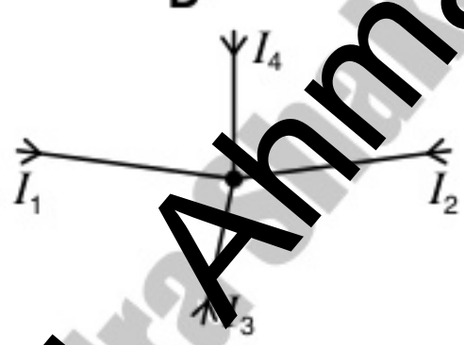
B



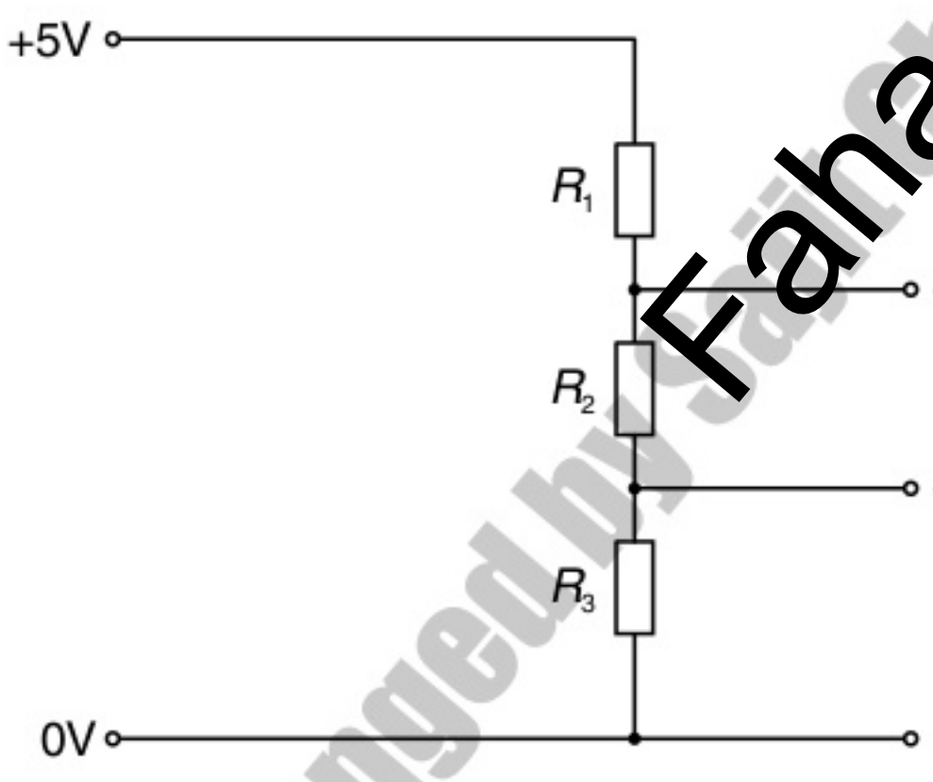
C



D



35 A potential divider is used to give outputs of 2 V and 3 V from a 5 V source, as shown. 9702/1/M/J/02



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

30 Which equation is used to define resistance? 9702/1/O/N/02

A power = (current)^2 × resistance

B resistivity = resistance × area ÷ length

C potential difference = current × resistance

D energy = (current)^2 × resistance × time

34 When four identical lamps P, Q, R and S are connected as shown in diagram 1, they have normal brightness. 9702/1/M/J/02

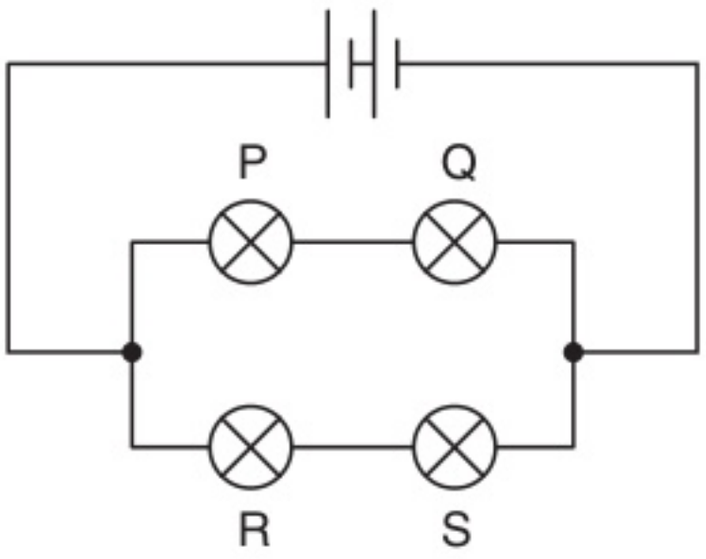


diagram 1

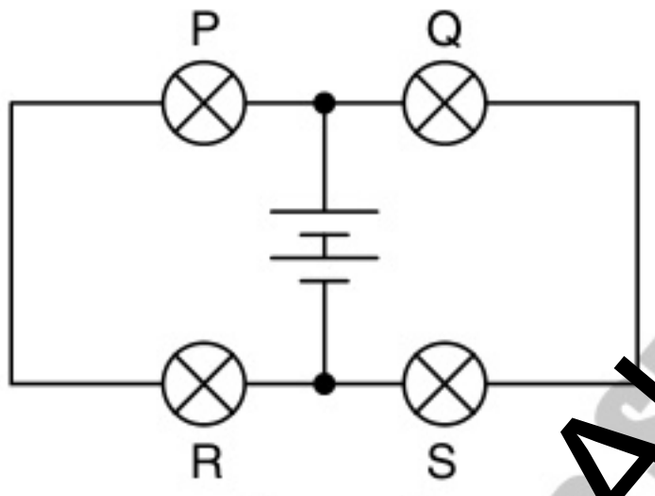


diagram 2

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.

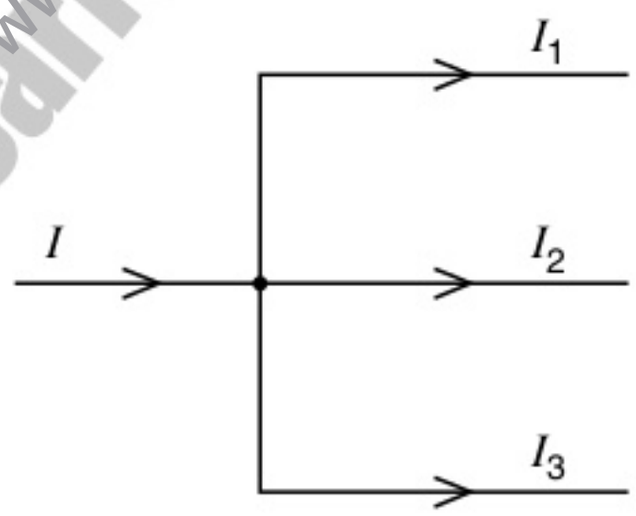
D The lamps are brighter than normal.

32 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. 9702/1/M/J/02

What is the resistance of this lamp at room temperature?

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

33 At a circuit junction, a current I divides into currents I_1, I_2 and I_3. 9702/1/O/N/02



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

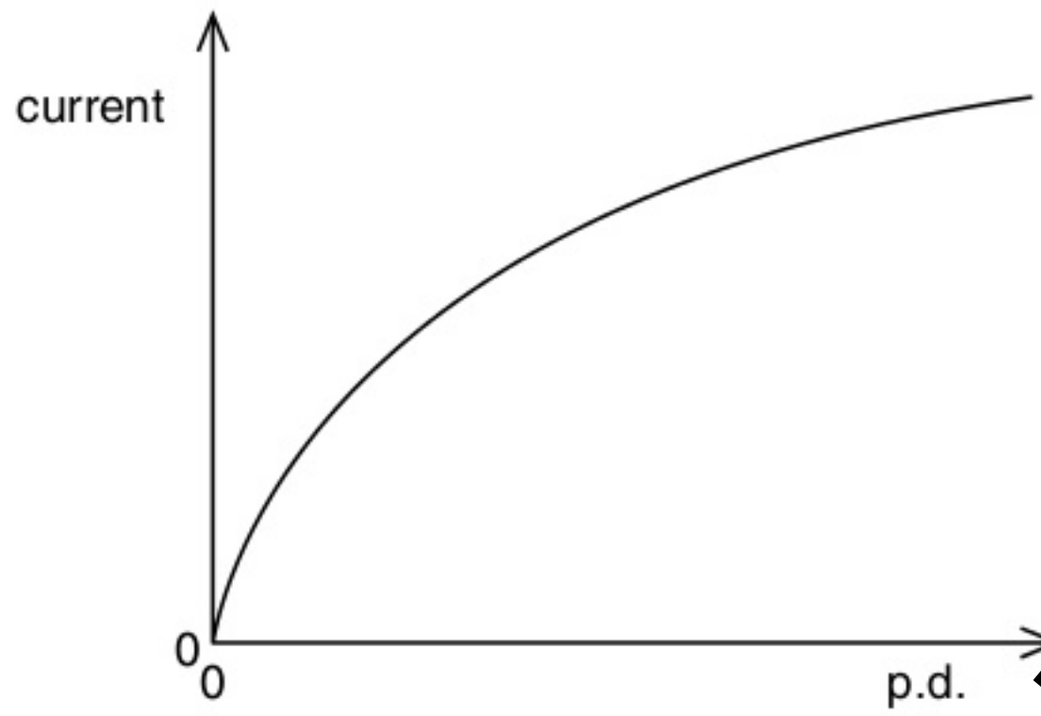
B Kirchhoff's first law based on conservation of energy

C Kirchhoff's second law based on conservation of charge

D Kirchhoff's second law based on conservation of energy

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

9702/1/O/N/02



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.

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

9702/1/O/N/02

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

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.

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

9702/01/M/J/03

Which of the following is correct?

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

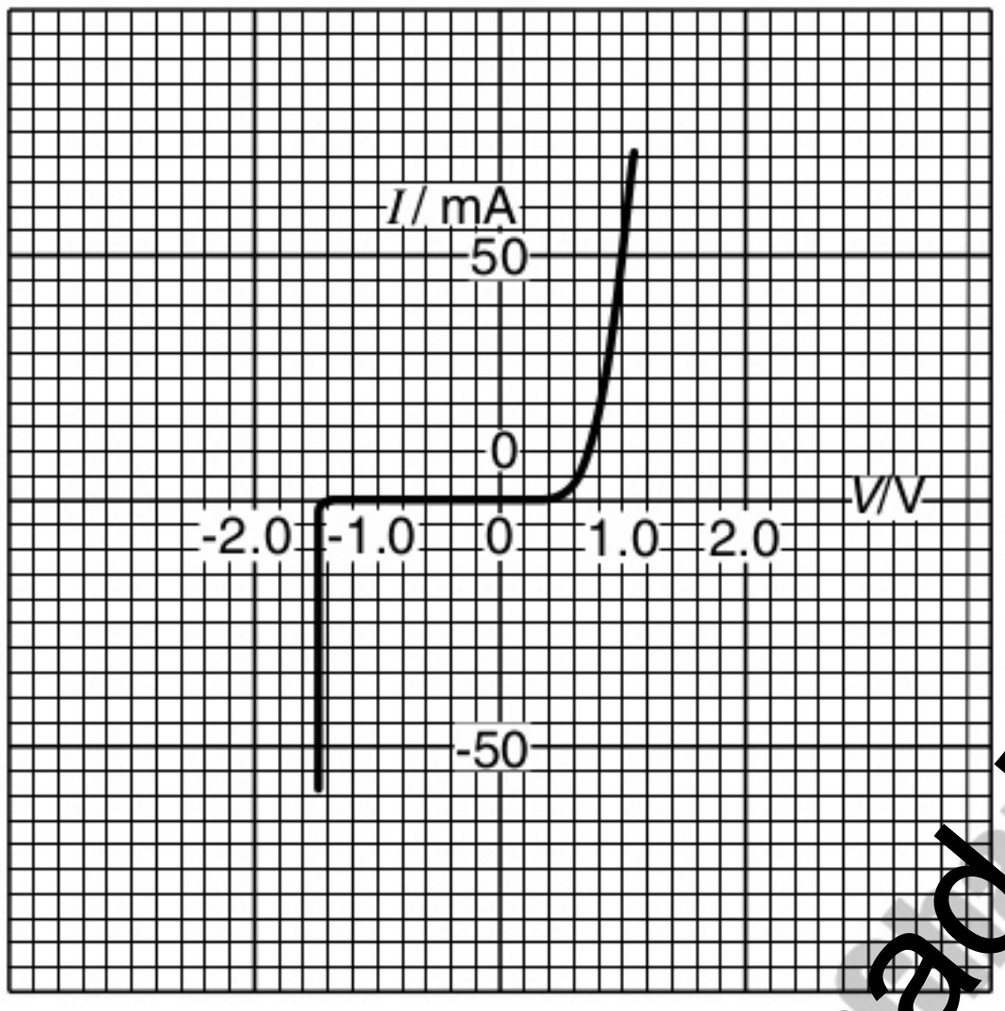
B This is Kirchhoff's first law, which results from the conservation of energy.

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.

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

9702/1/O/N/02

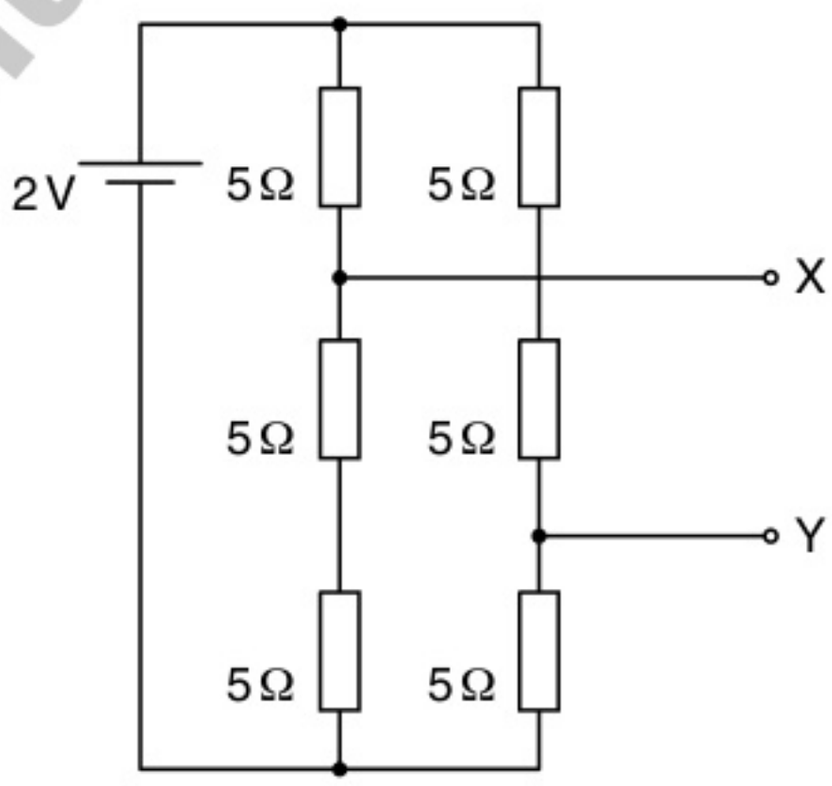


What is the resistance of the diode for applied potential differences of +1.0 V and –1.0 V?

	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

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

9702/1/O/N/02

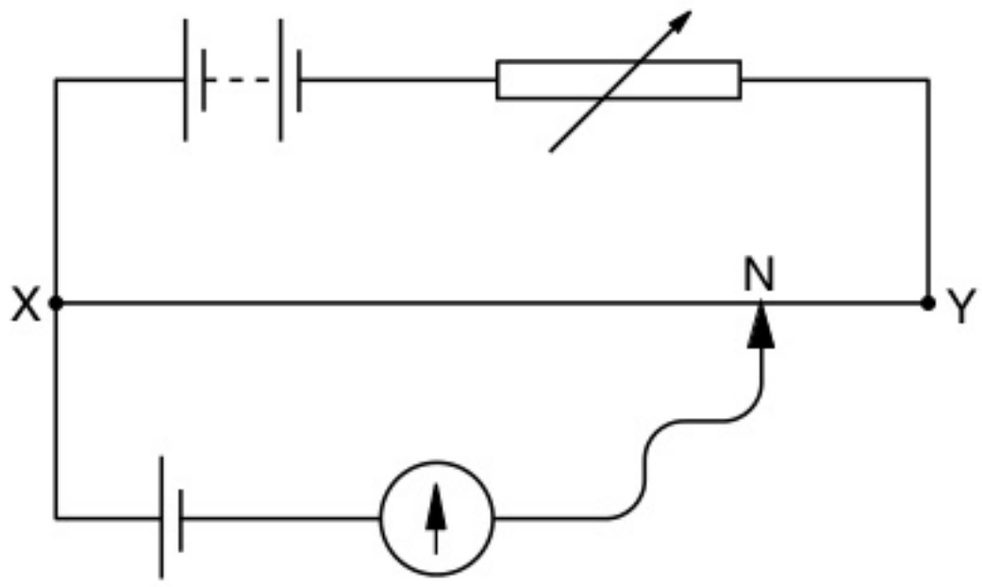


What is the potential difference between terminals X and Y?

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

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

9702/1/O/N/02



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

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

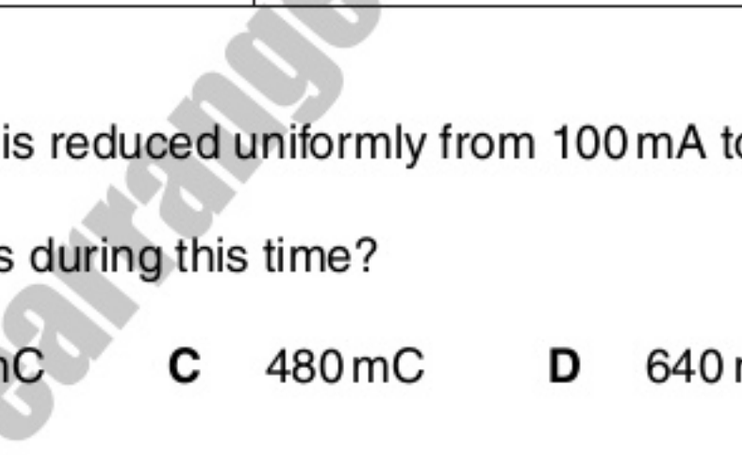
9702/01/M/J/03

What is the charge that flows during this time?

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

32 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.

9702/01/M/J/03

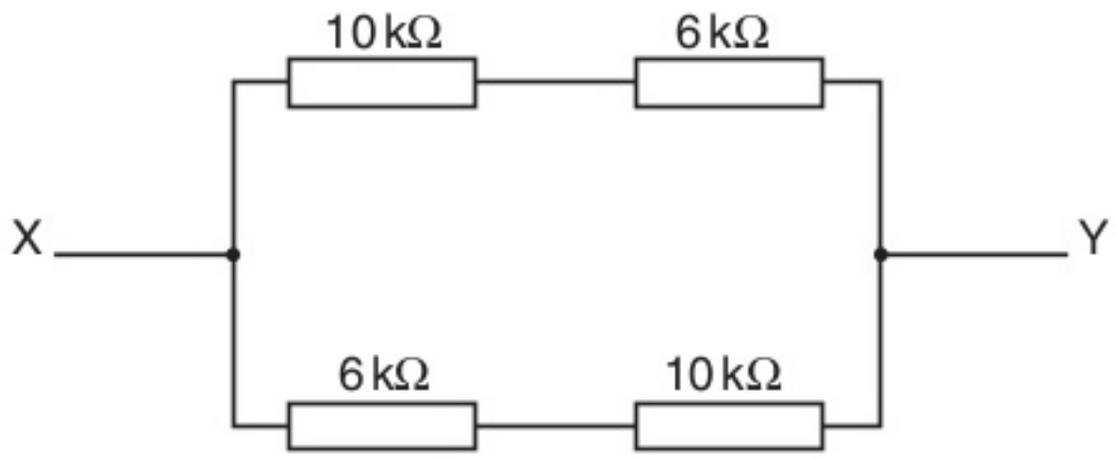


What is the current I?

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

33 The diagram shows an arrangement of four resistors.

9702/01/M/J/03

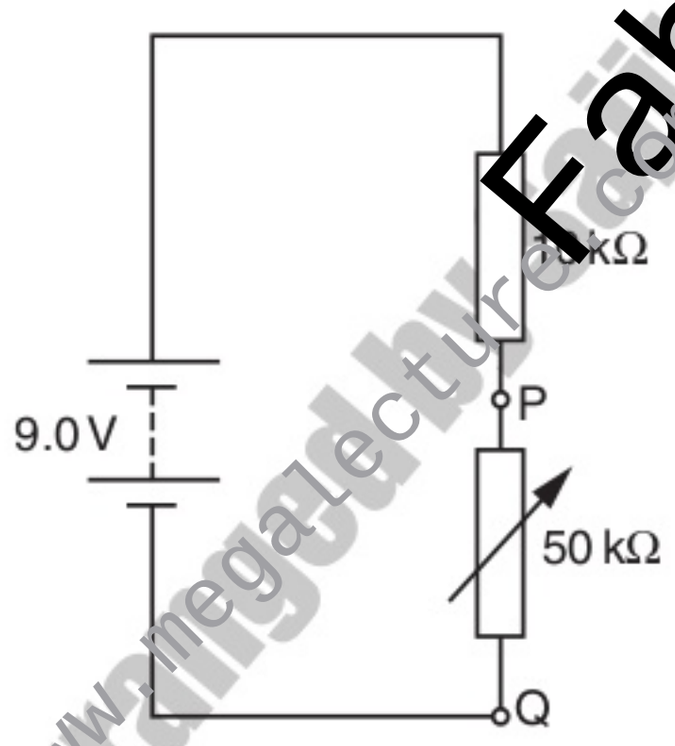


What is the resistance between X and Y?

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

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

9702/01/M/J/03



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

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

9702/01/O/N/03

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

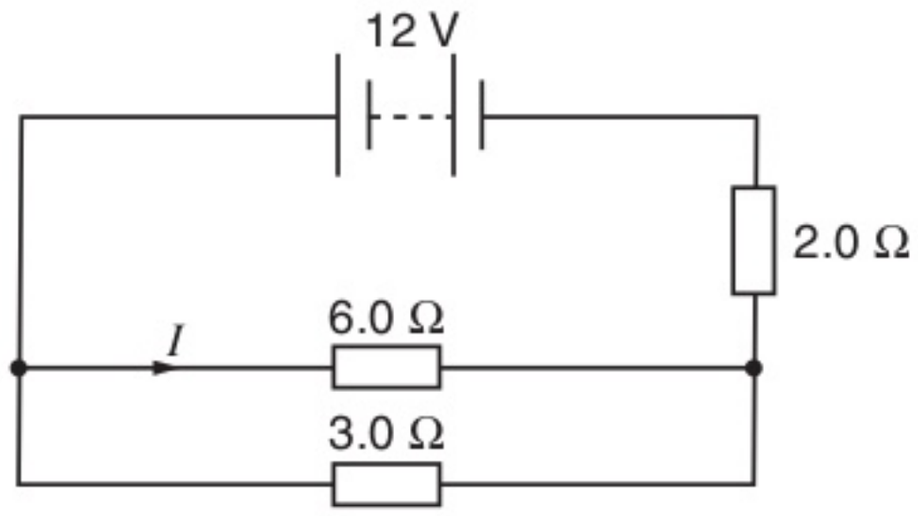
A 1.2×10^{-15}

B 7.2×10^{3}

C 1.3×10^{19}

D 4.5×10^{22}

31 The diagram shows a circuit in which the battery has negligible internal resistance. 9702/01/O/N/03



What is the value of the current I?

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

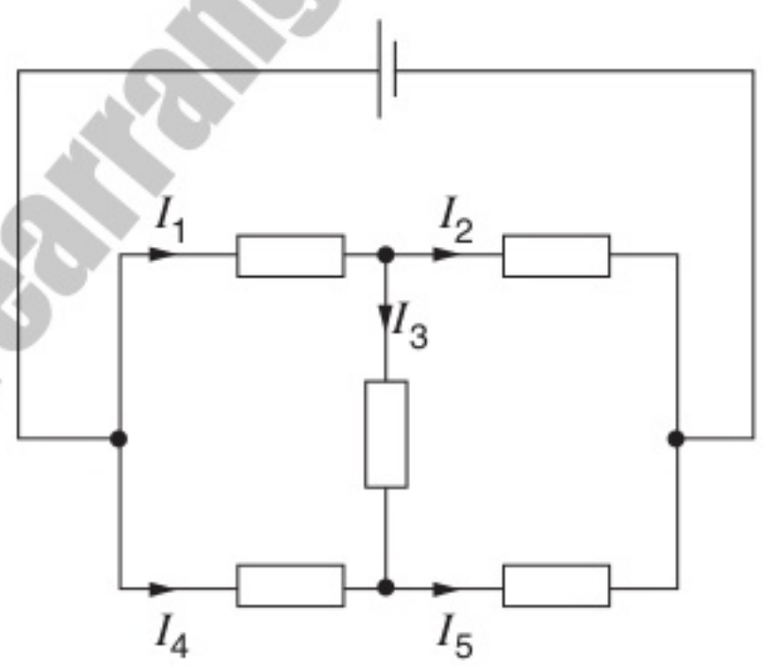
31 Two wires made of the same material and of the same length are connected in parallel to the same voltage supply. Wire P has a diameter of 2 mm. Wire Q has a diameter of 1 mm.

9702/01/M/J/04

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

32 The diagram shows currents I_1, I_2, I_3, I_4 and I_5 in different branches of a circuit. 9702/01/O/N/03



Which one of the following is correct?

A $I_1 = I_2 + I_3$

B $I_2 = I_1 + I_3$

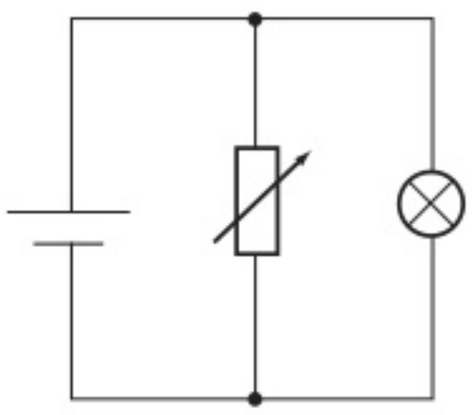
C $I_3 = I_4 + I_5$

D $I_4 = I_5 + I_3$

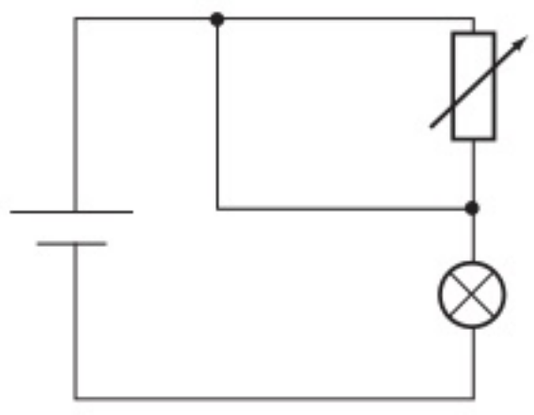
33 Which diagram shows a potential divider circuit that can vary the voltage across the lamp?

9702/01/O/N/03

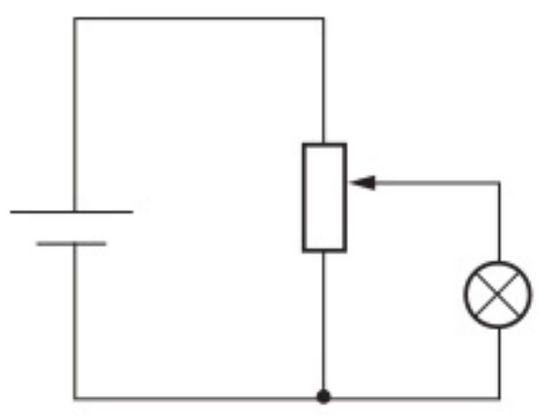
A



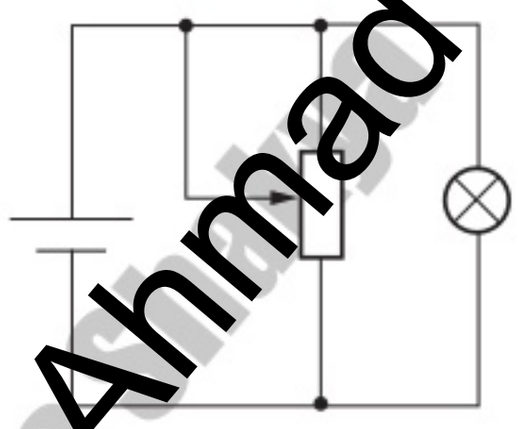
B



C

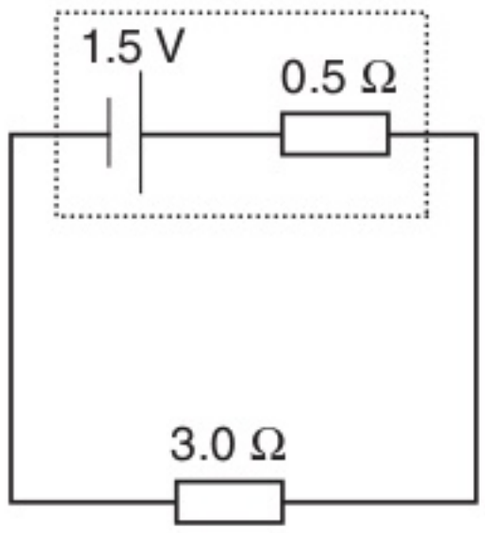


D

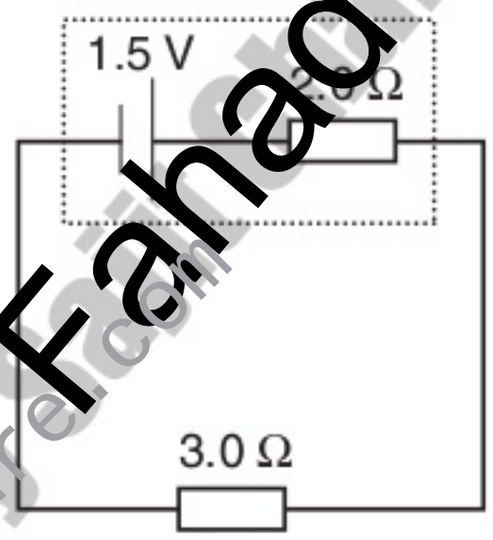


34 The diagram shows two circuits. In these circuits, only the internal resistances differ.

9702/01/O/N/03



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

32 What is an equivalent unit to 1 volt?

9702/01/M/J/04

A $1\,JA^{-1}$ **B** $1\,JC^{-1}$ **C** $1\,WC^{-1}$ **D** $1\,Ws^{-1}$

34 The potential difference between point X and point Y is 20V. 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.

9702/01/M/J/04

What is the current between X and Y?

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

33 The terminal voltage of a battery is observed to fall when the battery supplies a current to an external resistor. 9702/01/M/J/04

What quantities are needed to calculate the fall in voltage?

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

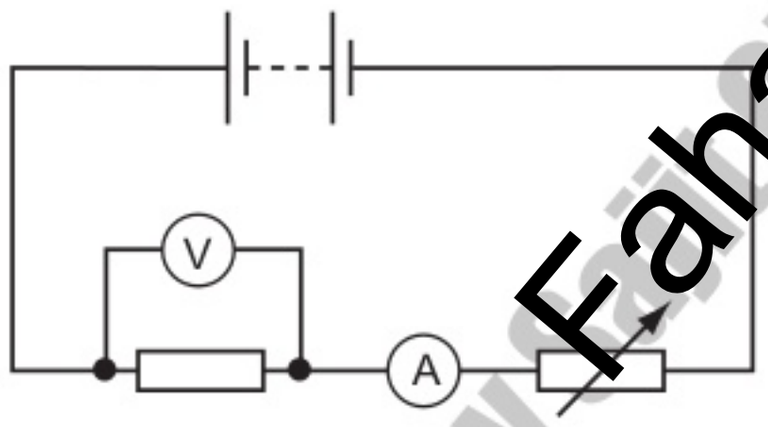
B the battery's e.m.f. and the current

C the current and the battery's internal resistance

D the current and the external resistance

35 The diagram shows a battery, a fixed resistor, an ammeter and a variable resistor connected in series. 9702/01/M/J/04

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?

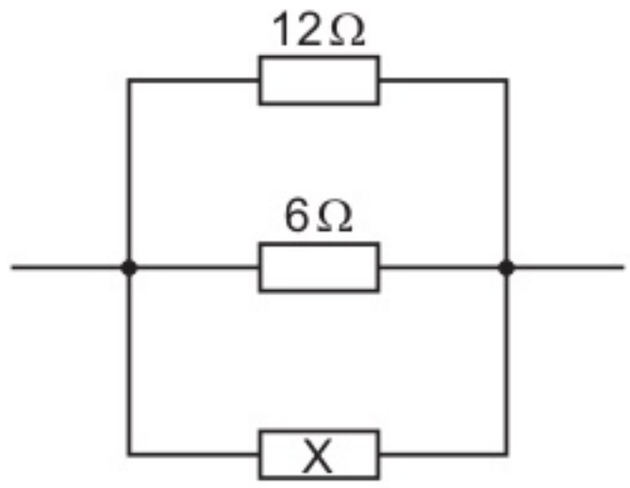
	ammeter	voltmeter
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

36 Kirchhoff's two laws for electric circuits can be derived by using conservation laws. 9702/01/M/J/04

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

37 The diagram shows a parallel combination of three resistors. The total resistance of the combination is 3Ω. 9702/01/M/J/04



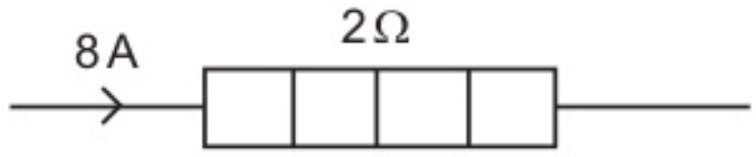
What is the resistance of resistor X?

A 2Ω **B** 3Ω **C** 6Ω **D** 12Ω

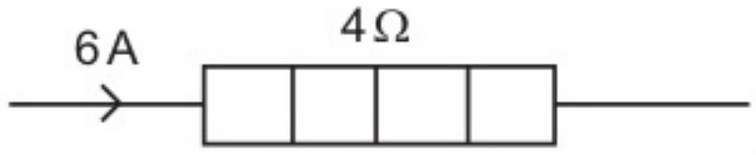
32 The diagram shows four heaters and the current in each. 9702/01/O/N/04

Which heater has the greatest power dissipation?

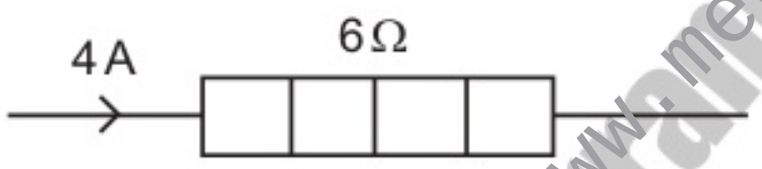
A



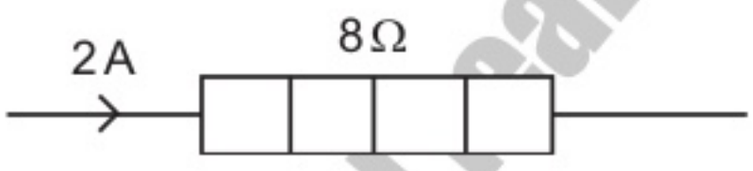
B



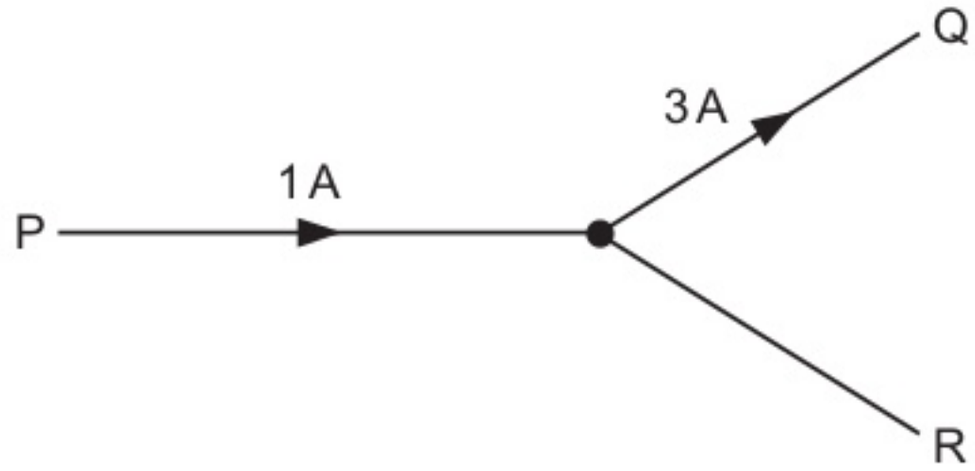
C



D



35 The diagram shows a junction in a circuit where three wires P, Q and R meet. The currents in P and Q are 1A and 3A respectively, in the directions shown. 9702/01/O/N/04



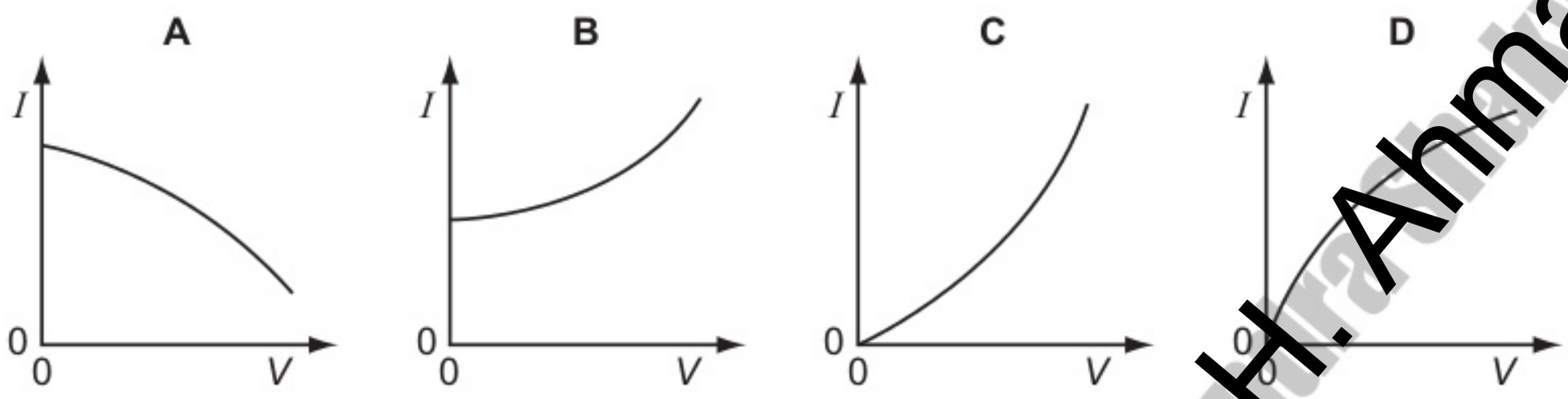
How many coulombs of charge pass a given point in wire R in 5 seconds?

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

34 The resistance of a thermistor decreases significantly as its temperature increases. 9702/01/O/N/04

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?

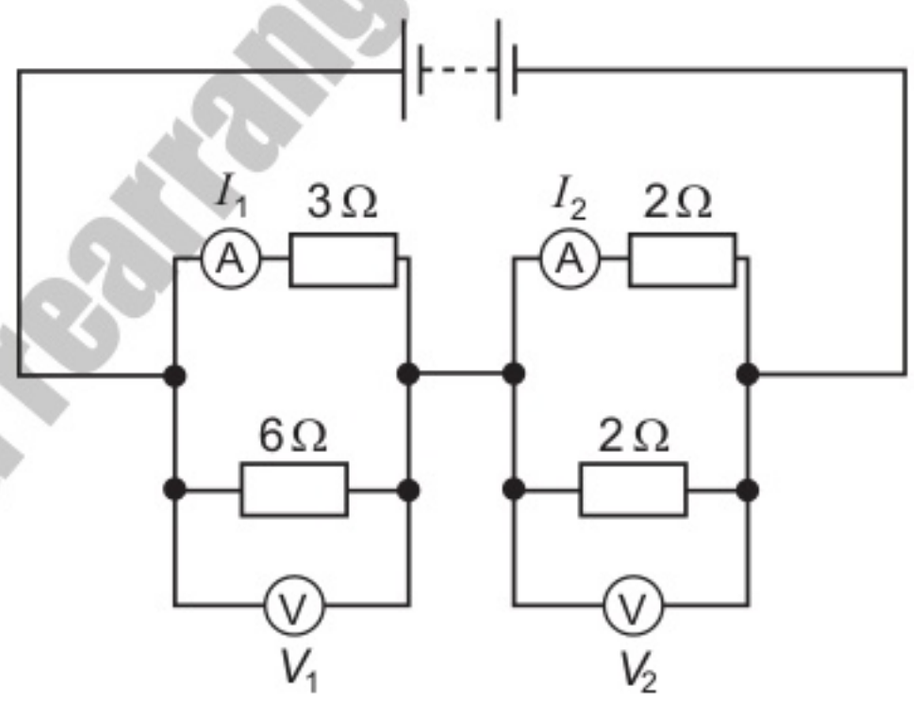


33 When a potential difference V is applied between the ends of a wire of diameter d and length l, the current in the wire is I. 9702/01/O/N/04

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** $8I$

37 In the circuit shown, the ammeters have negligible resistance and the voltmeters have infinite resistance. 9702/01/O/N/04



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 $V_1 > V_2$

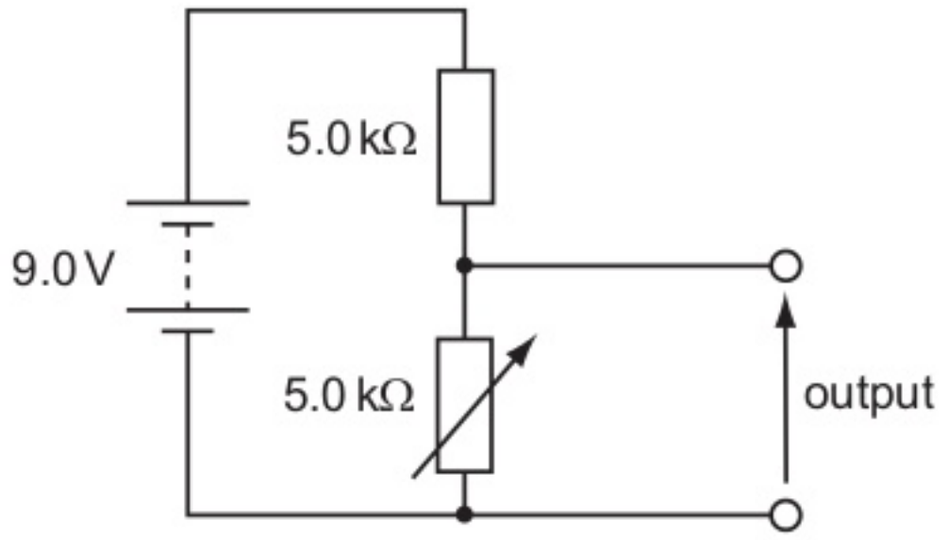
B $I_1 > I_2$ and $V_1 < V_2$

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

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

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

9702/01/O/N/04



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

32 A copper wire of cross-sectional area 2.0 mm^2 carries a current of 10 A. 9702/01/M/J/05

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

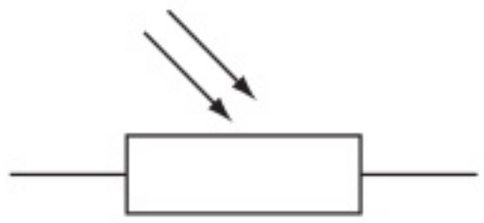
A 1.0×10^1 **B** 5.0×10^6 **C** 6.3×10^{19} **D** 3.1×10^{25}

33 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. 9702/01/M/J/05

What is its new resistance?

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

35 Which electrical component is represented by the following symbol? 9702/01/M/J/05



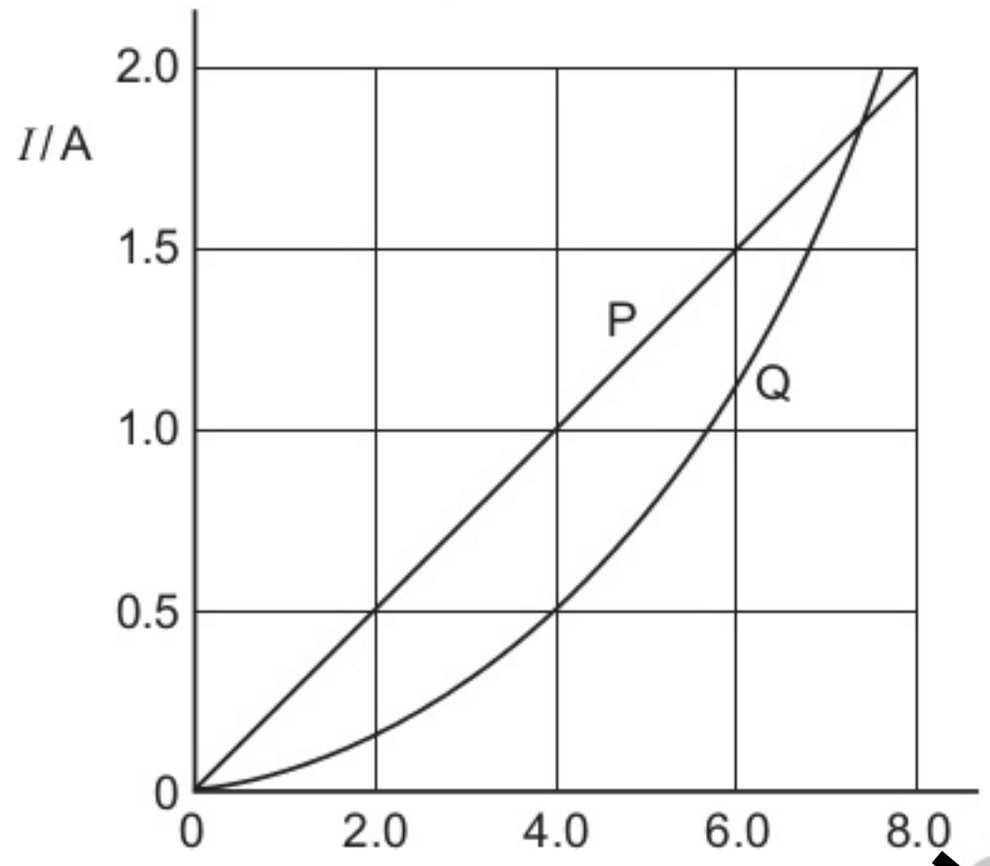
A a diode

B a light-dependent resistor

C a resistor

D a thermistor

34 The *I*-*V* characteristics of two electrical components P and Q are shown below. 9702/01/M/J/05



Which statement is correct?

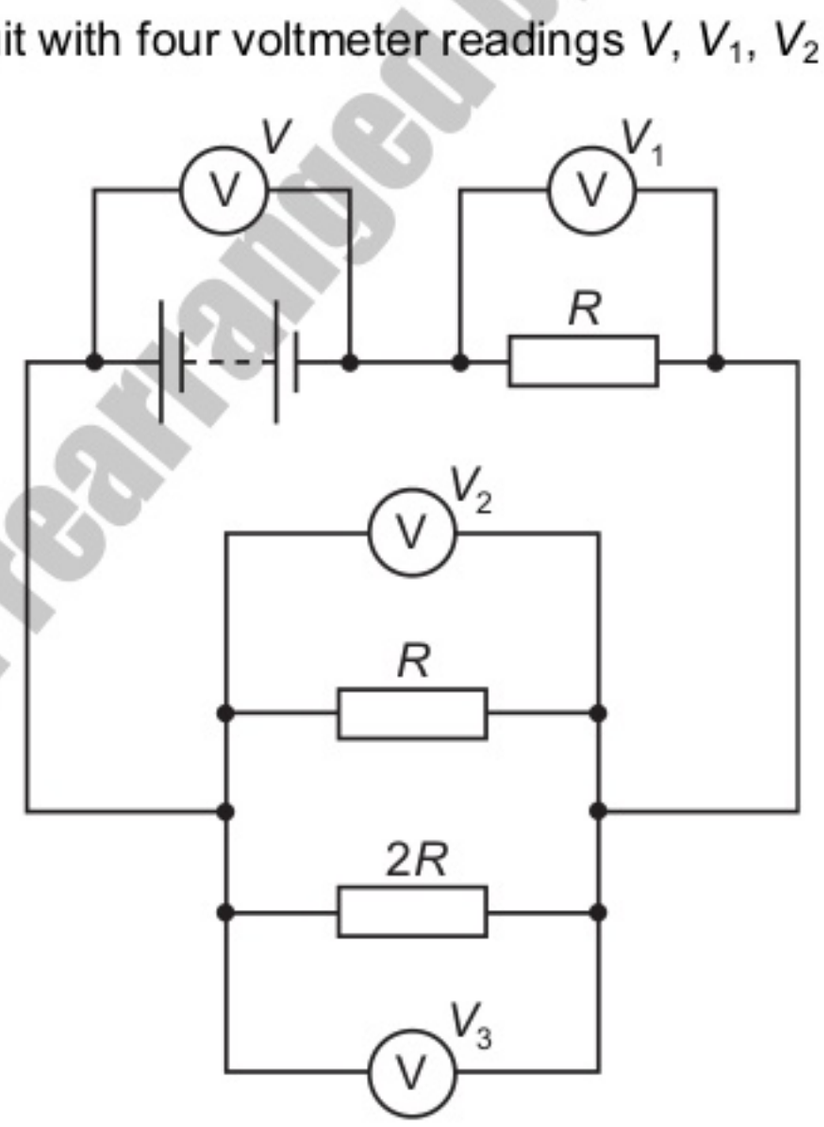
A P is a resistor and Q is a filament lamp.

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.

36 The diagram shows a circuit with four voltmeter readings V, V_1, V_2 and V_3. 9702/01/M/J/05



Which equation relating the voltmeter readings must be true?

A $V = V_1 + V_2 + V_3$

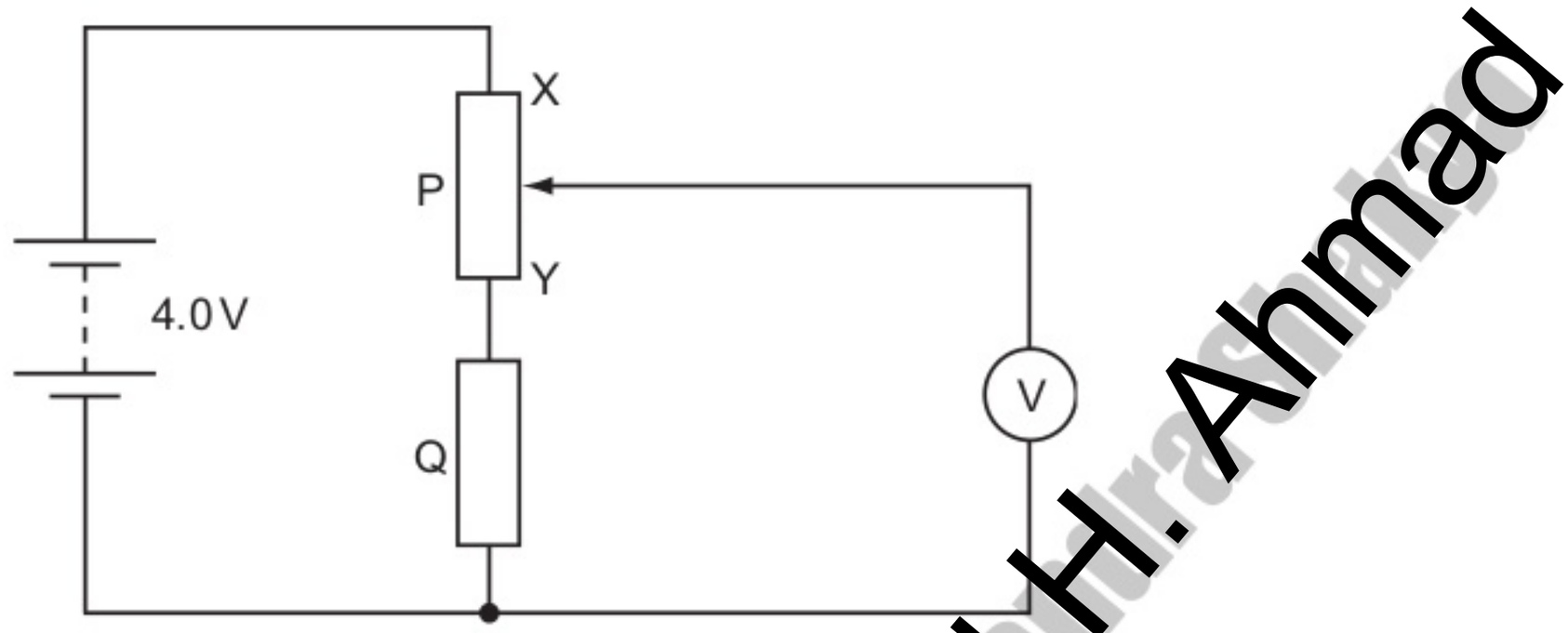
B $V + V_1 = V_2 + V_3$

C $V_3 = 2(V_2)$

D $V - V_1 = V_3$

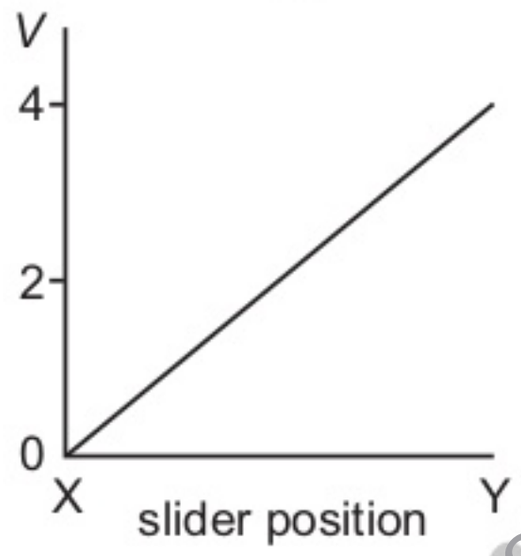
37 In the circuit below, P is a potentiometer of total resistance 10 Ω and Q is a fixed resistor of resistance 10 Ω. The battery has an e.m.f. of 4.0 V and negligible internal resistance. The voltmeter has a very high resistance. The slider on the potentiometer is moved from X to Y and a graph of voltmeter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

9702/01/M/J/05

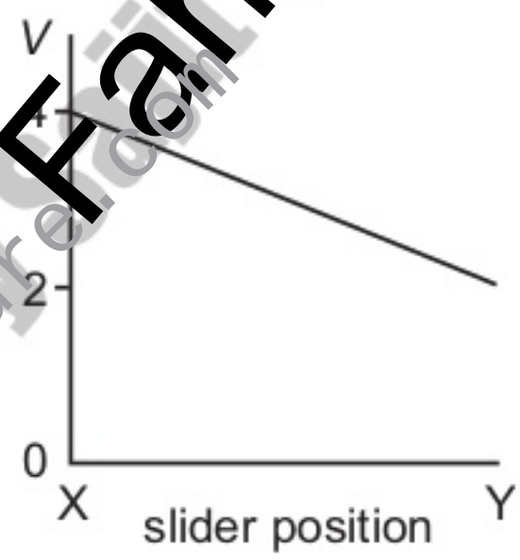


Which graph is obtained?

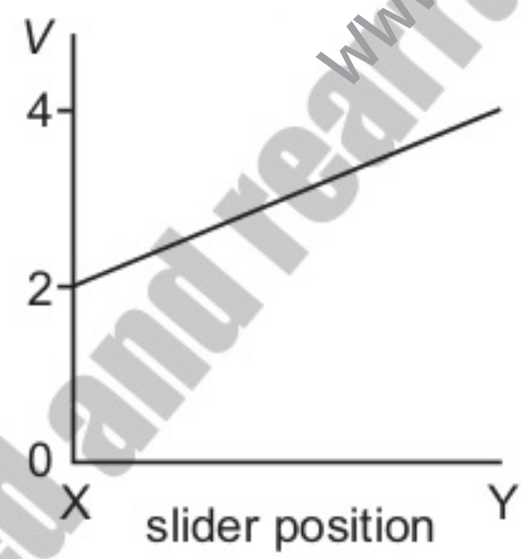
A



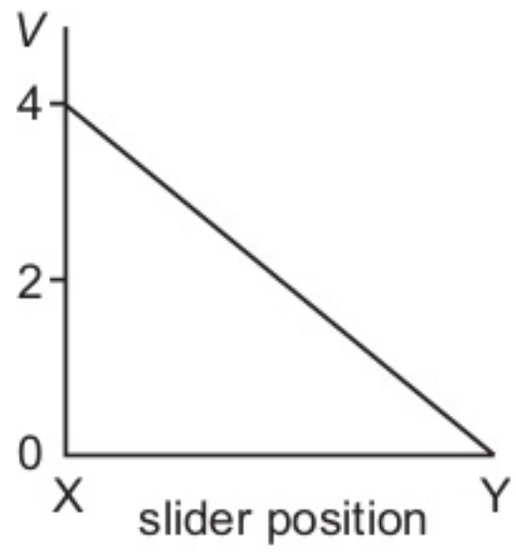
B



C



D



32 Which equation is used to define resistance?

9702/01/M/J/06

A energy = (current)^2 × resistance × time

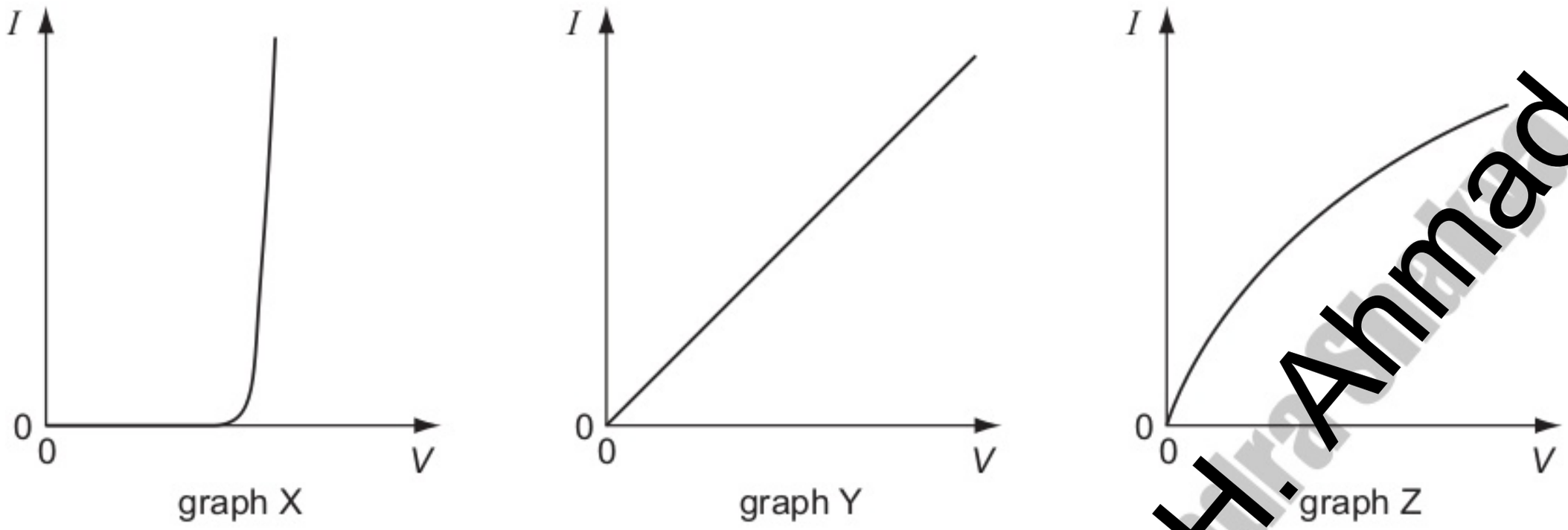
B potential difference = current × resistance

C power = (current)^2 × resistance

D resistivity = resistance × area ÷ length

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

9702/01/O/N/05



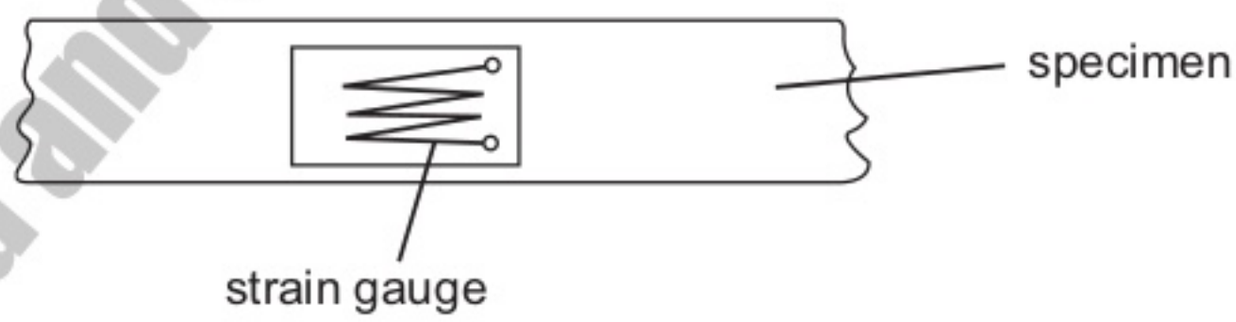
The components are a metal wire at constant temperature, a semiconductor diode and a filament lamp.

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

33 Tensile strain may be measured by the change in electrical resistance of a strain gauge. A strain gauge consists of folded fine metal wire mounted on a flexible insulating backing sheet. The strain gauge is firmly attached to the specimen, so that the strain in the metal wire is always identical to that in the specimen.

9702/01/O/N/05



When the strain in the specimen is increased, what happens to the resistance of the wire?

A It decreases, because the length decreases and the cross-sectional area increases.

B It decreases, because the length increases and the cross-sectional area decreases.

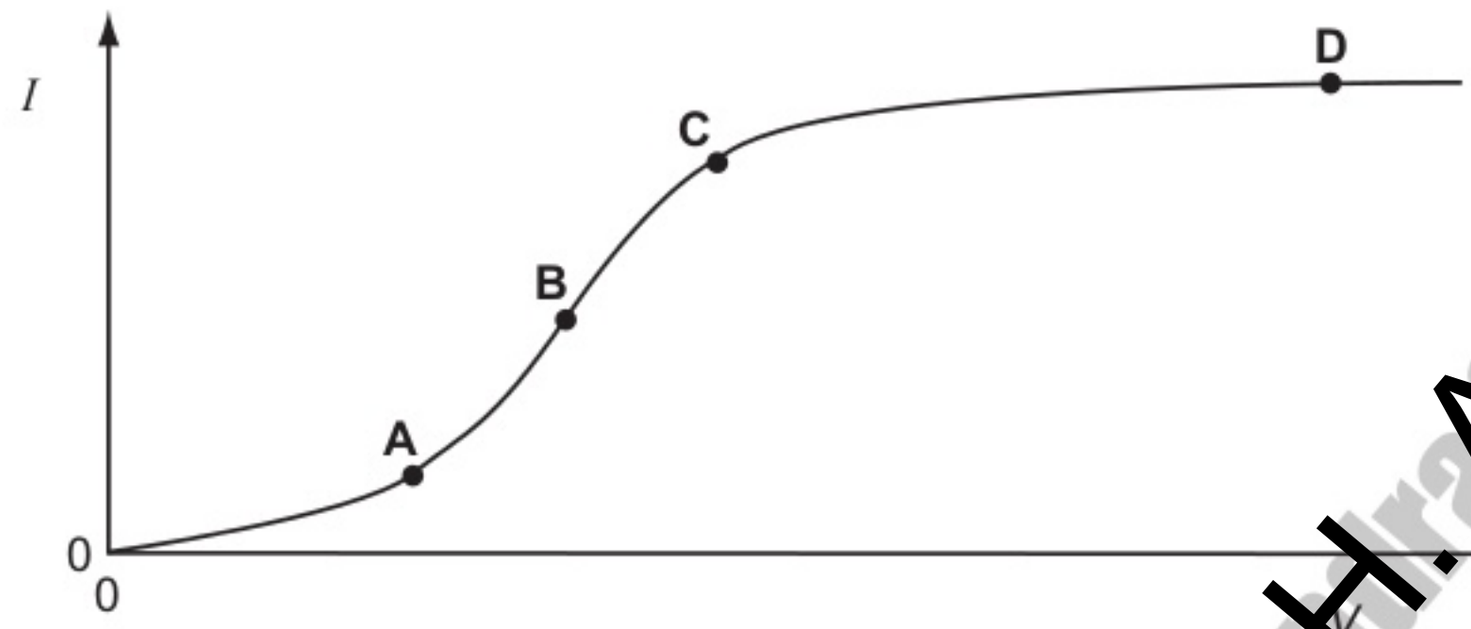
C It increases, because the length decreases and the cross-sectional area increases.

D It increases, because the length increases and the cross-sectional area decreases.

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

9702/01/O/N/05

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



35 An electrical component has the following circuit symbol.

9702/01/O/N/05

What does this symbol represent?

A variable resistor (rheostat)

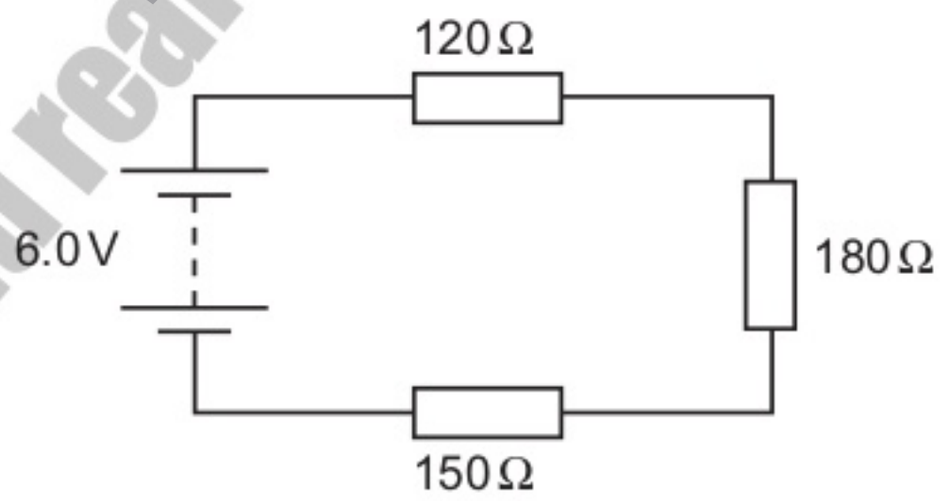
B fuse

C light-dependent resistor

D thermistor

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

9702/01/O/N/05



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

29 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.

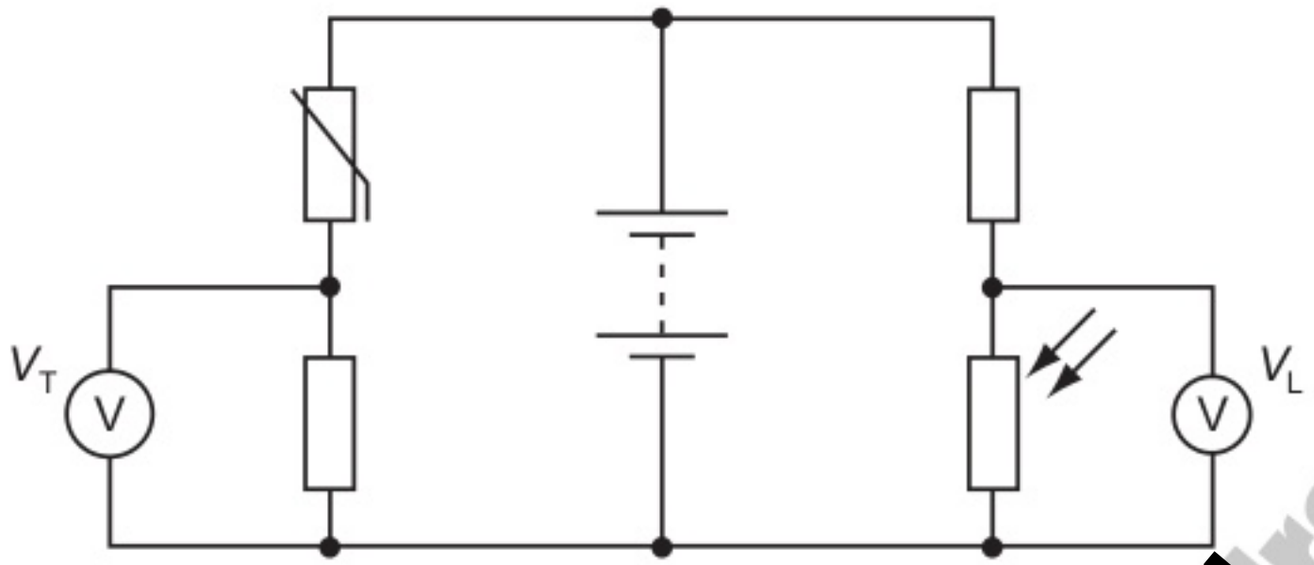
9702/01/O/N/07

What is the ratio R_X / R_Y?

A ¼ **B** ½ **C** 2 **D** 4

37 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.

9702/01/O/N/05



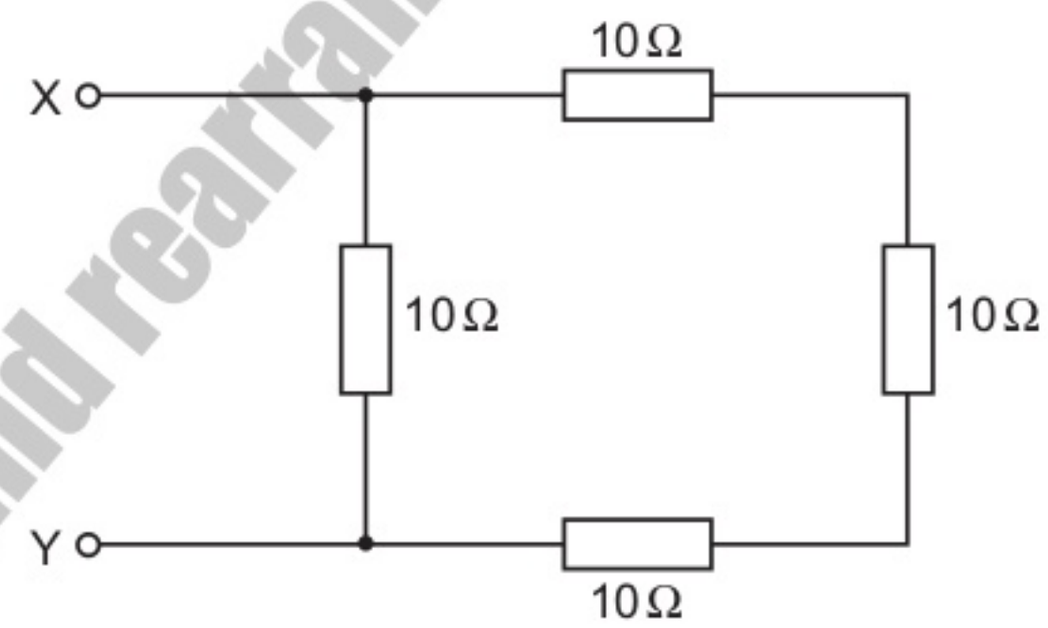
The readings on V_T and V_L are both high.

What are the conditions of temperature and light level?

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

35 The diagram shows an arrangement of resistors.

9702/01/M/J/06



What is the total electrical resistance between X and Y?

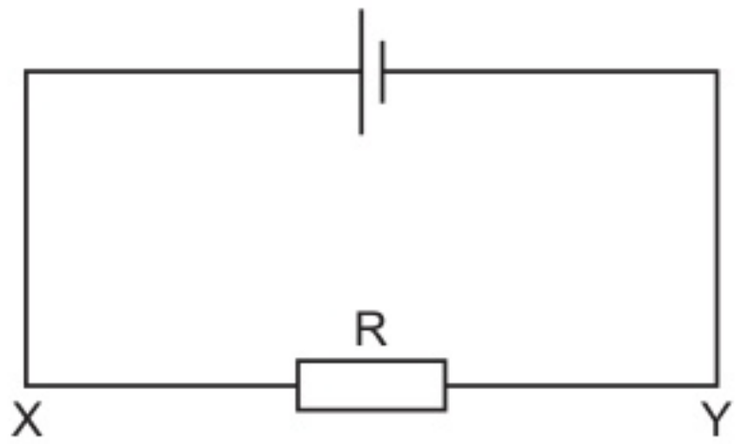
A less than 1 Ω

B between 1 Ω and 10 Ω

C between 10 Ω and 30 Ω

D 40 Ω

31 The current in the circuit is 4.8 A. 9702/01/M/J/06



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

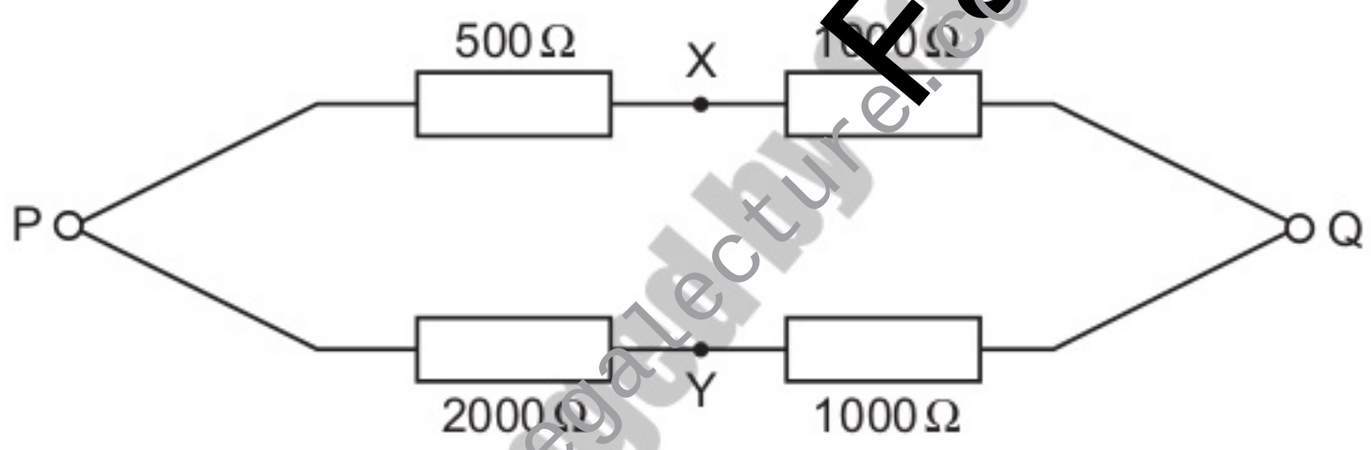
A $3.0 \times 10^{19}\,s^{-1}$ in direction X to Y

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

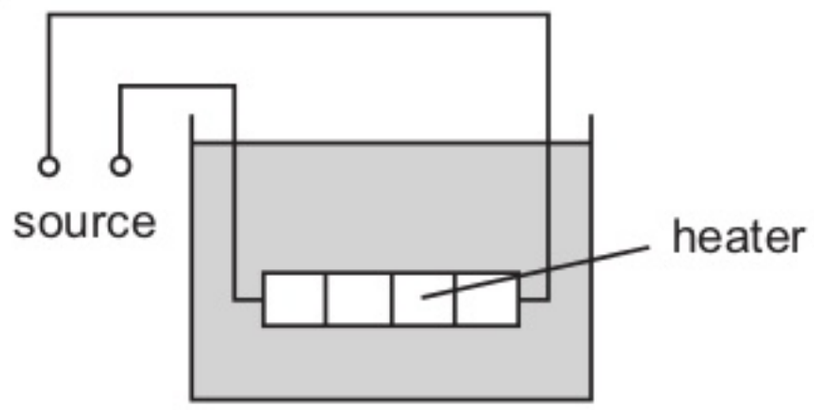
33 A p.d. of 12 V is connected between P and Q. 9702/01/M/J/06



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

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

34 The diagram shows a low-voltage circuit for heating the water in a fish tank. 9702/01/M/J/06



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

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

9702/01/M/J/06

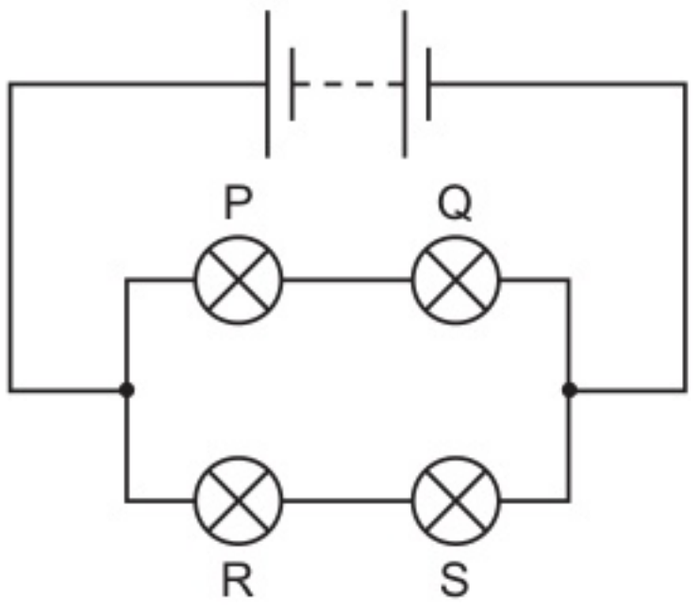


diagram 1

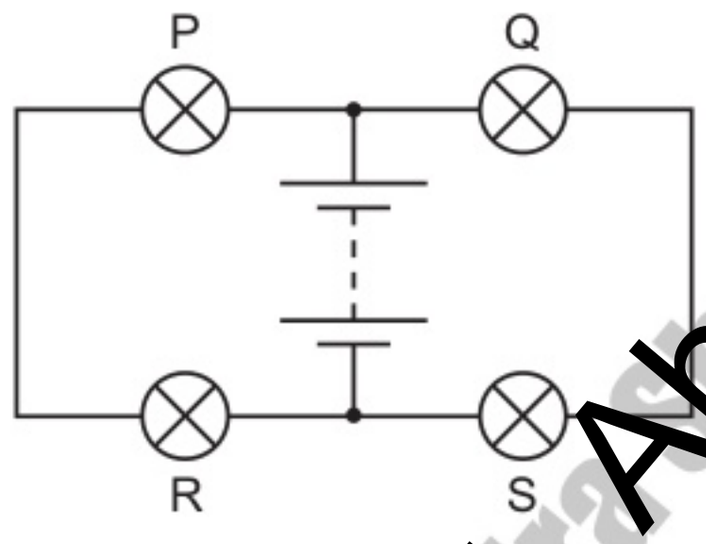


diagram 2

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

Which statement is correct?

A The lamps do not light.

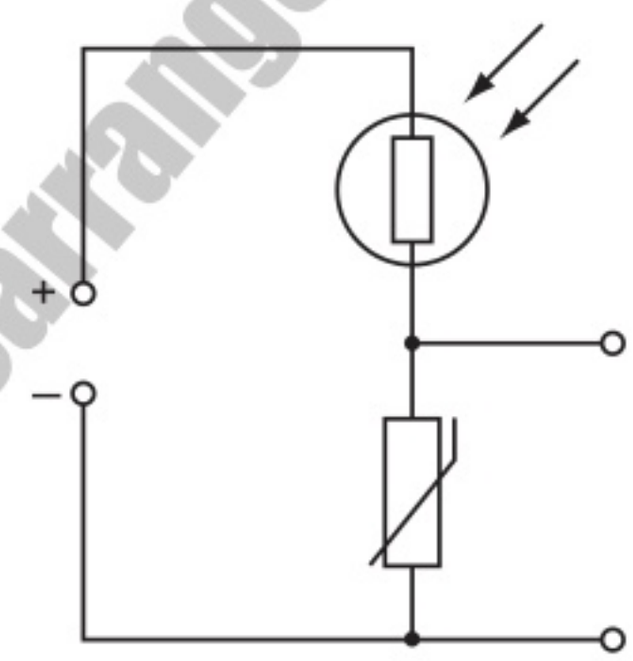
B The lamps are less bright than normal.

C The lamps have normal brightness.

D The lamps are brighter than normal.

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

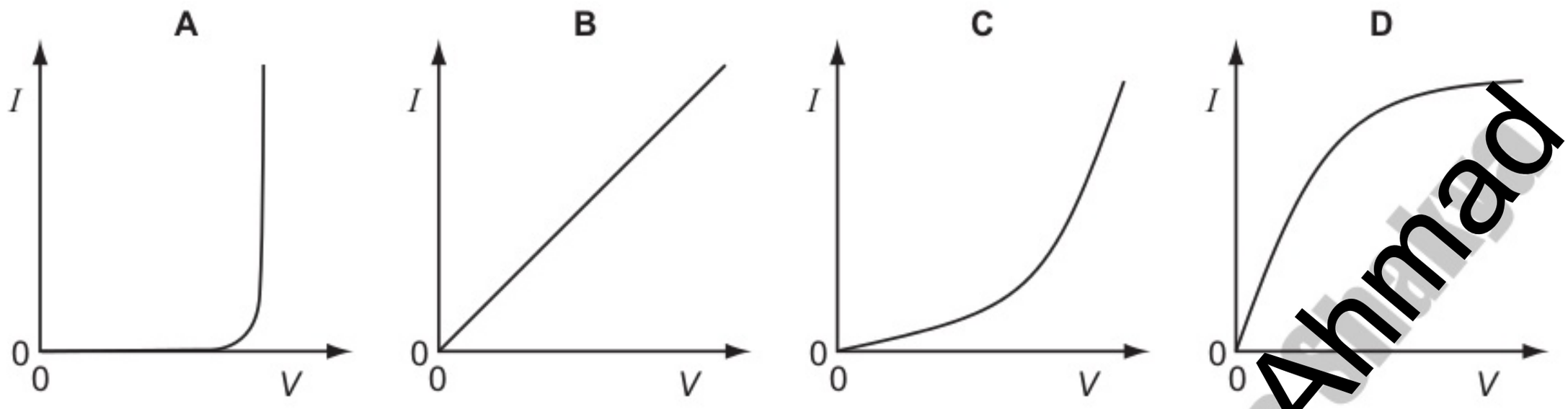
9702/01/M/J/06



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

32 Which graph shows the $I - V$ characteristic of a filament lamp? 9702/01/O/N/06



35 The resistance of a device is designed to change with temperature. 9702/01/O/N/06

What is the device?

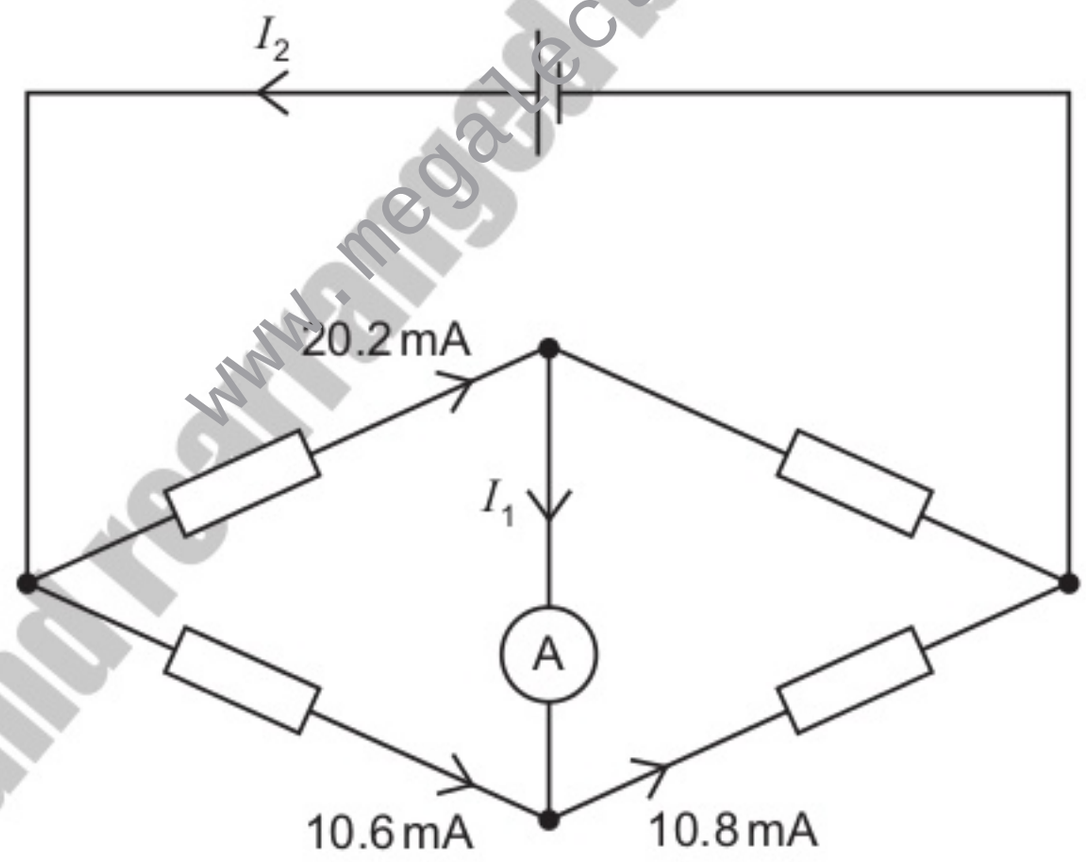
A a light-dependent resistor

B a potential divider

C a semiconductor diode

D a thermistor

36 The diagram represents a circuit. 9702/01/O/N/06

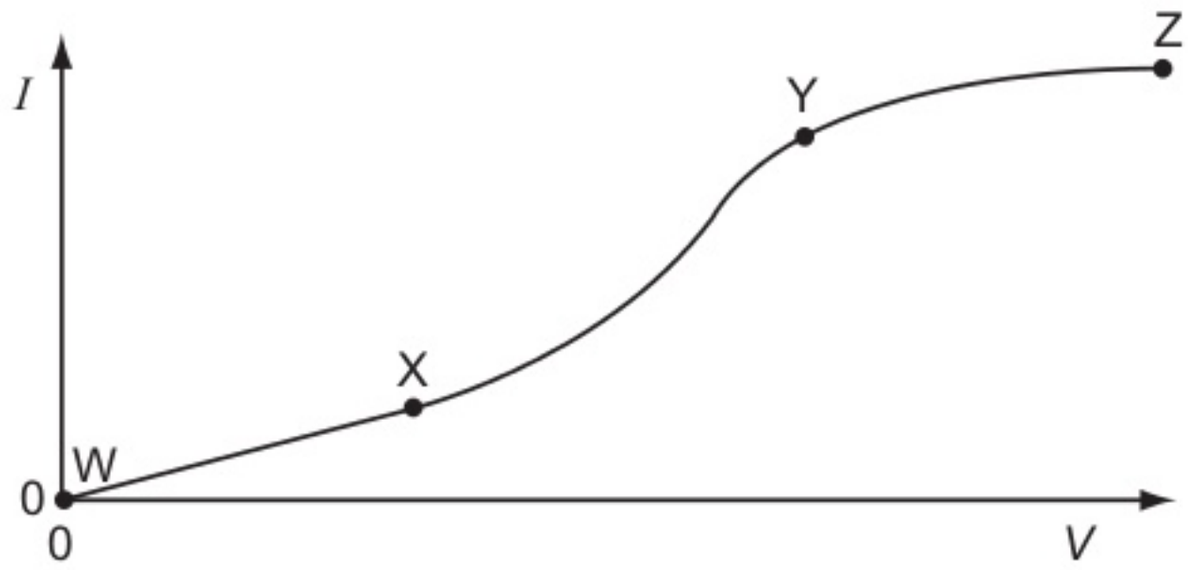


Some currents have been shown on the diagram.

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

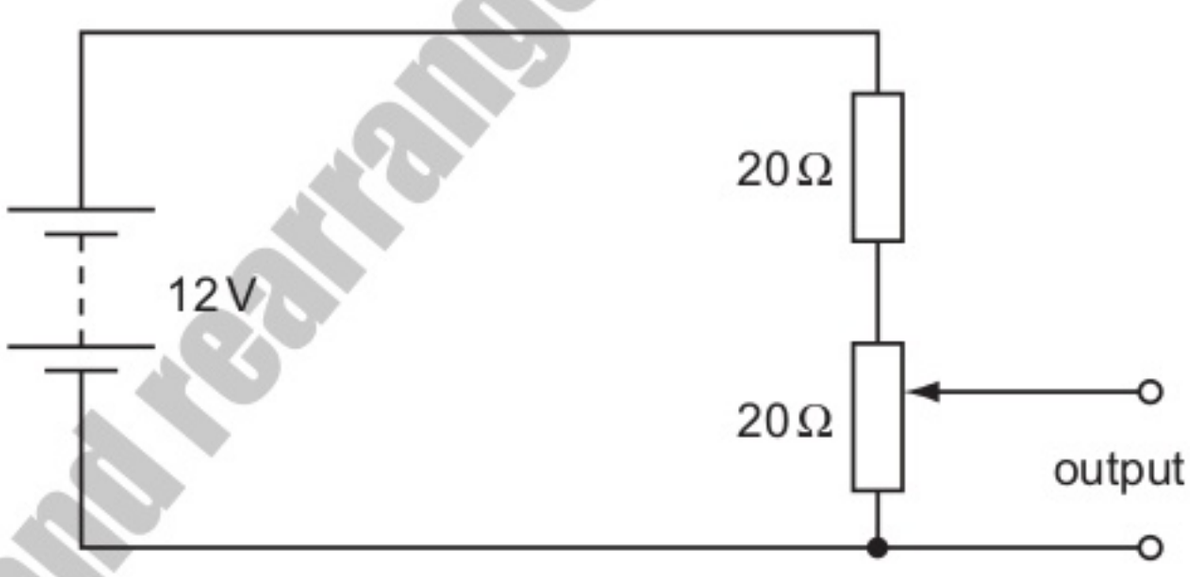
33 An electrical component has a potential difference V across it and a current I through it. A graph of I against V is drawn and is marked in three sections WX, XY and YZ. 9702/01/O/N/06



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

34 The diagram shows a potentiometer and a fixed resistor connected across a 12 V battery of negligible internal resistance. 9702/01/O/N/06



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

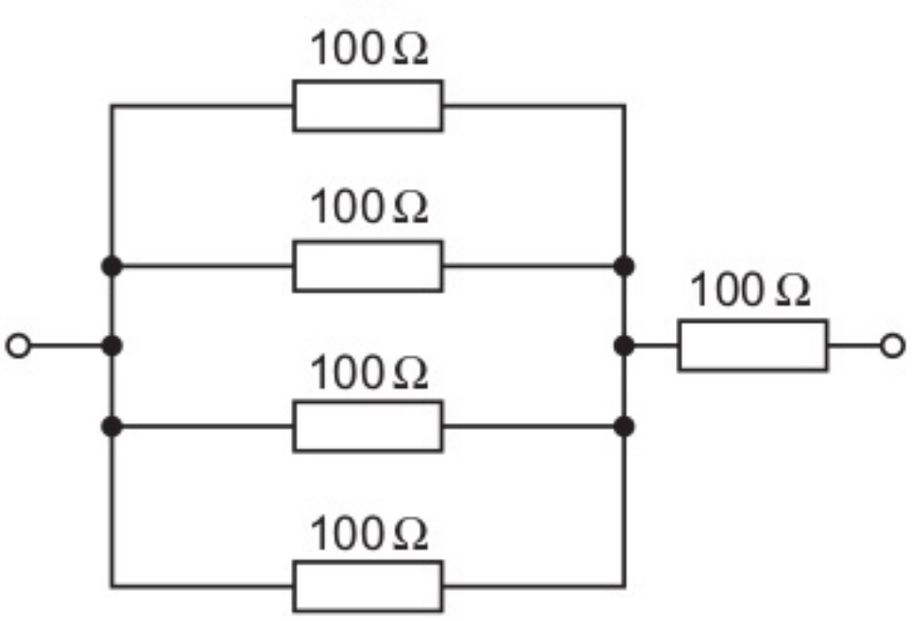
32 The current in a resistor is 8.0 mA. 9702/01/M/J/07

What charge flows through the resistor in 0.020 s?

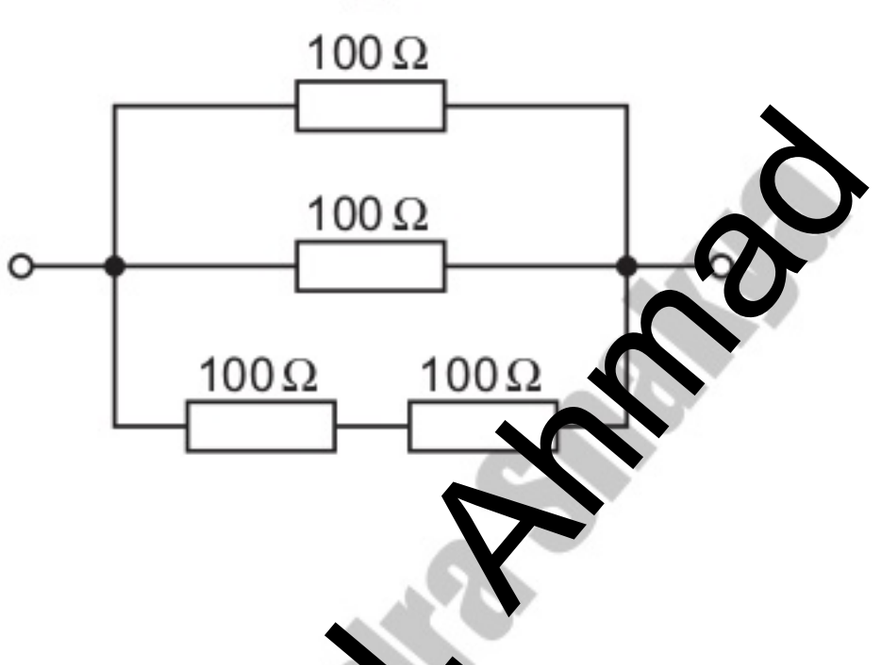
A 0.16 mC **B** 1.6 mC **C** 4.0 mC **D** 0.40 C

37 Which circuit has a resistance of 40 Ω between the terminals? 9702/01/O/N/06

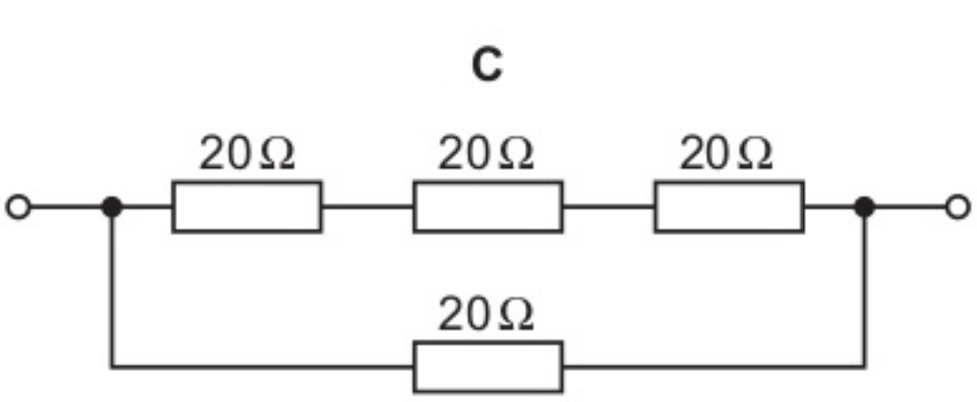
A



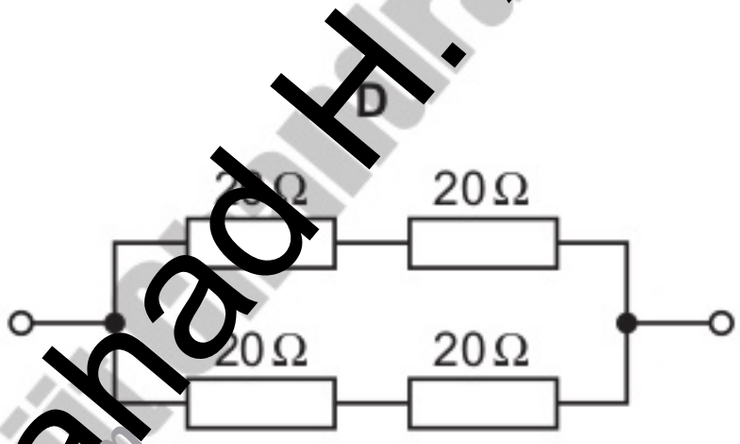
B



C



D



31 What is a correct statement of Ohm's law? 9702/01/M/J/07

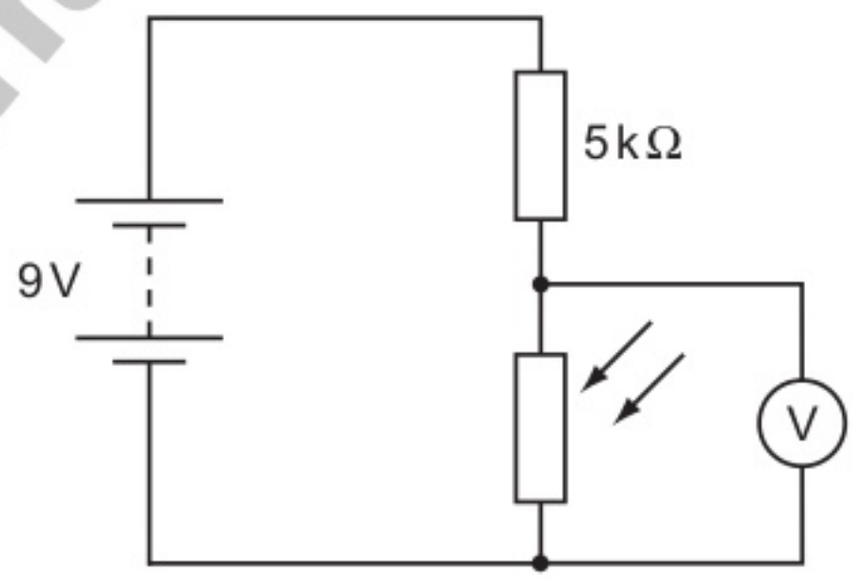
A The potential difference across a component equals the current providing the resistance and other physical conditions stay constant.

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 circuit is set up with an LDR and a fixed resistor as shown. 9702/01/M/J/07



The voltmeter reads 4 V.

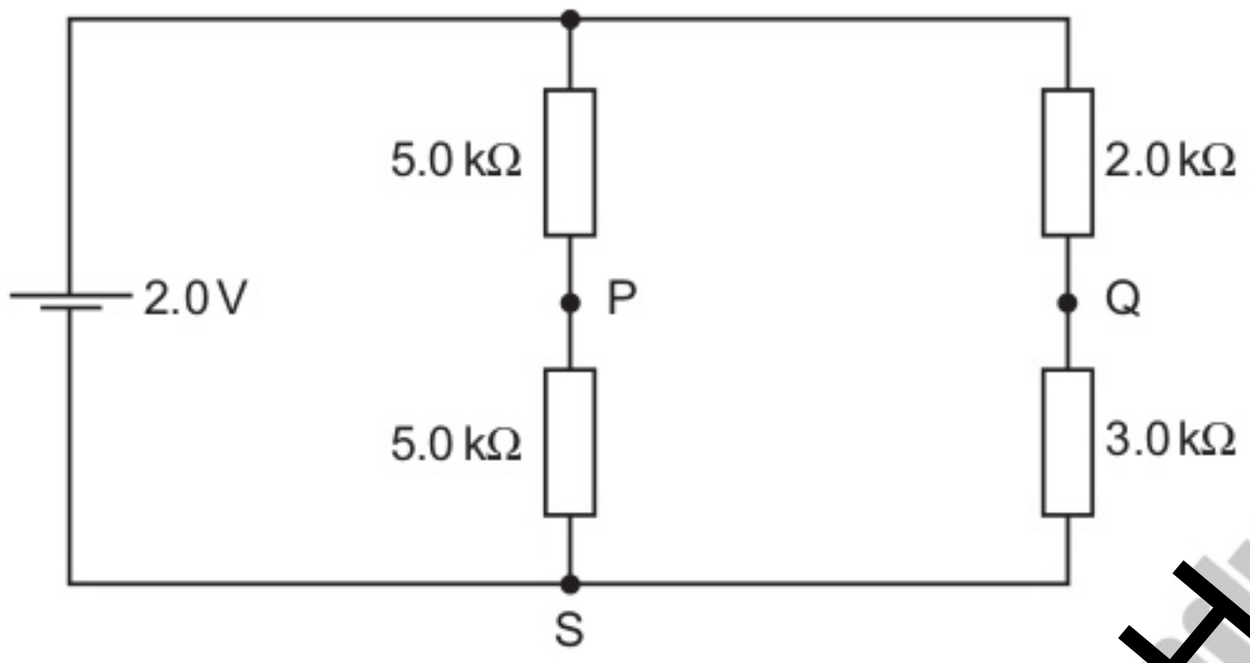
The light intensity is increased.

What is a possible voltmeter reading?

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

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

9702/01/M/J/07



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

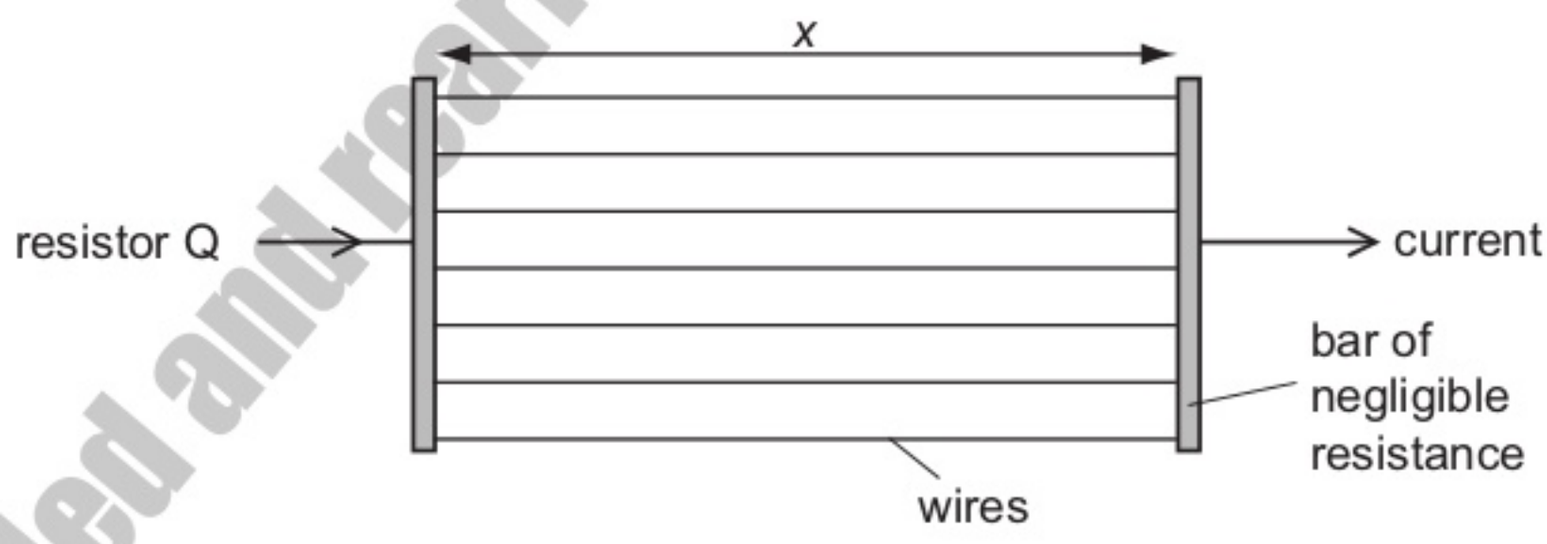
What is the value of $V_1 - V_2$?

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

37 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.

9702/01/M/J/07

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.

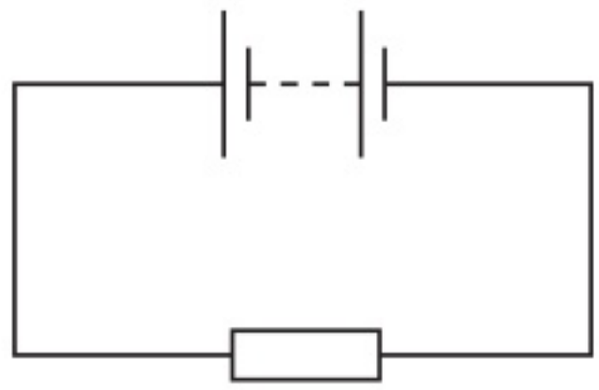
B Q has a larger resistance than P.

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.

35 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.

9702/01/M/J/07

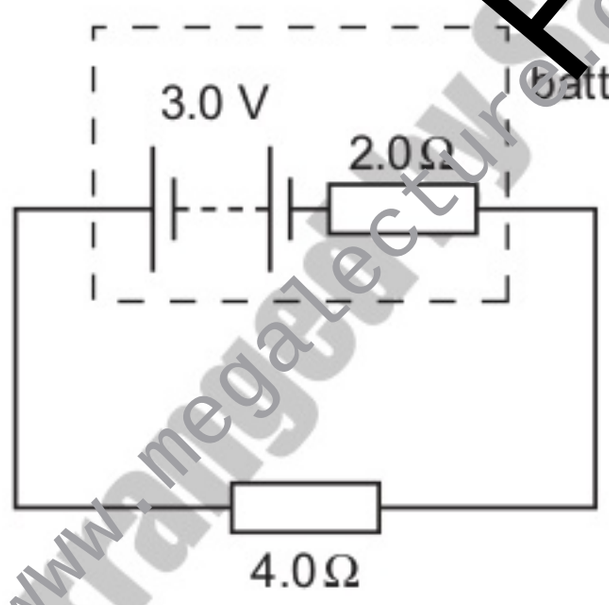


Which expressions give the e.m.f. of the battery and the current in the resistor?

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

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

9702/01/M/J/07



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

31 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.

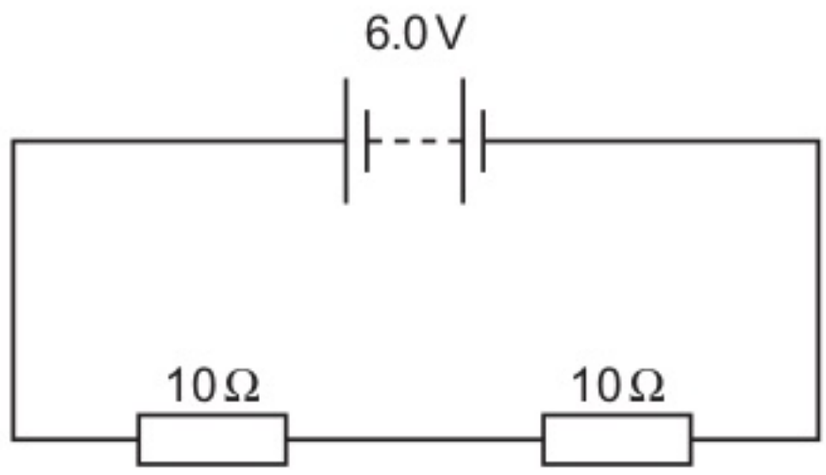
9702/01/O/N/07

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

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

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

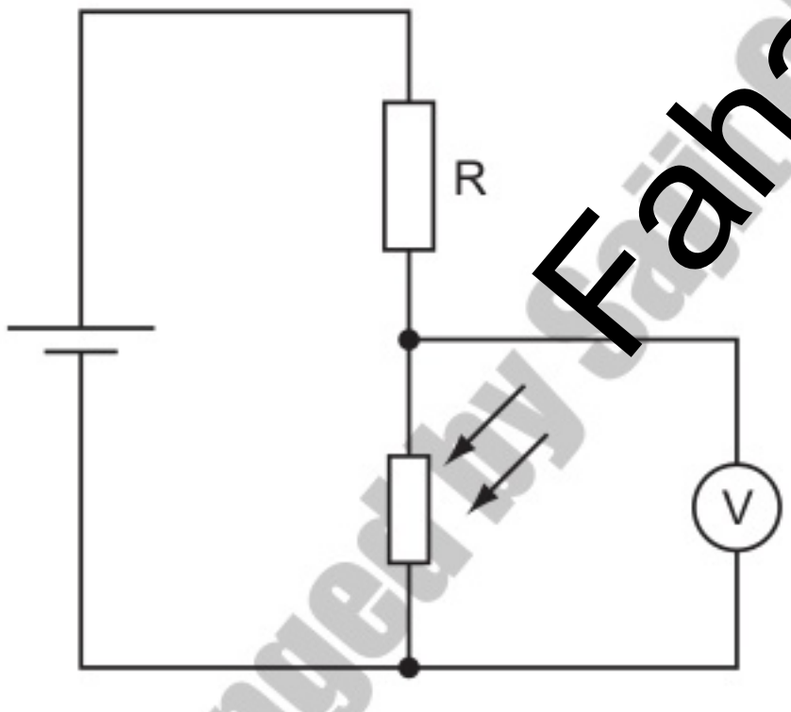
9702/01/O/N/07



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

32 A potential divider consists of a fixed resistor R and a light-dependent resistor (LDR). 9702/01/O/N/07



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.

32 A power cable X has a resistance R and carries current I. 9702/01/M/J/08

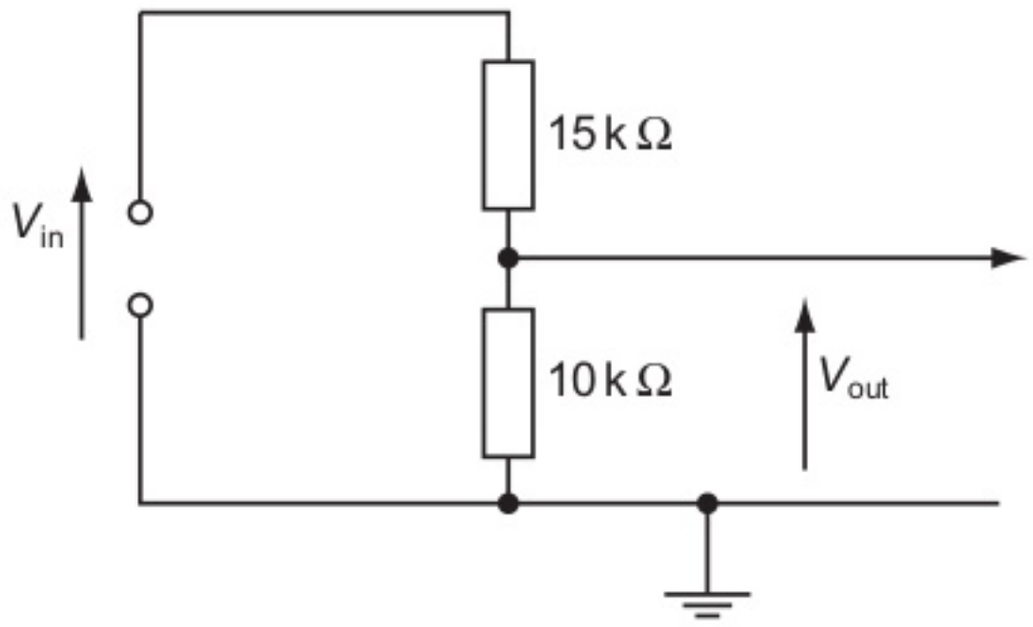
A second cable Y has a resistance $2R$ and carries current $\frac{1}{2}I$.

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

33 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.

9702/01/O/N/07



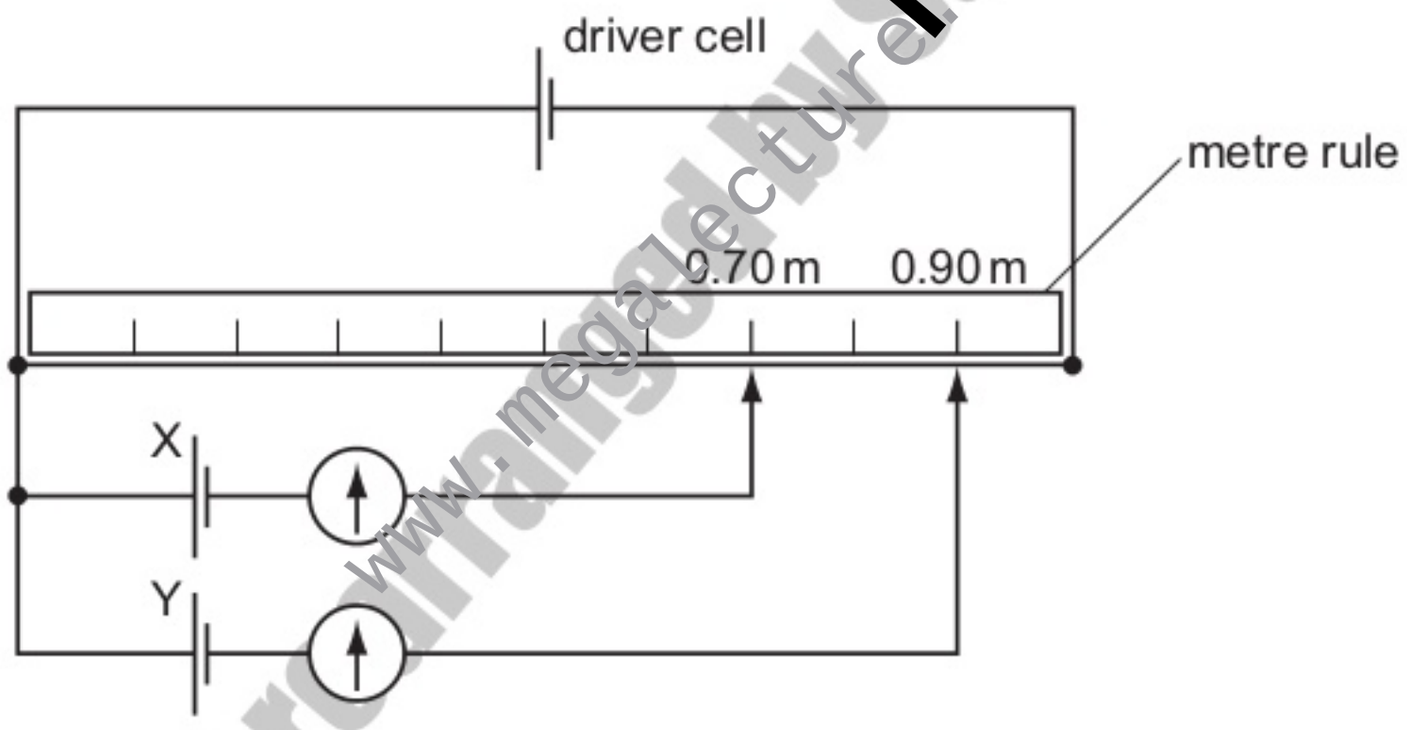
V_{out} is equal to 4.8 V.

What is the input voltage V_{in}?

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

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

9702/01/O/N/07



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

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

9702/01/O/N/07

A current

B potential difference

C power

D resistance

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

9702/01/O/N/07

diagram 1

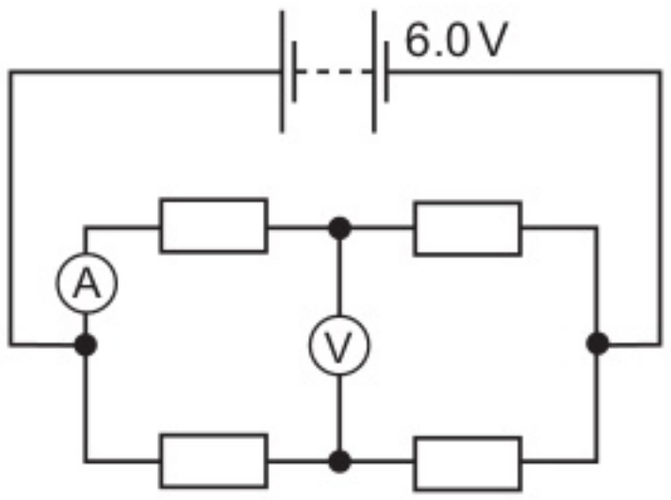
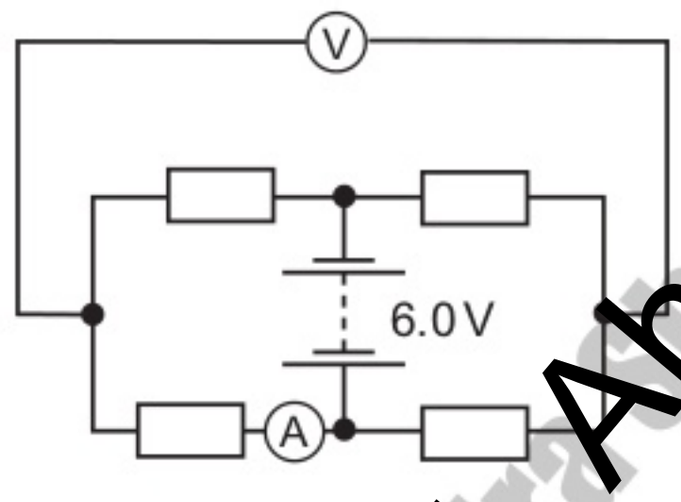


diagram 2



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

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

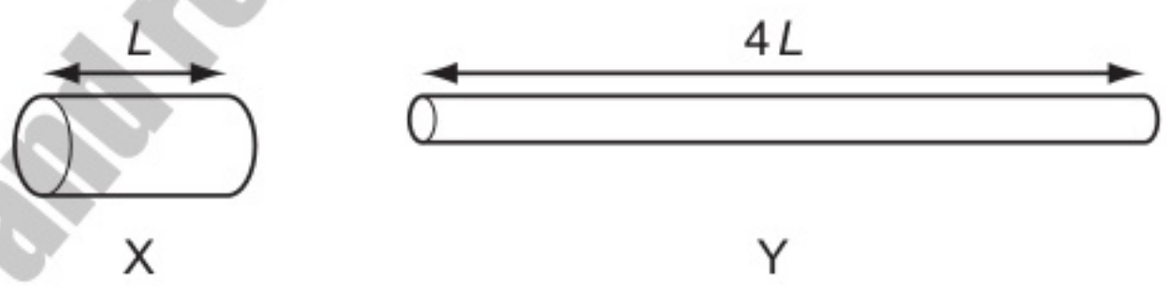
9702/01/M/J/08

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

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

9702/01/M/J/08



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

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

34 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.

9702/01/O/N/08

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

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

35 The potential difference across a resistor is 12 V. The current in the resistor is 2.0 A. 9702/01/M/J/08

4.0 C passes through the resistor.

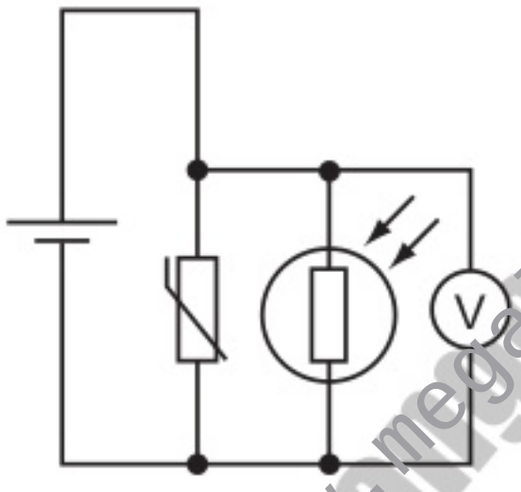
What is the energy transferred and the time taken?

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

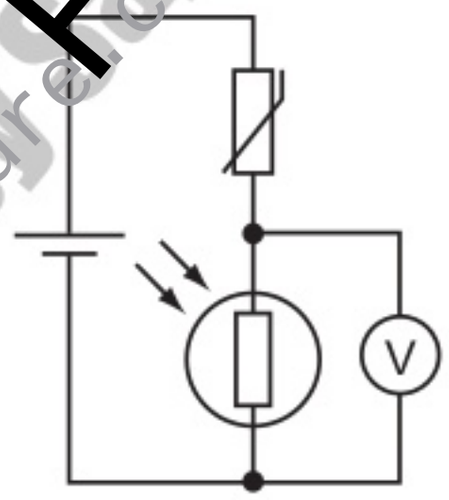
36 A thermistor and another component are connected to a constant voltage supply. A voltmeter is connected across one of the components. The temperature of the thermistor is then reduced but no other changes are made. 9702/01/M/J/08

In which circuit will the voltmeter reading increase?

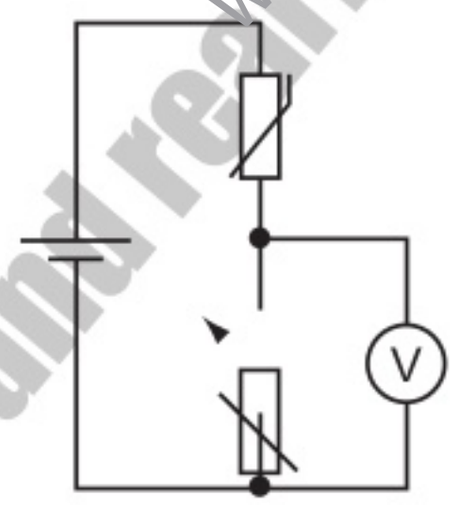
A



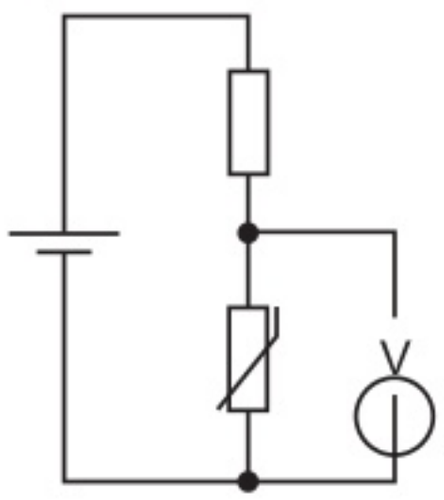
B



C



D



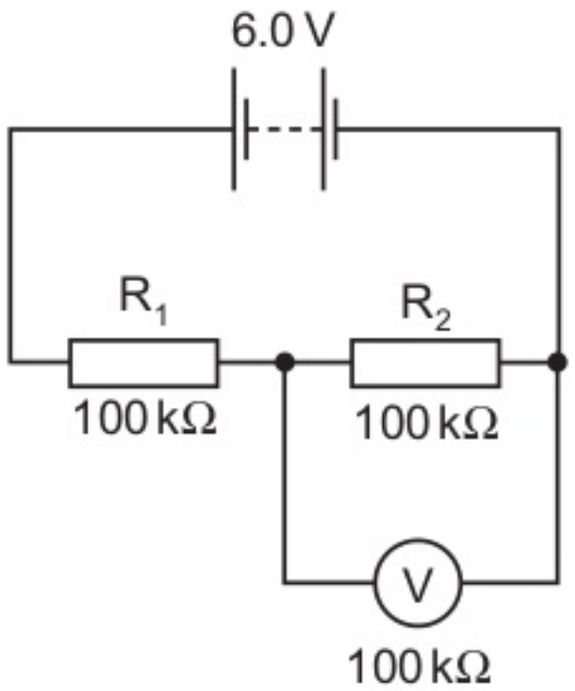
31 Two wires P and Q made of the same material and of the same length are connected in parallel to the same voltage supply. Wire P has diameter 2 mm and wire Q has diameter 1 mm.

9702/01/O/N/08

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** $\frac{4}{1}$

37 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. 9702/01/M/J/08



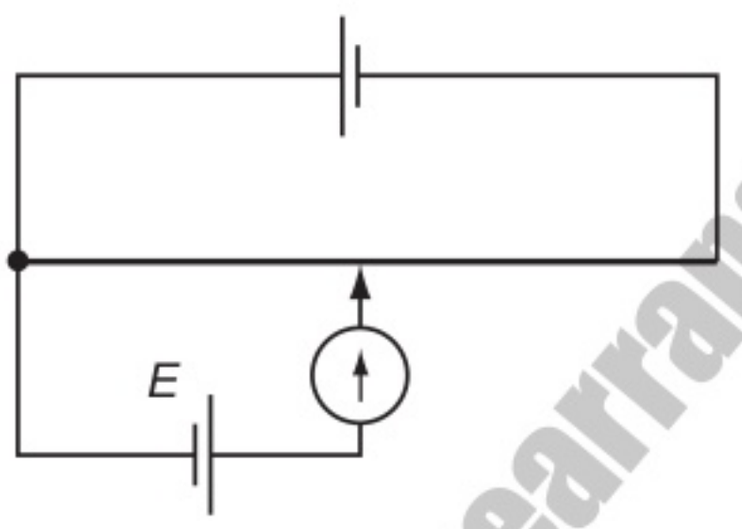
What is the current in the resistor R_2?

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

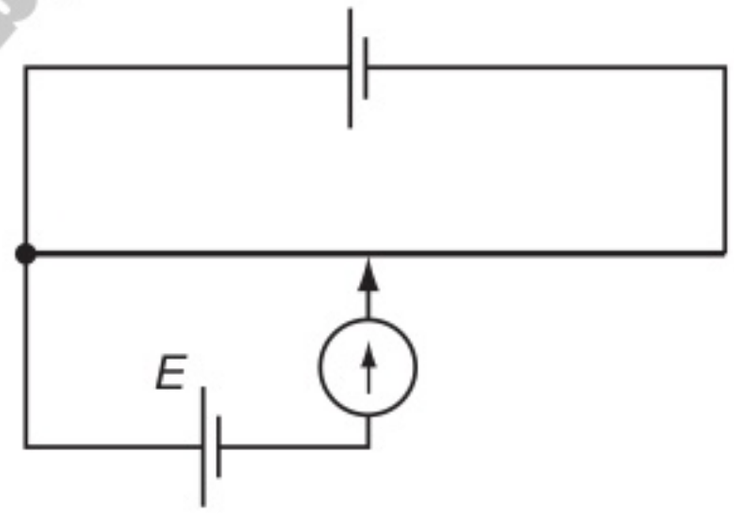
38 The unknown e.m.f. *E* of a cell is to be determined using a potentiometer circuit. The balance length is to be measured when the galvanometer records a null reading. 9702/01/M/J/08

What is the correct circuit to use?

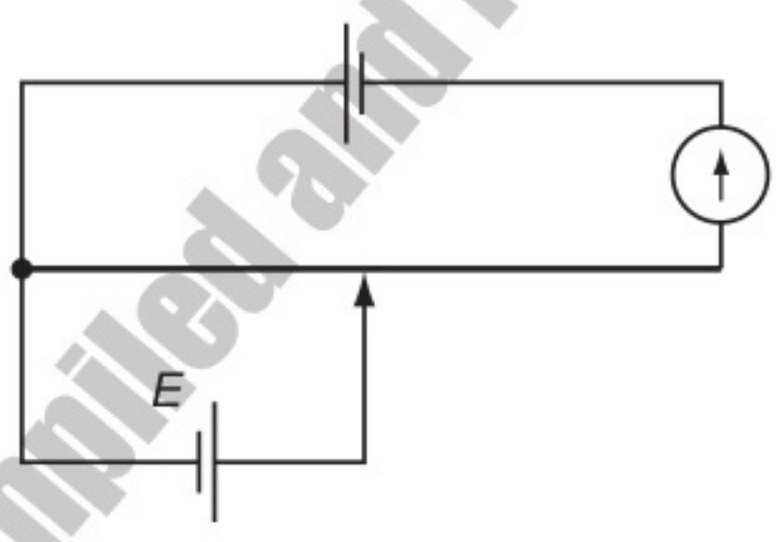
A



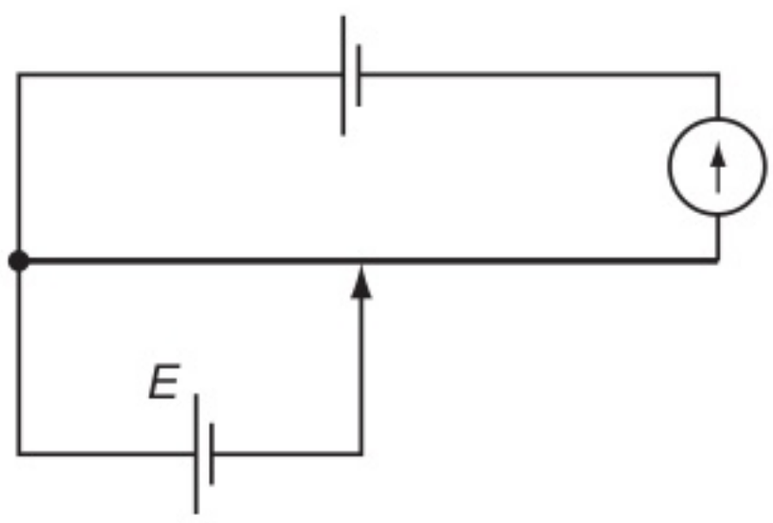
B



C



D

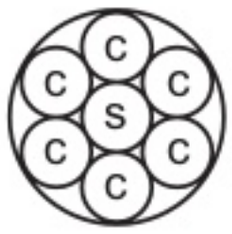


31 A 12 V battery is charged for 20 minutes by connecting it to a source of electromotive force (e.m.f.). The battery is supplied with 7.2×10^4 J of energy in this time. 9702/01/M/J/09

How much charge flows into the battery?

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

32 An electric power cable consists of six copper wires c surrounding a steel core s. 9702/01/O/N/08



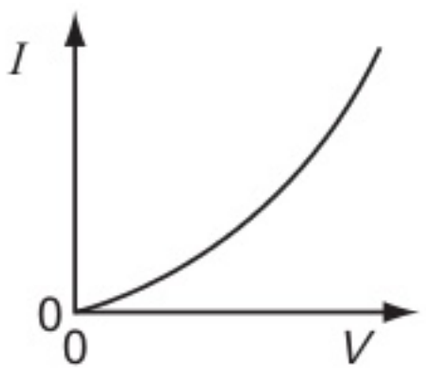
1.0 km of one of the copper wires has a resistance of 10 Ω and 1.0 km of the steel core has a resistance of 100 Ω.

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

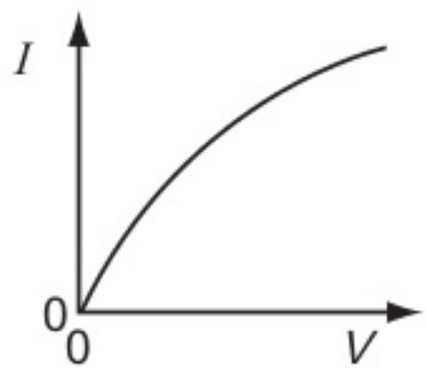
A 0.61 Ω **B** 1.6 Ω **C** 160 Ω **D** 610 Ω

33 Which graph best represents the way the current I through a filament lamp varies with the potential difference V across it? 9702/01/O/N/08

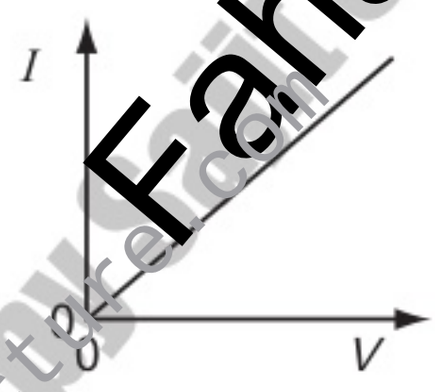
A



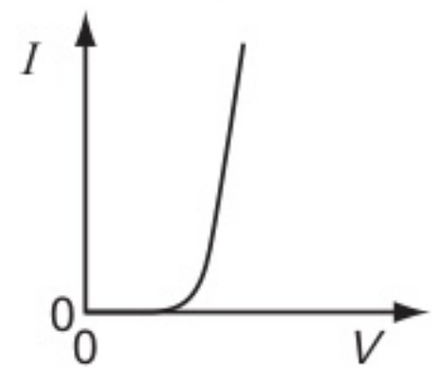
B



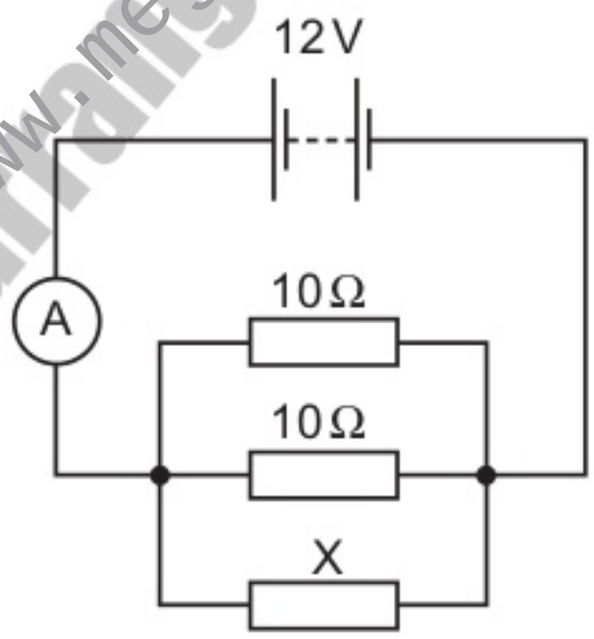
C



D



35 The diagram shows a circuit containing three resistors in parallel. 9702/01/O/N/08



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

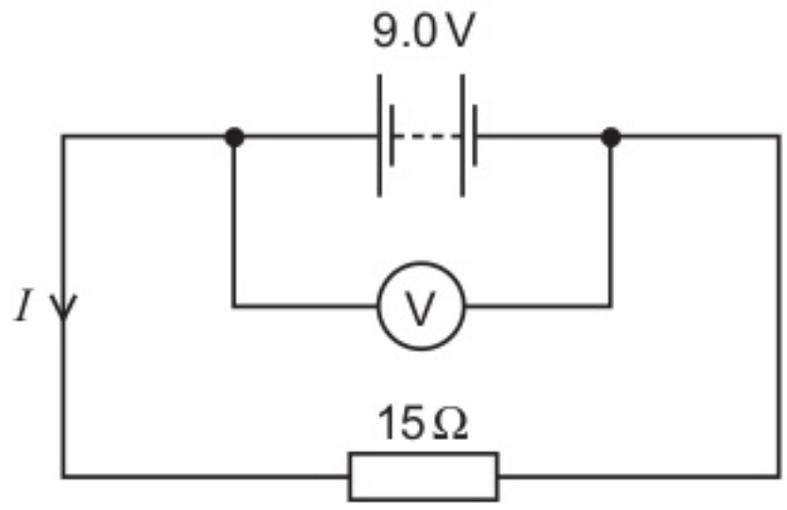
33 A copper wire is cylindrical and has resistance R. 9702/11/O/N/10

What will be the resistance of a copper wire of twice the length and twice the radius?

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

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

9702/01/O/N/08

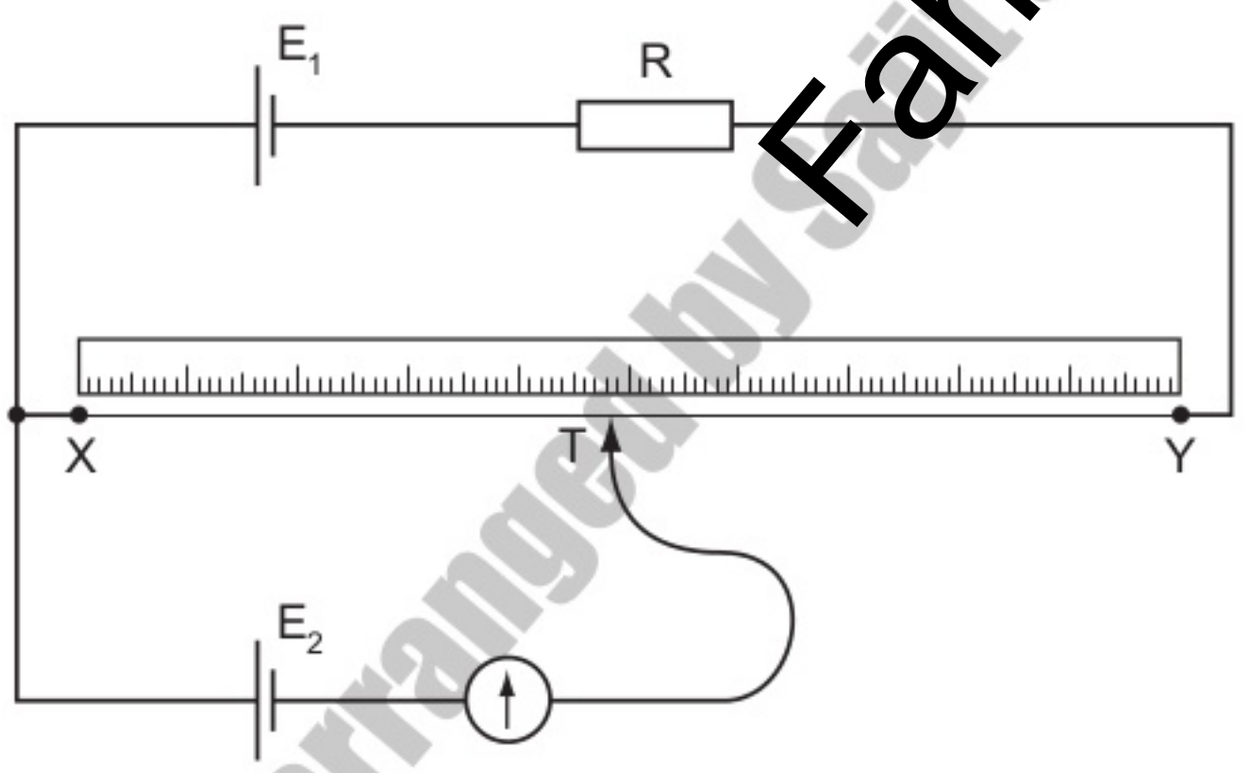


What is the current I?

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

37 The diagram shows a potentiometer circuit.

9702/01/O/N/08



The contact T is placed on the wire and moved along the wire until the galvanometer reading is zero. The length XT is then noted.

In order to calculate the potential difference per unit length on the wire XY, which value must also be known?

A the e.m.f. of the cell E_1

B the e.m.f. of the cell E_2

C the resistance of resistor R

D the resistance of the wire XY

31 What is the unit of resistivity?

9702/11/M/J/10

A $\Omega\,m^{-2}$ **B** $\Omega\,m^{-1}$ **C** Ω **D** $\Omega\,m$

32 What is meant by the electromotive force (e.m.f.) of a cell? 9702/01/M/J/09

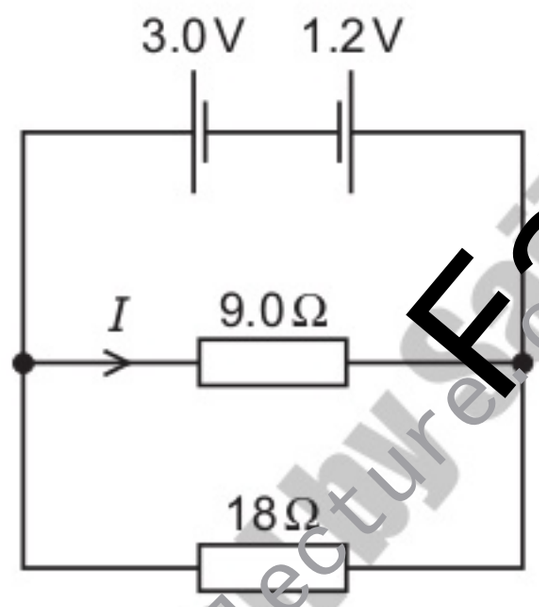
A The e.m.f. of a cell is the energy converted into electrical energy when unit charge passes through the cell.

B The e.m.f. of a cell is the energy transferred by the cell in driving unit charge through the external resistance.

C The e.m.f. of a cell is the energy transferred by the cell in driving unit charge through the internal resistance of the cell.

D The e.m.f. of a cell is the amount of energy needed to bring a unit positive charge from infinity to its positive pole.

33 Two cells of e.m.f. 3.0 V and 1.2 V and negligible internal resistance are connected to resistors of resistance 9.0 Ω and 18 Ω as shown. 9702/01/M/J/09



What is the value of the current I in the 9.0Ω resistor?

A 0.10 A **B** 0.20 A **C** 0.30 A **D** 0.47 A

30 Which amount of charge, flowing in the given time, will produce the largest current? 9702/01/M/J/09

	charge / C	time / s
A	4	$\frac{1}{4}$
B	4	1
C	1	4
D	$\frac{1}{4}$	4

35 A source of e.m.f. of 9.0 mV has an internal resistance of 6.0 Ω. 9702/11/M/J/10

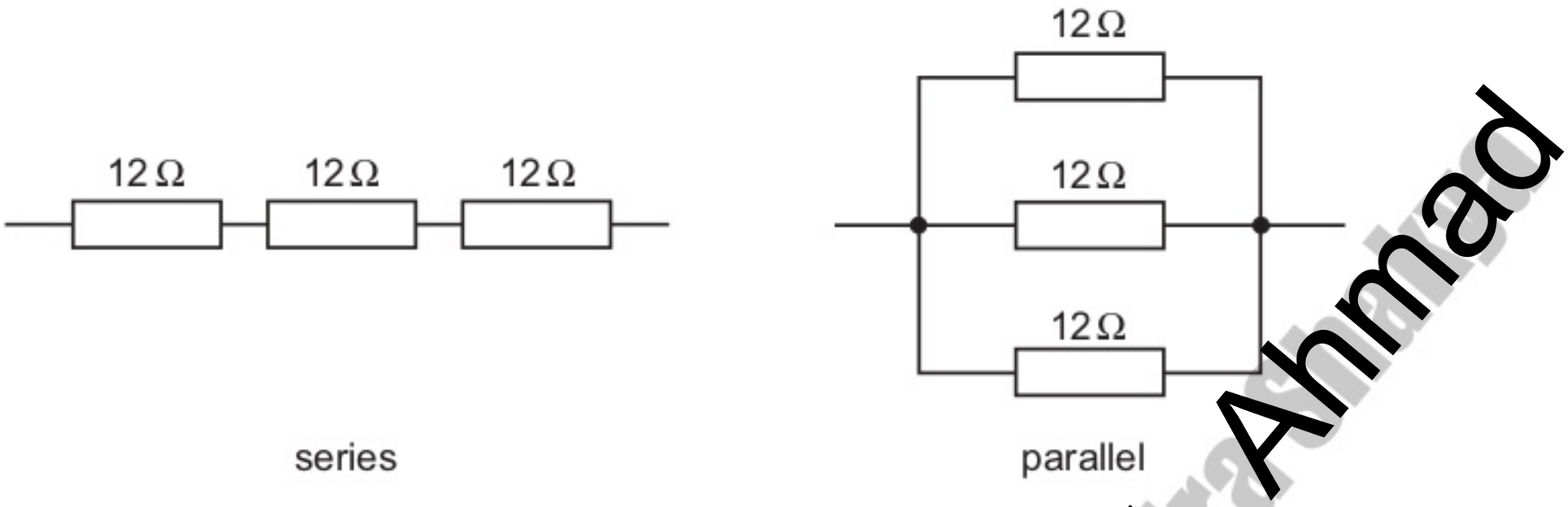
It is connected across a galvanometer of resistance 30 Ω.

What will be the current in the galvanometer?

A 250 μA **B** 300 μA **C** 1.5 mA **D** 2.5 mA

34 Six identical 12 Ω resistors are arranged in two groups, one with three in series and the other with three in parallel.

9702/01/M/J/09

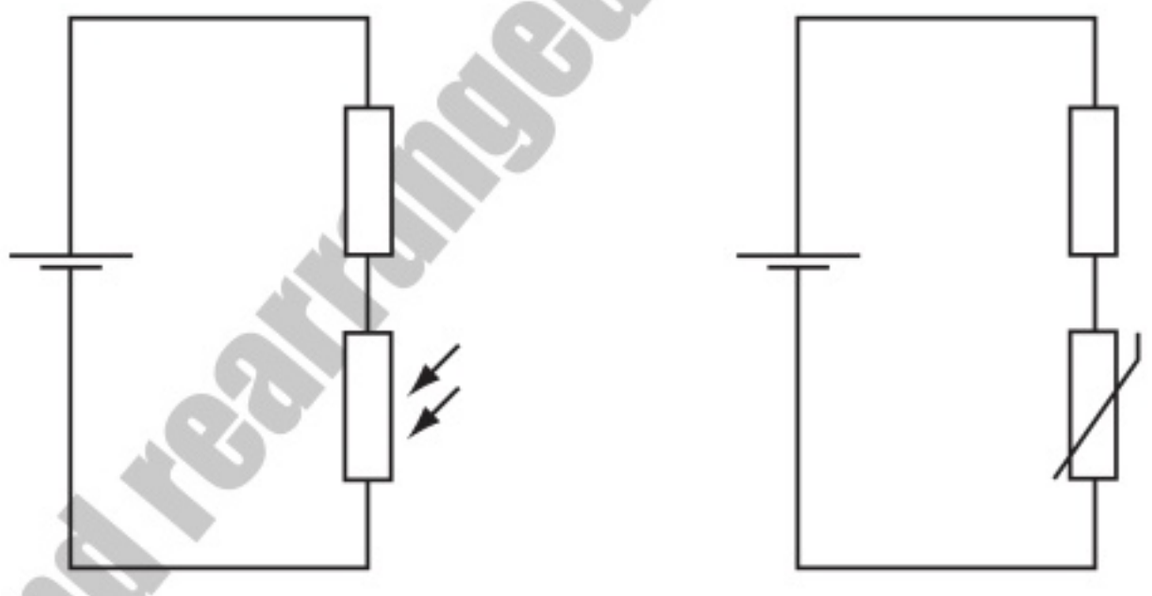


What are the combined resistances of each of these two arrangements?

	series	parallel
A	4.0 Ω	0.25 Ω
B	4.0 Ω	36 Ω
C	36 Ω	0.25 Ω
D	36 Ω	4.0 Ω

35 The diagrams show a light-dependent resistor in circuit P, and a thermistor in circuit Q.

9702/01/M/J/09



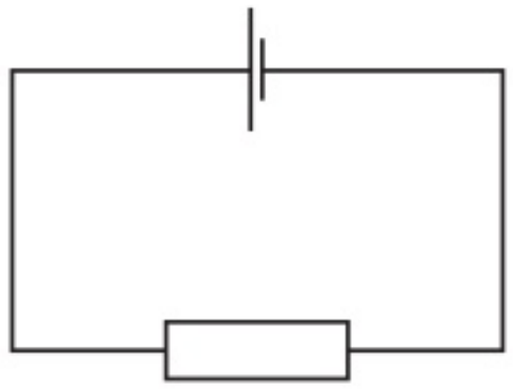
How does the potential difference across the fixed resistor in each circuit change when both the brightness of the light on the light-dependent resistor and the temperature of the thermistor are increased?

9702/01/M/J/09

	circuit P	circuit Q
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

30 A cell is connected to a resistor. 9702/11/O/N/09

At any given moment, the potential difference across the cell is less than its electromotive force.



Which statement explains this?

A The cell is continually discharging.

B The connecting wire has some resistance.

C Energy is needed to drive charge through the cell.

D Power is used when there is a current in the resistor.

31 Which values of current and resistance will produce a rate of energy transfer of $16\,J\,s^{-1}$? 9702/11/O/N/09

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

32 A cylindrical wire 4.0 m long has a resistance of 31 Ω and is made of metal of resistivity $1.0 \times 10^{-6}\,\Omega\,m$. 9702/11/O/N/09

What is the radius of cross-section of the wire?

A $1.0 \times 10^{-8}\,m$

B $2.0 \times 10^{-8}\,m$

C $6.4 \times 10^{-8}\,m$

D $2.0 \times 10^{-4}\,m$

33 A source of e.m.f. of 9.0 mV has an internal resistance of 6.0 Ω. 9702/12/M/J/10

It is connected across a galvanometer of resistance 30 Ω.

What will be the current in the galvanometer?

A 250 μA **B** 300 μA **C** 1.5 mA **D** 2.5 mA

33 Each of Kirchhoff's two laws presumes that some quantity is conserved. 9702/11/O/N/09

Which row states Kirchhoff's **first** law and names the quantity that is conserved?

	statement	quantity
A	the algebraic sum of currents into a junction is zero	charge
B	the algebraic sum of currents into a junction is zero	energy
C	the e.m.f. in a loop is equal to the algebraic sum of the product of current and resistance round the loop	charge
D	the e.m.f. in a loop is equal to the algebraic sum of the product of current and resistance round the loop	energy

34 The diagram shows the symbol for a wire carrying a current I. 9702/11/O/N/09

What does this current represent?

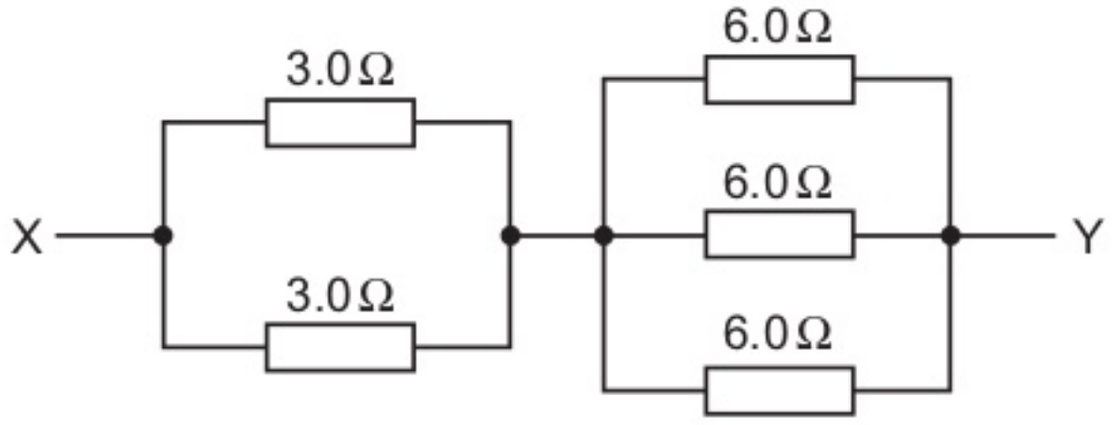
A the amount of charge flowing past a point in XY per second

B the number of electrons flowing past a point in XY per second

C the number of positive ions flowing past a point in XY per second

D the number of protons flowing past a point in XY per second

36 A network of resistors consists of two 3.0 Ω resistors and three 6.0 Ω resistors. 9702/11/O/N/09

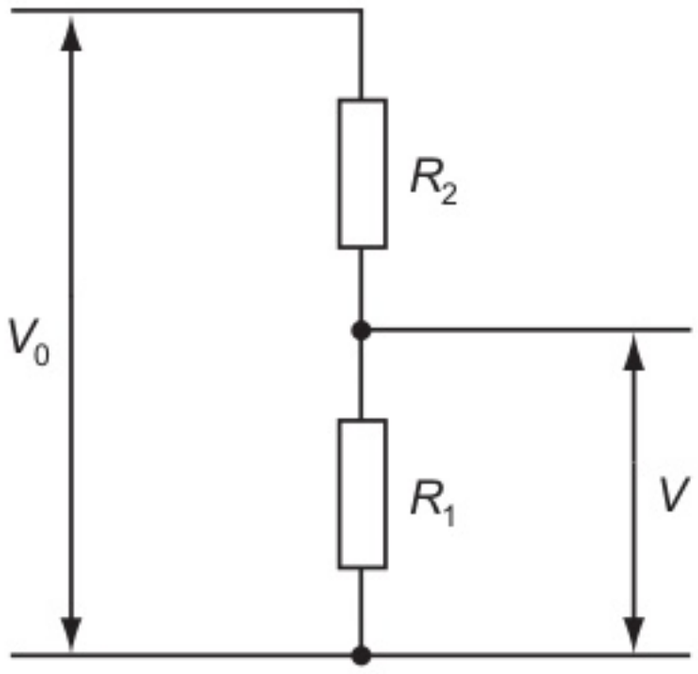


What is the combined resistance of this network between points X and Y?

A 0.86 Ω **B** 1.2 Ω **C** 3.5 Ω **D** 24 Ω

35 A potential divider consisting of resistors of resistance R_1 and R_2 is connected to an input potential difference of V_0 and gives an output p.d. of V.

9702/11/O/N/09



What is the value of V?

A $\frac{V_0 R_1}{R_2}$ **B** $\frac{V_0 R_1}{R_1 + R_2}$ **C** $\frac{V_0 R_2}{R_1 + R_2}$ **D** $\frac{V_0 (R_1 + R_2)}{R_1}$

29 A cell is connected to a resistor.

9702/12/O/N/09

At any given moment, the potential difference across the cell is less than its electromotive force.

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9702/12/O/N/09

What is the radius of cross-section of the wire?

A 1.0×10^{-8} m

B 2.0×10^{-8} m

C 6.4×10^{-8} m

D 2.0×10^{-4} m

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

9702/12/O/N/09

	current / A	resistance / Ω
A	1	4
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9702/12/O/N/09

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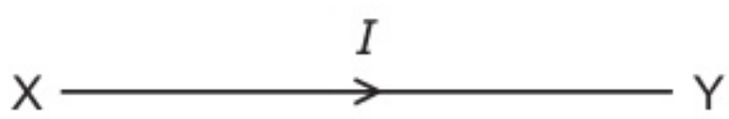
33 The diagram shows the symbol for a wire carrying a current I.

9702/12/O/N/09



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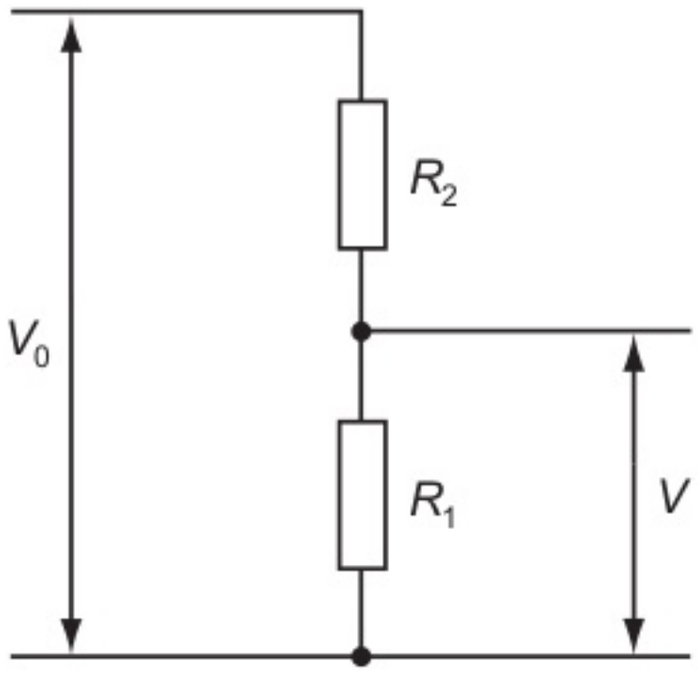
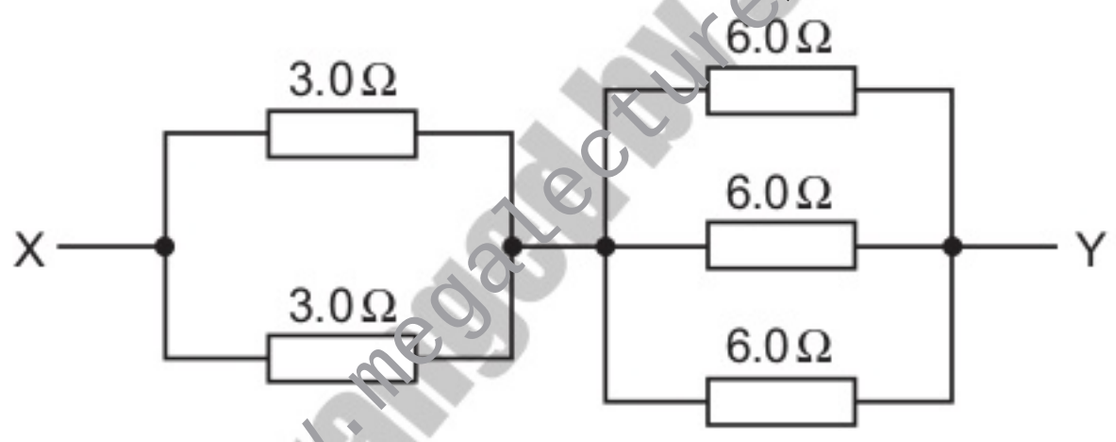


What is the value of V?

A $\frac{V_0 R_1}{R_2}$ **B** $\frac{V_0 R_1}{R_1 + R_2}$ **C** $\frac{V_0 R_2}{R_1 + R_2}$ **D** $\frac{V_0 (R_1 + R_2)}{R_1}$

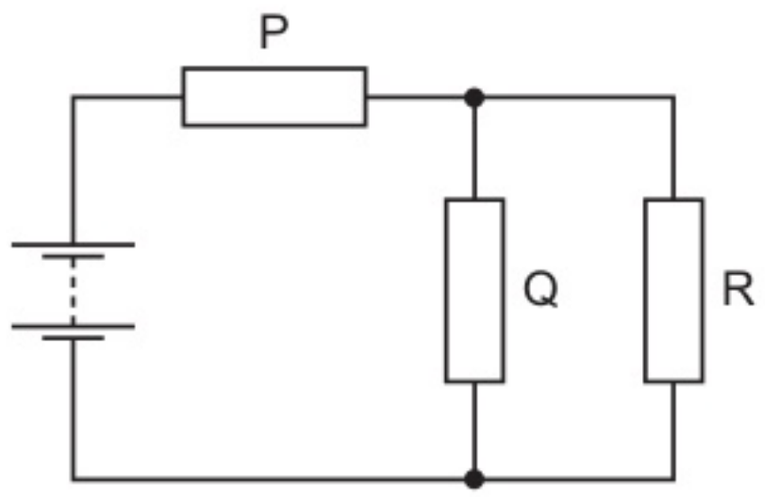
35 A network of resistors consists of two 3.0 Ω resistors and three 6.0 Ω resistors. 9702/12/O/N/09



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

A 0.86Ω **B** 1.2Ω **C** 3.5Ω **D** 24Ω

33 The resistors P, Q and R in the circuit have equal resistance. 9702/11/M/J/10



The battery, of negligible internal resistance, supplies a total power of 12 W.

What is the power dissipated by heating in resistor R?

A 2W **B** 3W **C** 4W **D** 6W

32 The resistance of a thermistor depends on its temperature, and the resistance of a light-dependent resistor (LDR) depends on the illumination. 9702/11/M/J/10

Under which conditions will the resistance of both a thermistor and an LDR be highest?

	thermistor	LDR
A	highest temperature	highest illumination
B	highest temperature	lowest illumination
C	lowest temperature	highest illumination
D	lowest temperature	lowest illumination

34 In deriving a formula for the combined resistance of three different resistors in series, Kirchhoff's laws are used. 9702/11/M/J/10

Which physics principle is involved in this derivation?

A the conservation of charge

B the direction of the flow of charge is from negative to positive

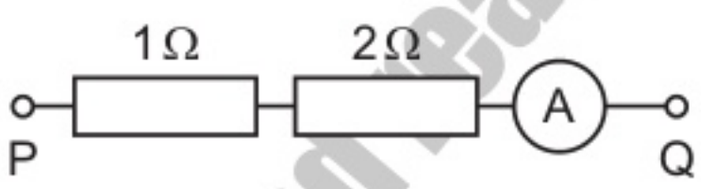
C the potential difference across each resistor is the same

D the current varies in each resistor, in proportion to the resistor value

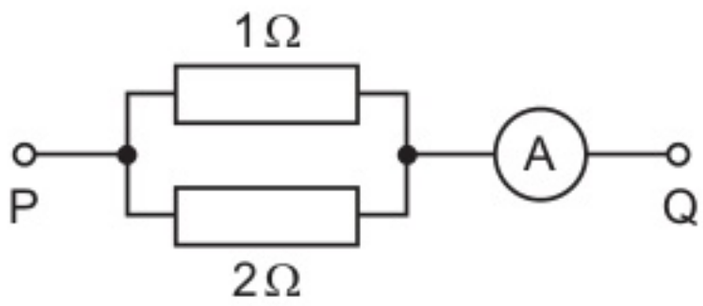
36 In each arrangement of resistors, the ammeter has a resistance of 2Ω. 9702/11/M/J/10

Which arrangement gives the largest reading on the ammeter when the same potential difference is applied between points P and Q?

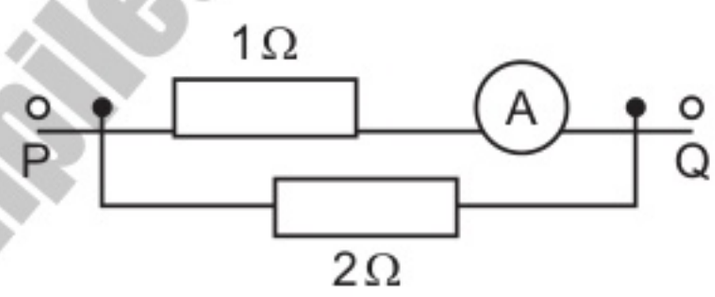
A



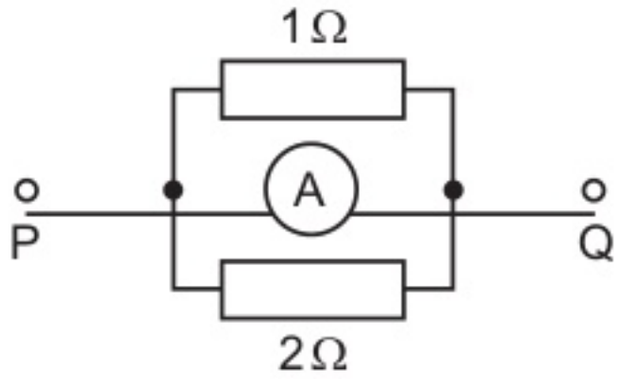
B



C



D



36 What is the unit of resistivity? 9702/12/M/J/10

A Ωm^{-2} **B** Ωm^{-1} **C** Ω **D** Ωm

30 The resistance of a thermistor depends on its temperature, and the resistance of a light-dependent resistor (LDR) depends on the illumination. 9702/12/M/J/10

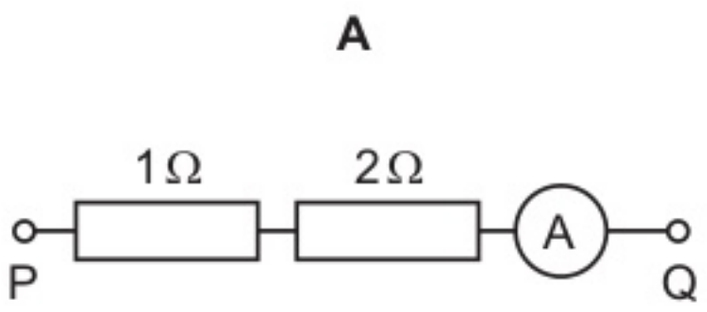
Under which conditions will the resistance of both a thermistor and an LDR be highest?

	thermistor	LDR
A	highest temperature	highest illumination
B	highest temperature	lowest illumination
C	lowest temperature	highest illumination
D	lowest temperature	lowest illumination

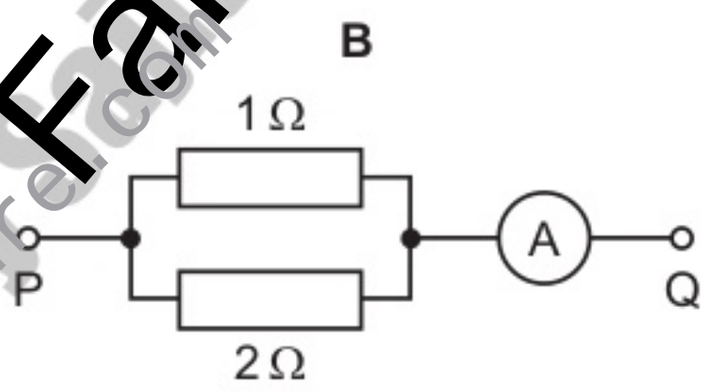
32 In each arrangement of resistors, the ammeter has a resistance of 3Ω. 9702/12/M/J/10

Which arrangement gives the largest reading on the ammeter when the same potential difference is applied between points P and Q?

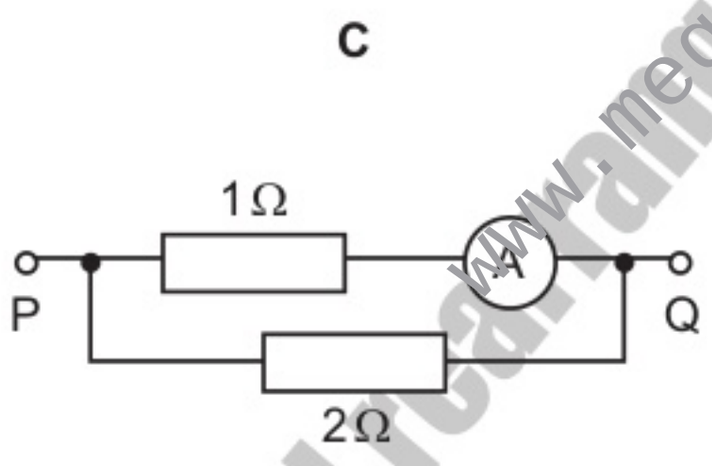
A



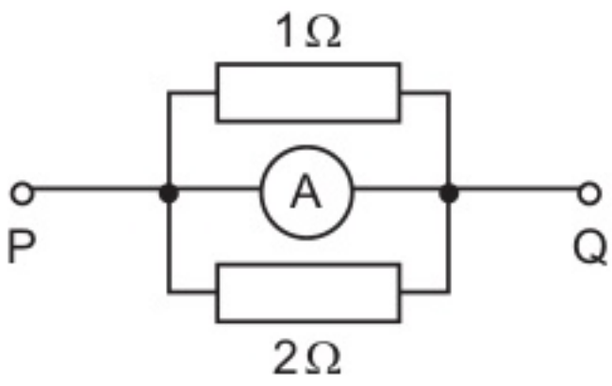
B



C



D



33 The resistance of a thermistor depends on its temperature, and the resistance of a light-dependent resistor (LDR) depends on the illumination. 9702/13/M/J/10

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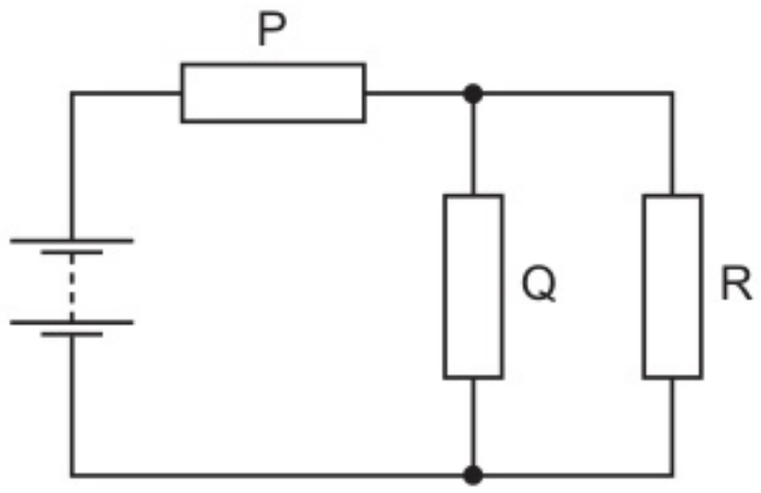
34 The resistors P, Q and R in the circuit have equal resistance. 9702/12/M/J/10



The battery, of negligible internal resistance, supplies a total power of 12W.

What is the power dissipated by heating in resistor R?

A 2W **B** 3W **C** 4W **D** 6W

35 In deriving a formula for the combined resistance of three different resistors in series, Kirchhoff's laws are used. 9702/12/M/J/10

Which physics principle is involved in this derivation?

A the conservation of charge

B the direction of the flow of charge is from negative to positive

C the potential difference across each resistor is the same

D the current varies in each resistor, in proportion to the resistor value

31 A source of e.m.f. of 9.0mV has an internal resistance of 6.0Ω. 9702/13/M/J/10

It is connected across a galvanometer of resistance 30Ω.

What will be the current in the galvanometer?

A 250μA **B** 300μA **C** 1.5mA **D** 2.5mA

36 In deriving a formula for the combined resistance of three different resistors in series, Kirchhoff's laws are used. 9702/13/M/J/10

Which physics principle is involved in this derivation?

A the conservation of charge

B the direction of the flow of charge is from negative to positive

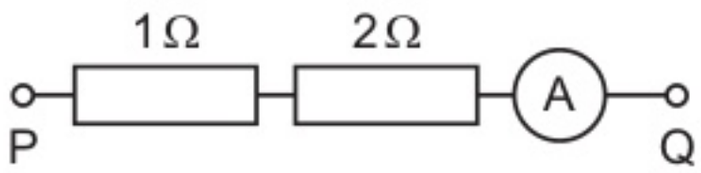
C the potential difference across each resistor is the same

D the current varies in each resistor, in proportion to the resistor value

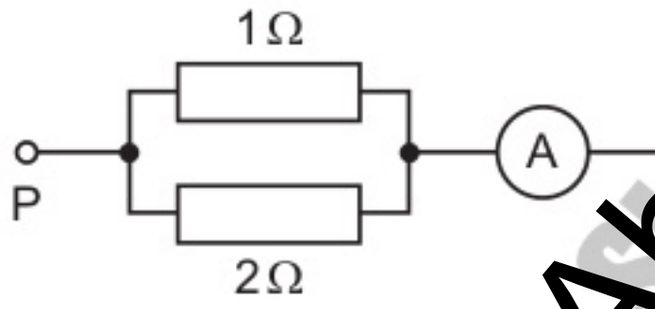
34 In each arrangement of resistors, the ammeter has a resistance of 2Ω. 9702/13/M/J/10

Which arrangement gives the largest reading on the ammeter when the same potential difference is applied between points P and Q?

A



B



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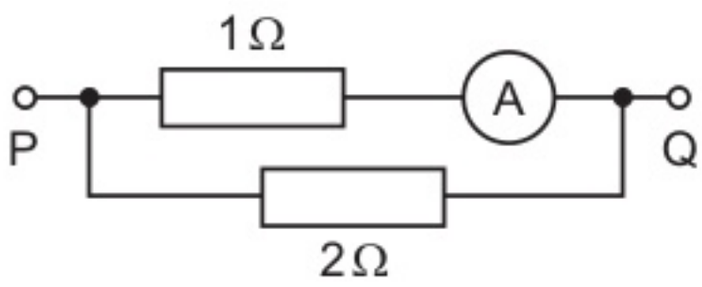
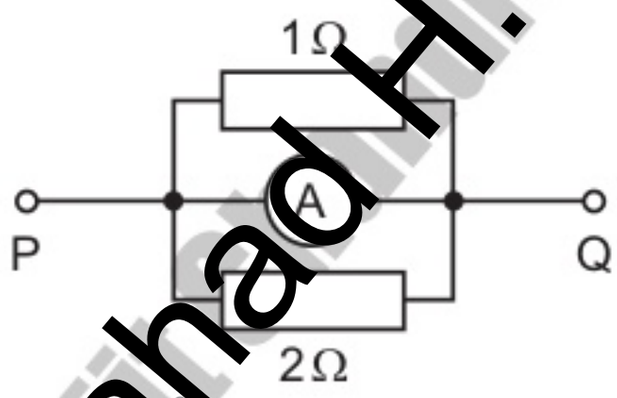
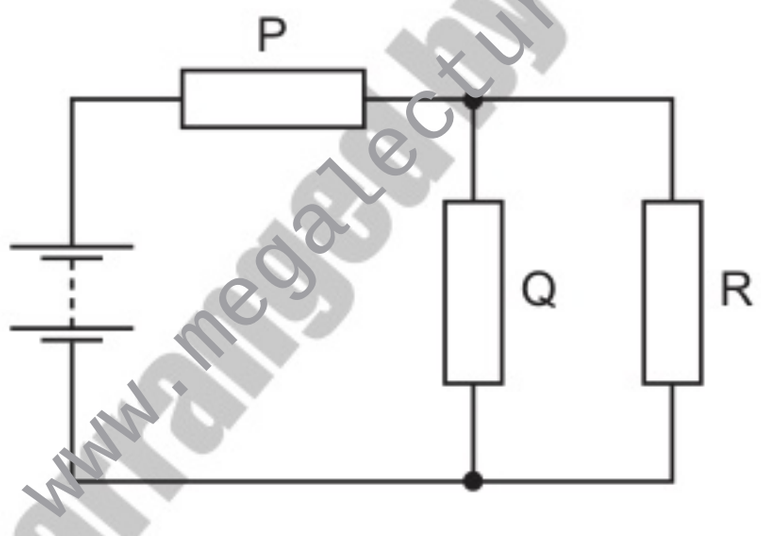


D



35 The resistors P, Q and R in the circuit have equal resistance. 9702/13/M/J/10



The battery, of negligible internal resistance, supplies a total power of 12 W.

What is the power dissipated by heating in resistor R?

A 2 W **B** 3 W **C** 4 W **D** 6 W

30 Which electrical component is represented by the following symbol? 9702/12/O/N/10

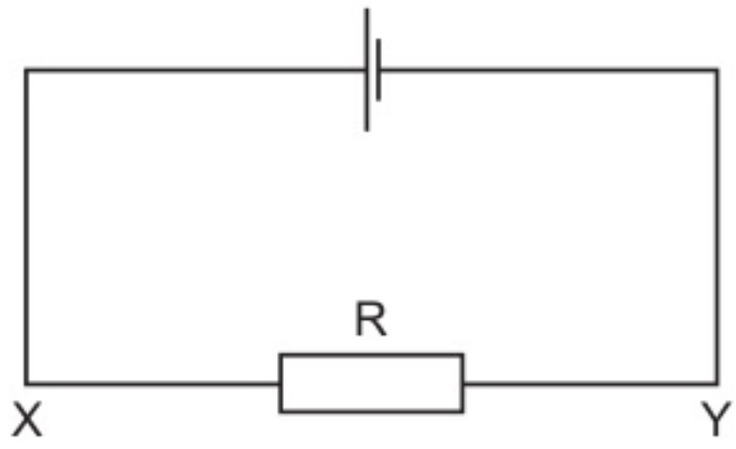
A a diode

B a potentiometer

C a resistor

D a thermistor

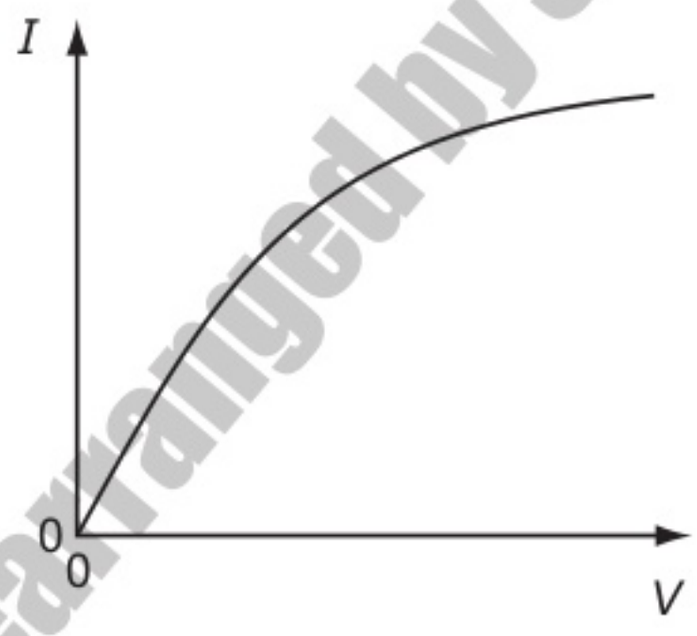
31 The current in the circuit shown is 4.8 A. 9702/11/O/N/10



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

	direction of flow	rate of flow
A	X to Y	$3.0 \times 10^{19}\,s^{-1}$
B	X to Y	$6.0 \times 10^{18}\,s^{-1}$
C	Y to X	$3.0 \times 10^{19}\,s^{-1}$
D	Y to X	$6.0 \times 10^{18}\,s^{-1}$

32 Which component has the *I*-*V* graph shown? 9702/11/O/N/10



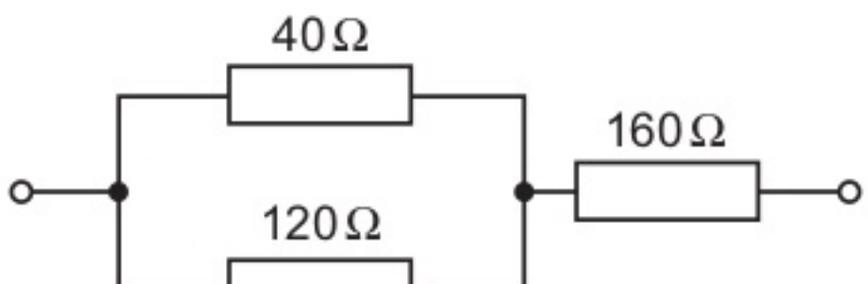
A filament lamp

B light-dependent resistor

C semiconductor diode

D thermistor

35 The diagram shows part of a circuit. 9702/11/O/N/10

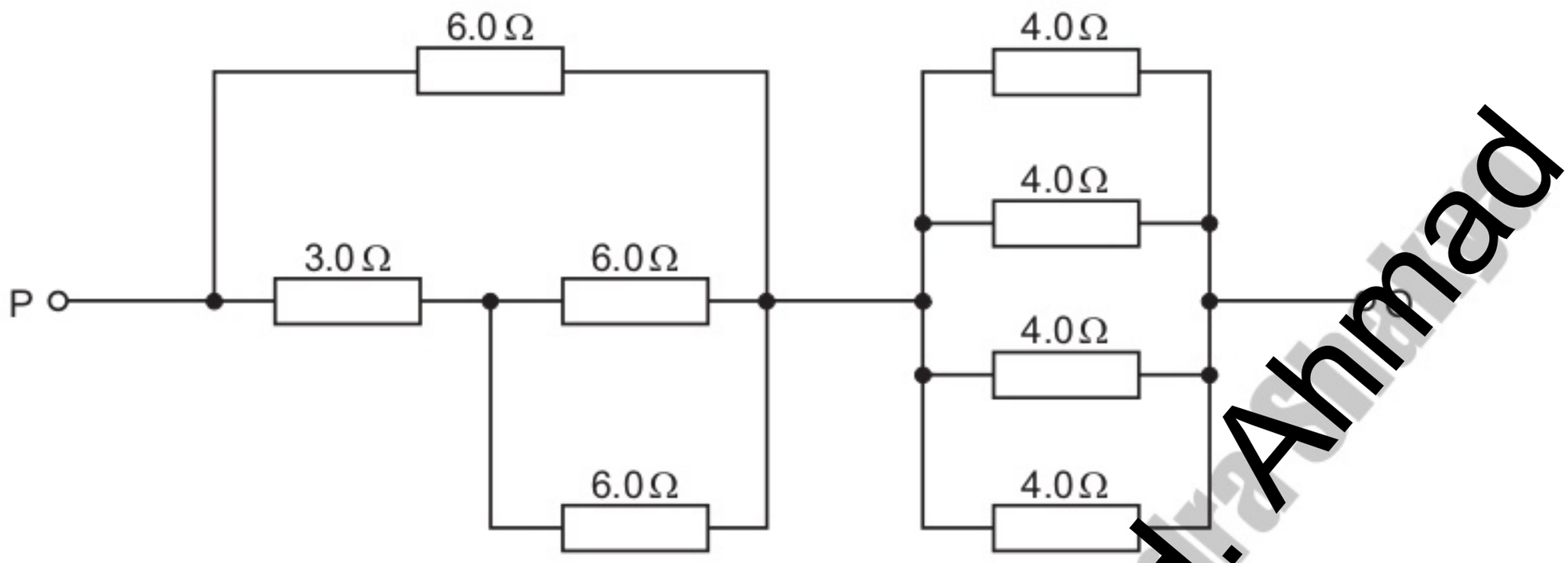


What is the total resistance of the combination of the three resistors?

A 320 Ω **B** 240 Ω **C** 190 Ω **D** 80 Ω

35 The diagram shows part of a circuit.

9702/12/O/N/10

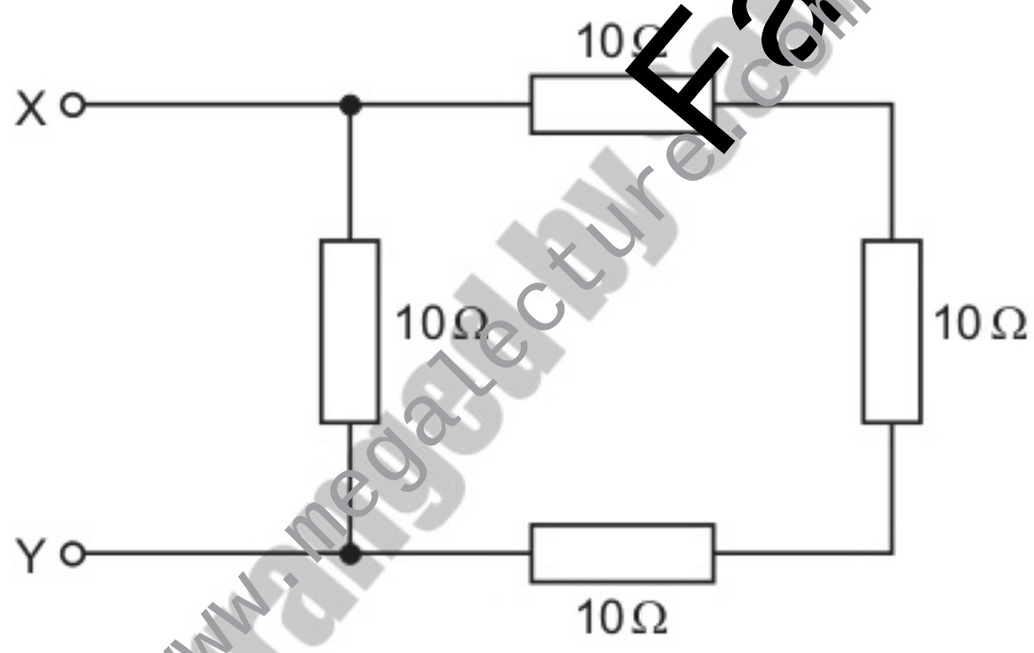


What is the resistance between the points P and Q due to the resistance network?

A 1.3 Ω **B** 4.0 Ω **C** 10 Ω **D** 37 Ω

36 The diagram shows an arrangement of resistors.

9702/11/O/N/10



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

31 When there is **no current** in a wire, which statement about the conduction electrons in that wire is correct?

9702/12/O/N/10

A Electrons in the wire are moving totally randomly within the wire.

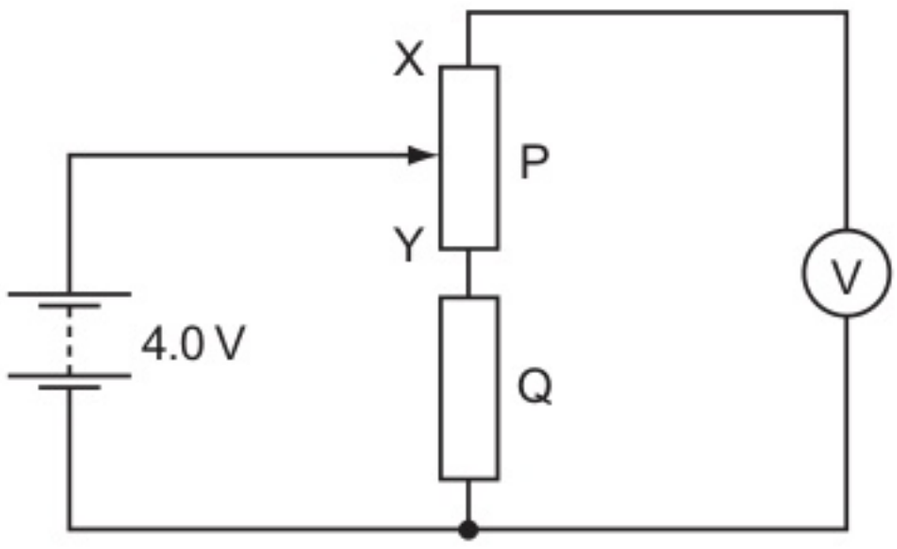
B Equal numbers of electrons move at the same speed, but in opposite directions, along the wire.

C No current is flowing therefore the electrons in the wire are stationary.

D No current is flowing therefore the electrons in the wire are vibrating around a fixed point.

37 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.

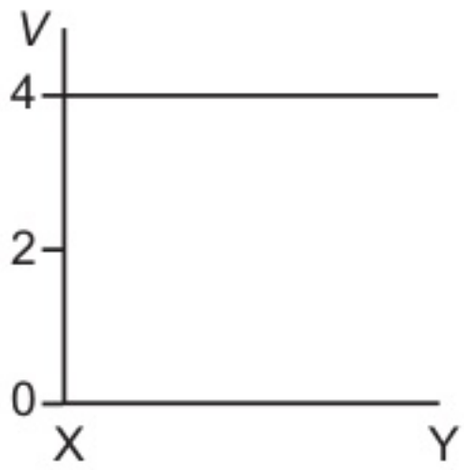
9702/11/O/N/10



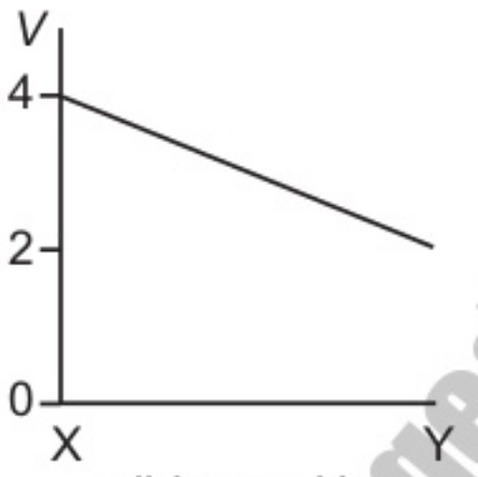
The slider on the potentiometer is moved from X to Y and a graph of voltmeter reading V is plotted against slider position.

Which graph would be obtained?

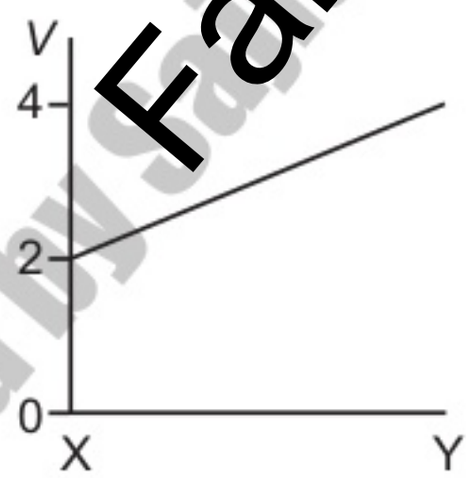
A



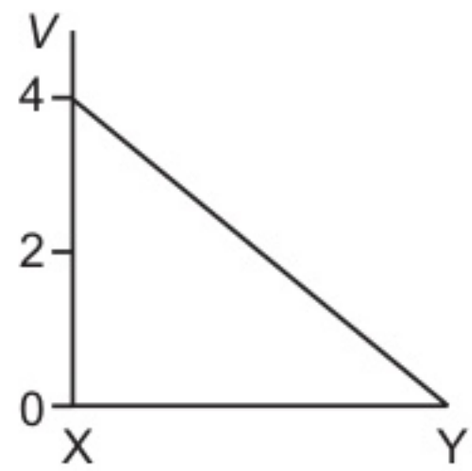
B



C

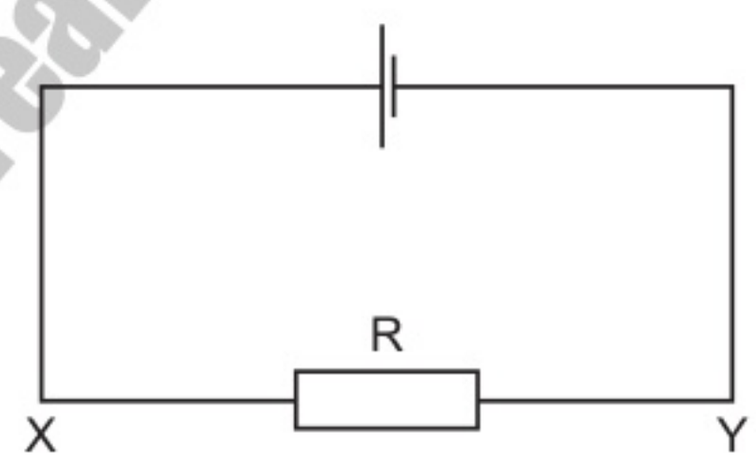


D



32 The current in the circuit shown is 4.8 A.

9702/13/O/N/10



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

	direction of flow	rate of flow
A	X to Y	$3.0 \times 10^{19}\ s^{-1}$
B	X to Y	$6.0 \times 10^{18}\ s^{-1}$
C	Y to X	$3.0 \times 10^{19}\ s^{-1}$
D	Y to X	$6.0 \times 10^{18}\ s^{-1}$

32 A high-resistance voltmeter connected across a battery reads 6.0 V. 9702/12/O/N/10

When the battery is connected in series with a lamp of resistance of 10 Ω, the voltmeter reading falls to 5.6 V.

Which statement explains this observation?

A The electromotive force (e.m.f.) of the battery decreases because more work is done across its internal resistance.

B The e.m.f. of the battery decreases because work is done across the lamp.

C The potential difference (p.d.) across the battery decreases because more work is done across its internal resistance.

D The p.d. across the battery decreases because work is done across the lamp.

31 A relay is required to operate 800 m from its power supply. The power supply has negligible internal resistance. The relay requires 16.0 V and a current of 0.50 A to operate. 9702/13/O/N/10

A cable connects the relay to the power supply and two of the wires in the cable are used to supply power to the relay.

The resistance of each of these wires is 0.0050 Ω per metre.

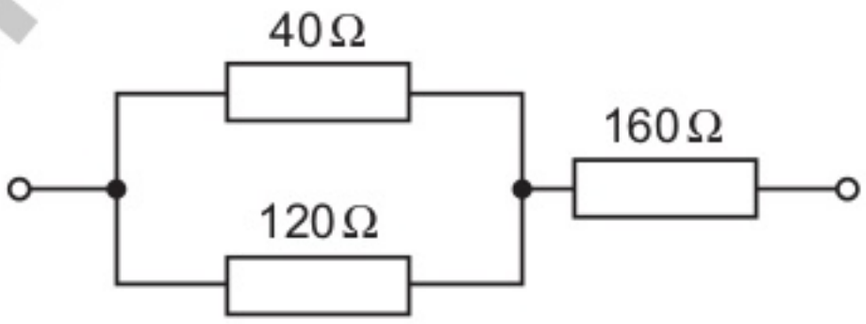
What is the minimum output e.m.f. of the power supply?

A 16.6 V **B** 18.4 V **C** 20.8 V **D** 29.3 V

30 What is the unit of resistivity? 9702/13/M/J/10

A $\Omega\,m^{-2}$ **B** $\Omega\,m^{-1}$ **C** Ω **D** $\Omega\,m$

33 The diagram shows part of a circuit. 9702/13/O/N/10



What is the total resistance of the combination of the three resistors?

A 320 Ω **B** 240 Ω **C** 190 Ω **D** 80 Ω

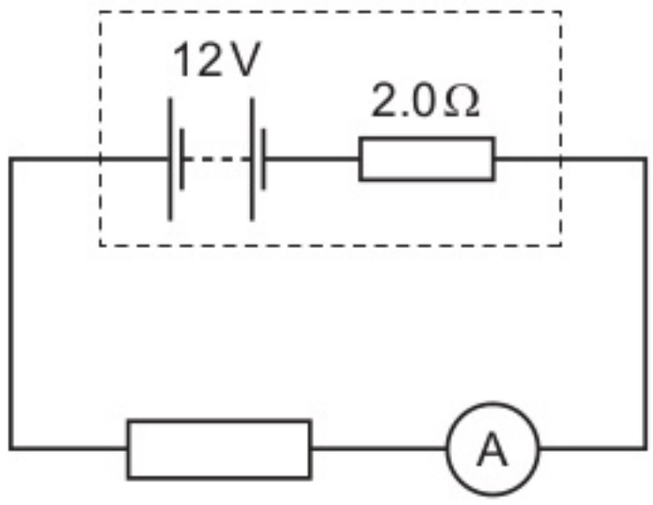
31 A copper wire of cross-sectional area 2.0 mm^2 carries a current of 10 A. 9702/11/M/J/11

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}

33 A battery of e.m.f. 12 V and internal resistance 2.0 Ω is connected in series with an ammeter of negligible resistance and an external resistor. External resistors of various different values are used.

9702/12/O/N/10

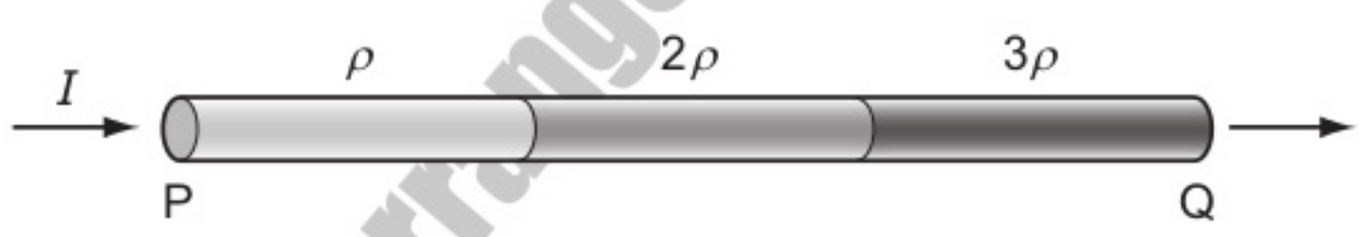


Which combination of current and resistor value is **not** correct?

	current / A	external resistor value / Ω
A	1.0	10
B	1.2	8
C	1.5	6
D	1.8	4

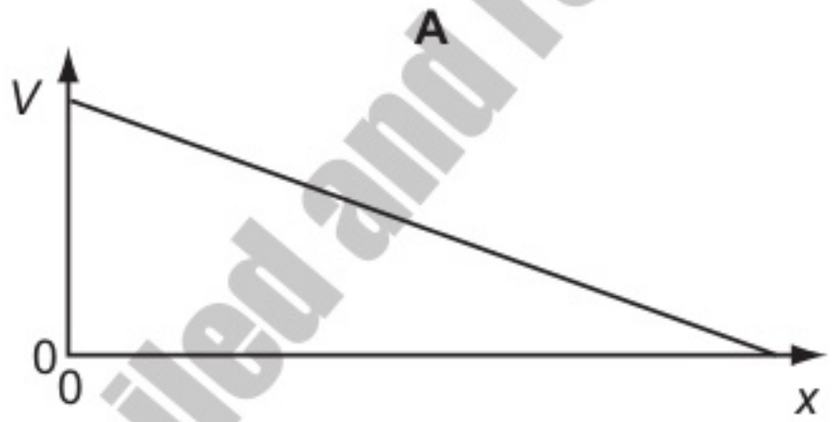
34 A wire PQ is made of three different materials, with resistivities ρ, 2ρ and 3ρ. There is a current I in this composite wire, as shown.

9702/12/O/N/10

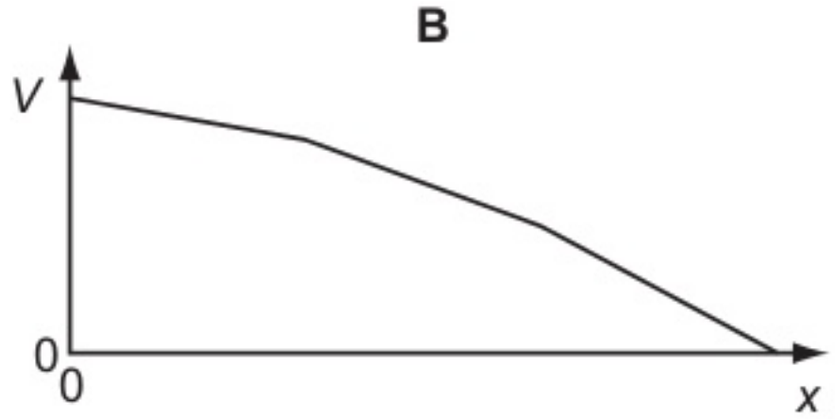


Which graph best shows how the potential V along the wire varies with distance x from P?

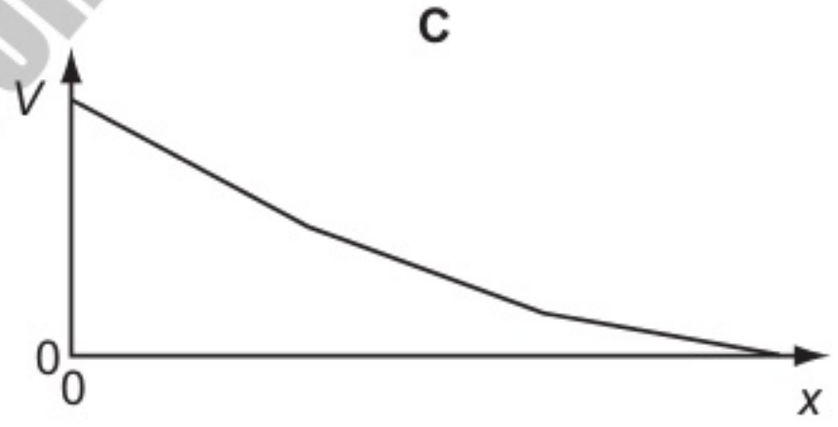
A



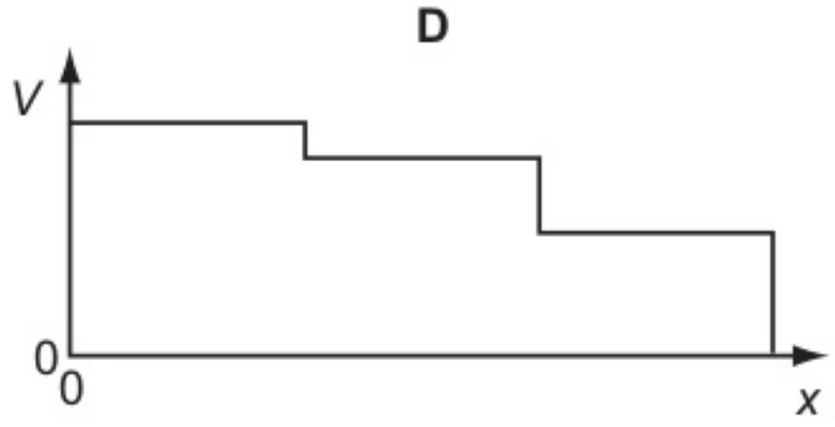
B



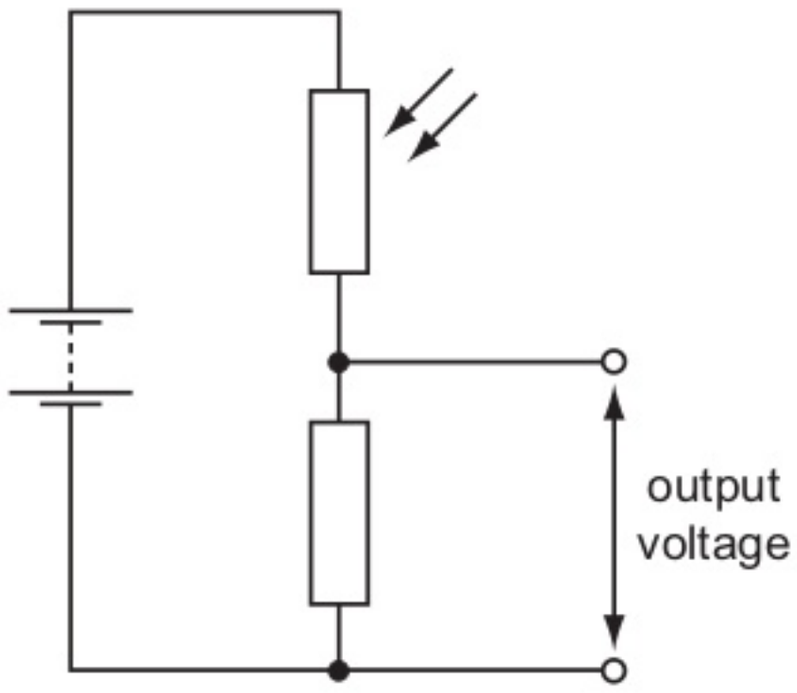
C



D



36 The diagram shows a potential divider circuit. 9702/12/O/N/10



The light level increases.

What is the effect on the resistance of the light-dependent resistor (LDR) and on the output voltage?

	resistance of the LDR	output voltage
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

34 A relay is required to operate 800 m from its power supply. The power supply has negligible internal resistance. The relay requires 16.0 V and a current of 0.60 A to operate. 9702/11/O/N/10

A cable connects the relay to the power supply and two of the wires in the cable are used to supply power to the relay.

The resistance of each of these wires is 0.0050 Ω per metre.

What is the minimum output e.m.f. of the power supply?

A 16.6 V **B** 18.4 V **C** 20.8 V **D** 29.3 V

32 A battery is marked 9.0 V. 9702/11/M/J/11

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 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 9.0 V across the battery terminals.

37 Three resistors, with resistances R_1, R_2 and R_3, are connected in series and are found to have a combined resistance of 500 Ω. When connected in parallel, the combined resistance is found to be 50 Ω.

9702/12/O/N/10

Which values will correspond to these results?

	R_1 / Ω	R_2 / Ω	R_3 / Ω
A	160	160	80
B	200	200	100
C	225	225	50
D	230	230	40

34 A copper wire is cylindrical and has resistance R.

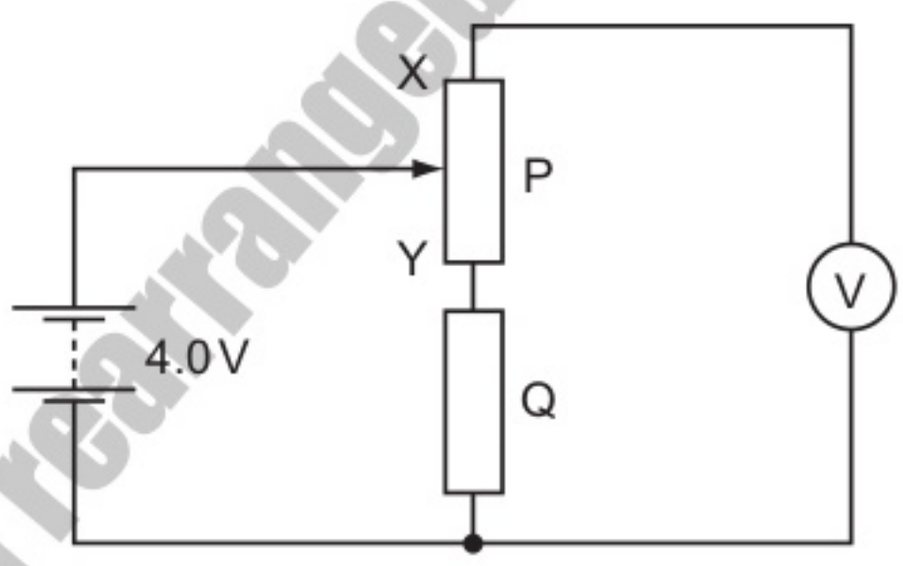
9702/13/O/N/10

What will be the resistance of a copper wire of twice the length and twice the radius?

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

35 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.

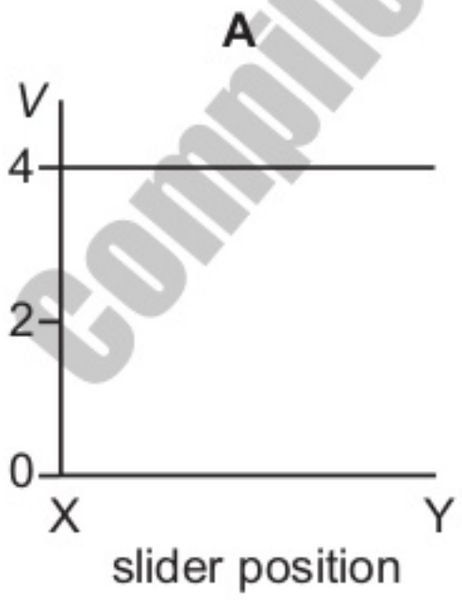
9702/13/O/N/10



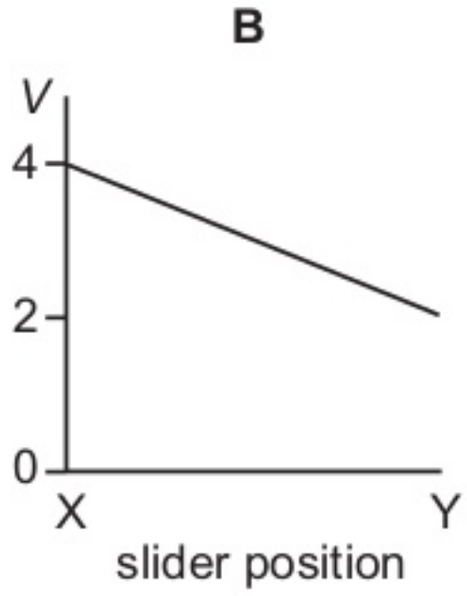
The slider on the potentiometer is moved from X to Y and a graph of voltmeter reading V is plotted against slider position.

Which graph would be obtained?

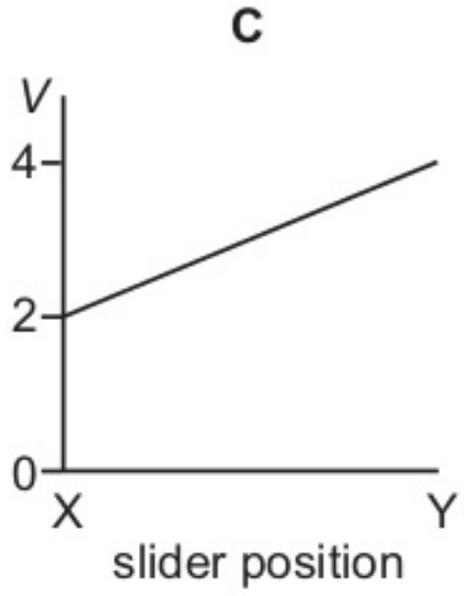
A



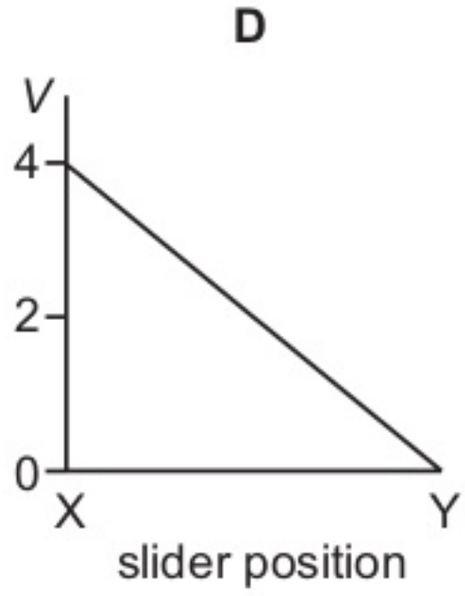
B



C

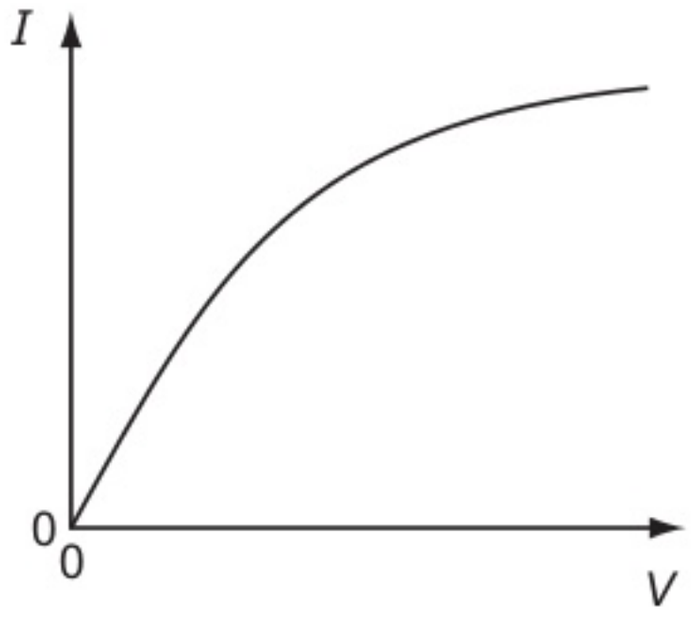


D



36 Which component has the *I*-*V* graph shown?

9702/13/O/N/10



A filament lamp

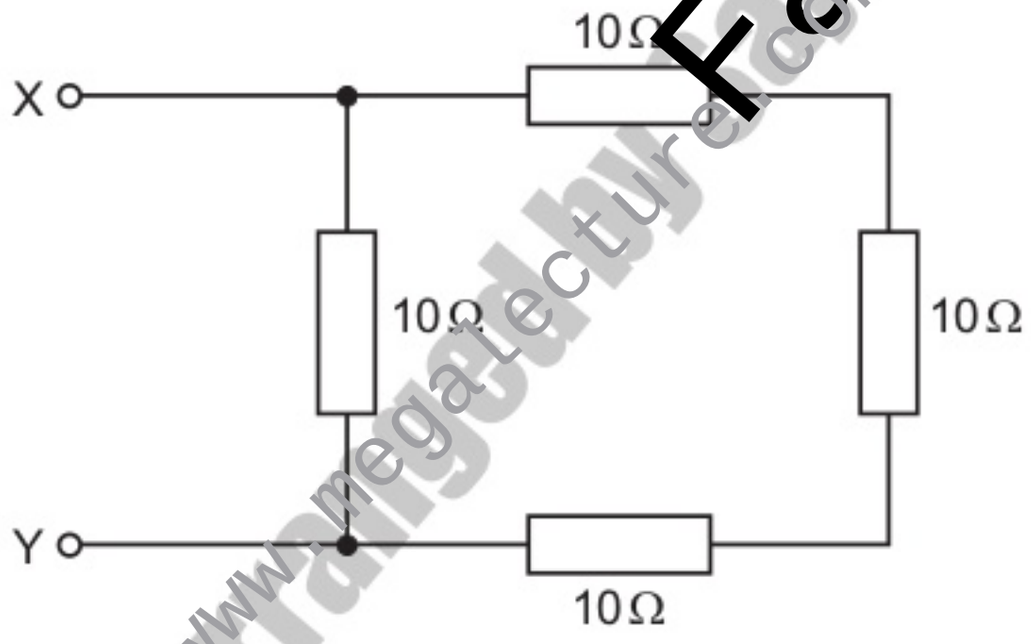
B light-dependent resistor

C semiconductor diode

D thermistor

37 The diagram shows an arrangement of resistors.

9702/13/O/N/10



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

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

9702/12/M/J/11

A the force required to move a unit positive charge between the points

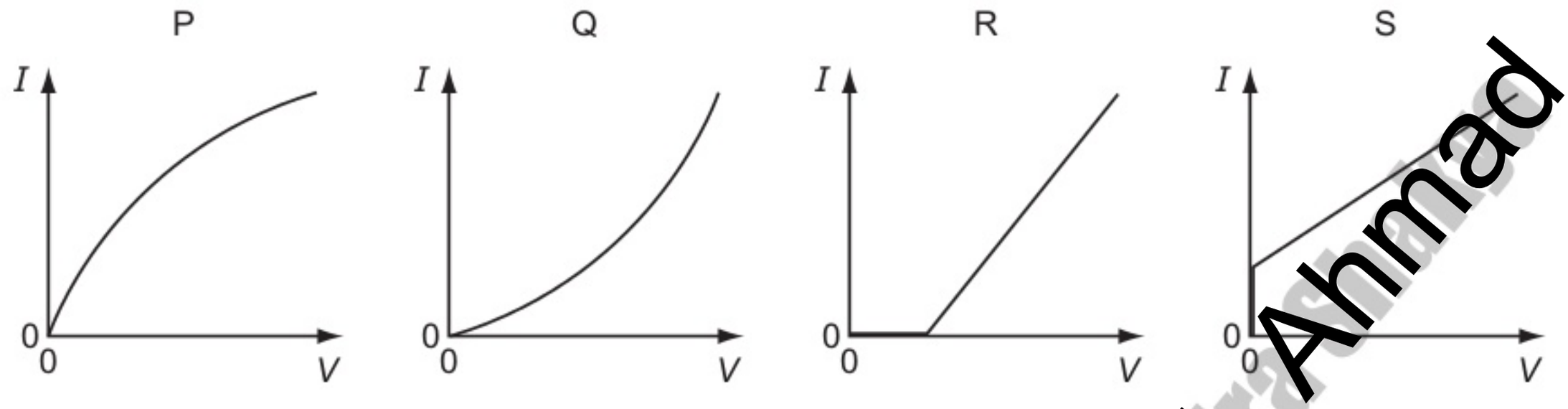
B the ratio of the energy dissipated between the points to the current

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

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

9702/11/M/J/11

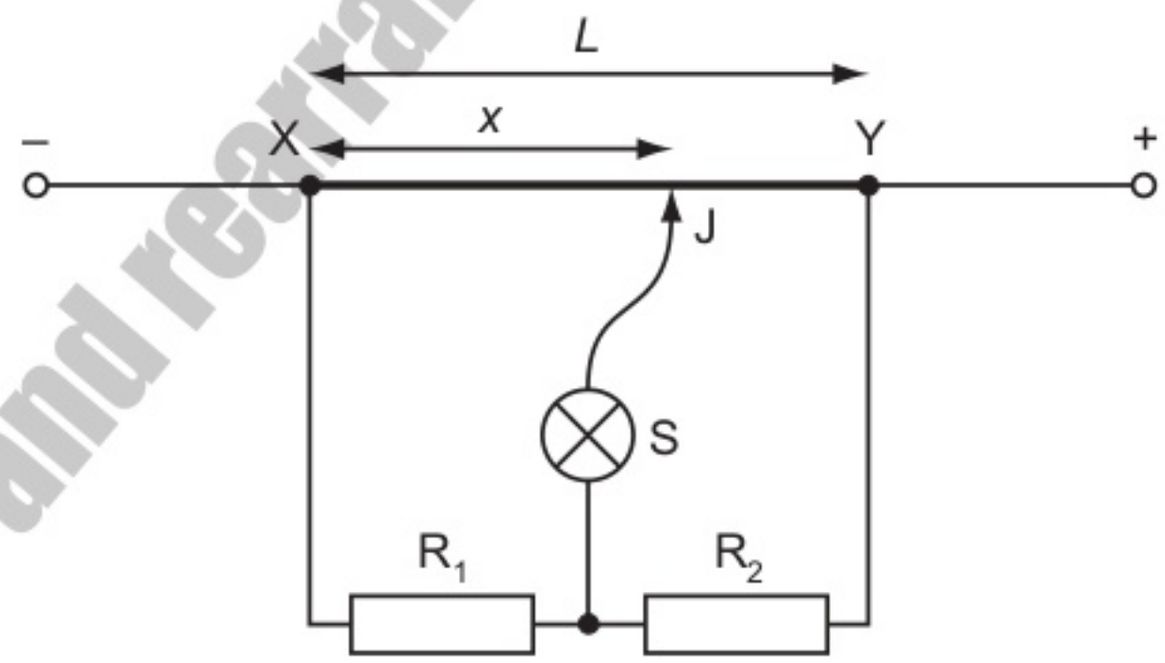


Which row best specifies the correct I-V graphs for the lamp and the diode?

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

37 In the circuit shown, XY is a length L of uniform resistance wire. R_1 and R_2 are unknown resistors. J is a sliding contact that joins the junction of R_1 and R_2 to points on XY through a small signal lamp S.

9702/11/M/J/11



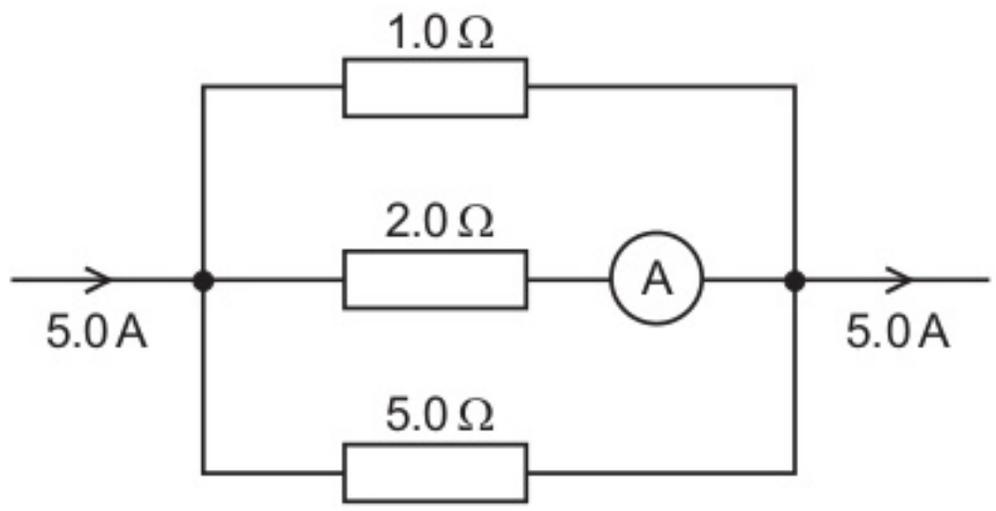
To determine the ratio $\frac{V_1}{V_2}$ of the potential differences across R_1 and R_2, a point is found on XY at which the lamp is off. This point is at a distance x from X.

What is the value of the ratio $\frac{V_1}{V_2}$?

A $\frac{L}{x}$ **B** $\frac{x}{L}$ **C** $\frac{L-x}{x}$ **D** $\frac{x}{L-x}$

35 The diagram shows part of a current-carrying circuit. The ammeter has negligible internal resistance.

9702/11/M/J/11

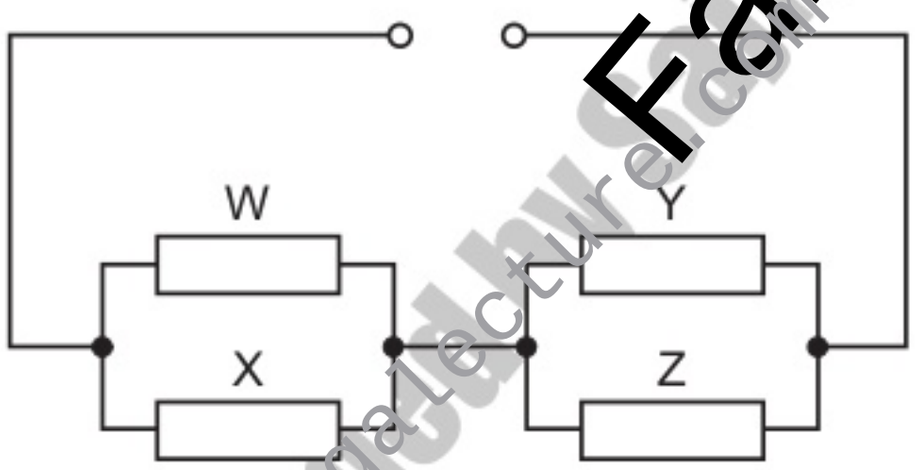


What is the reading on the ammeter?

A 0.7 A **B** 1.3 A **C** 1.5 A **D** 1.7 A

36 Four resistors of equal value are connected as shown.

9702/11/M/J/11



How will the powers to the resistors change when resistor W is removed?

A The powers to X, Y and Z will all increase.

B The power to X will decrease and the powers to Y and Z will increase.

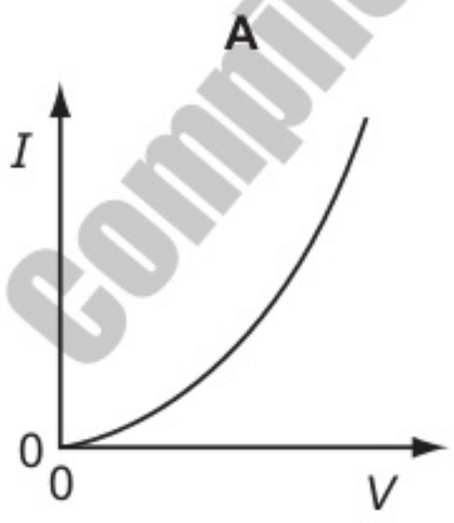
C The power to X will increase and the powers to Y and Z will decrease.

D The power to X will increase and the powers to Y and Z will remain unaltered.

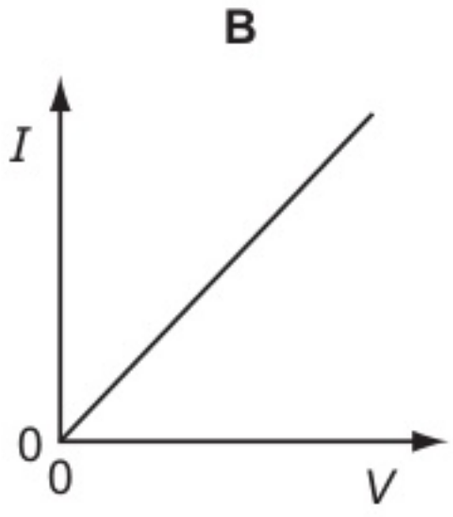
35 Which graph best represents the way in which the current I through a thermistor depends upon the potential difference V across it?

9702/12/M/J/11

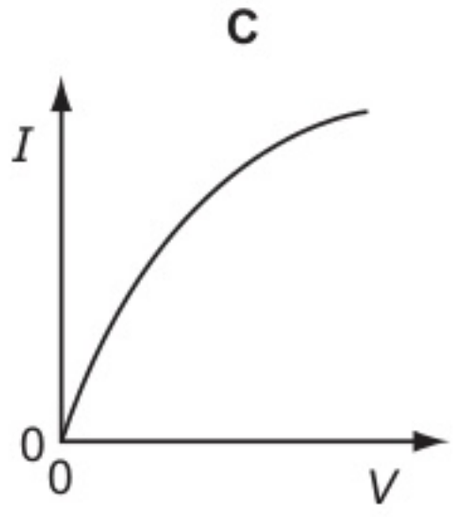
A



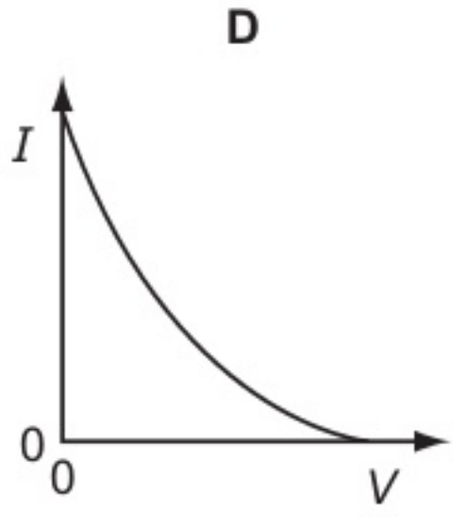
B



C



D



33 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.

9702/12/M/J/11

What is its new resistance?

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

34 A source of electromotive force (e.m.f.) E has a constant internal resistance r and is connected to an external variable resistor of resistance R.

9702/12/M/J/11

As R is increased from a value below r to a value above r, which statement is correct?

A The terminal potential difference remains constant.

B The current in the circuit increases.

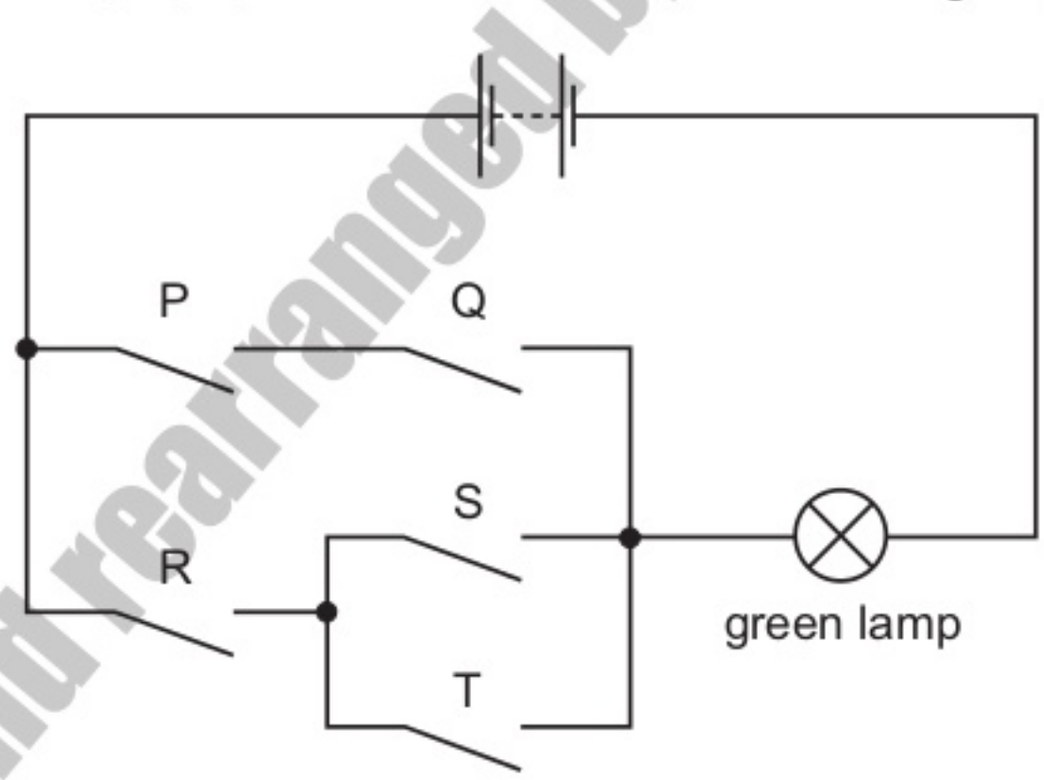
C The e.m.f. of the source increases.

D The largest output power is obtained when R reaches r.

36 Safety on railways is increased by using several electrical switches.

9702/12/M/J/11

In the diagram, switches P, Q, R, S and T control the current through a green lamp.

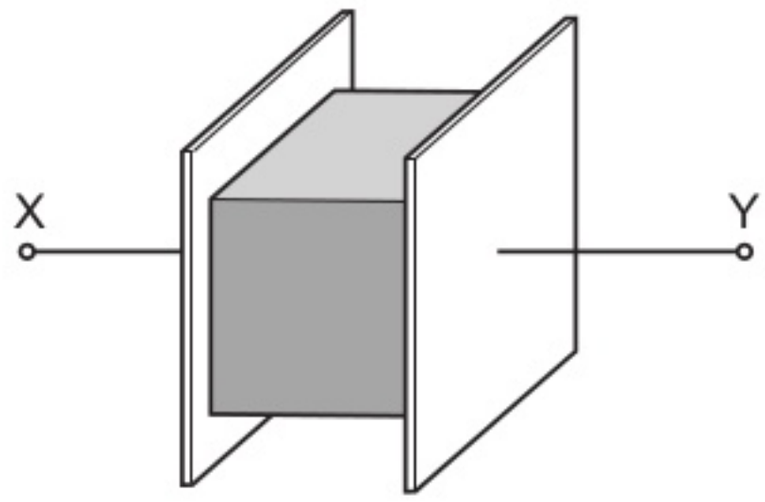


Which row does **not** allow the green lamp to light?

	P	Q	R	S	T
A	closed	closed	closed	open	closed
B	closed	open	closed	closed	open
C	closed	open	open	closed	closed
D	open	open	closed	open	closed

34 The resistance of a metal cube is measured by placing it between two parallel plates, as shown.

9702/11/M/J/11



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** $\frac{\rho}{V^{\frac{2}{3}}}$

31 A battery is marked 9.0 V.

9702/13/M/J/11

What does this mean?

A Each coulomb of charge from the battery supplies 9.0 J of electrical energy to the whole circuit.

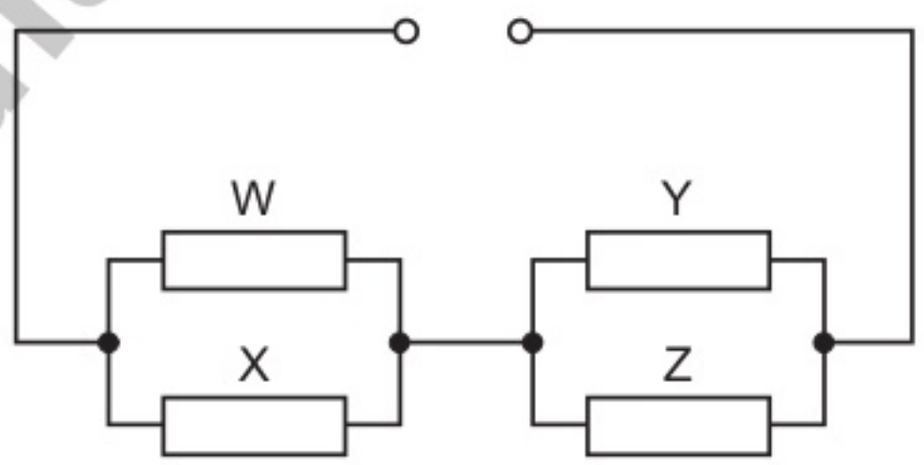
B The battery supplies 9.0 J to an external circuit for each coulomb of charge.

C The potential difference across any component connected to the battery will be 9.0 V.

D There will always be 9.0 V across the battery terminals.

33 Four resistors of equal value are connected as shown.

9702/13/M/J/11



How will the powers to the resistors change when resistor W is removed?

A The powers to X, Y and Z will all increase.

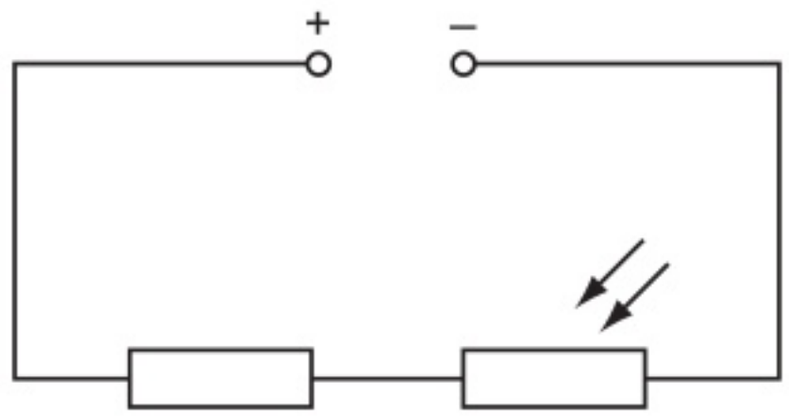
B The power to X will decrease and the powers to Y and Z will increase.

C The power to X will increase and the powers to Y and Z will decrease.

D The power to X will increase and the powers to Y and Z will remain unaltered.

37 The diagram shows a fixed resistor and a light-dependent resistor (LDR) in series with a constant low-voltage supply.

9702/12/M/J/11



When the LDR is in the dark, the fixed resistor and the LDR have the same value of resistance.

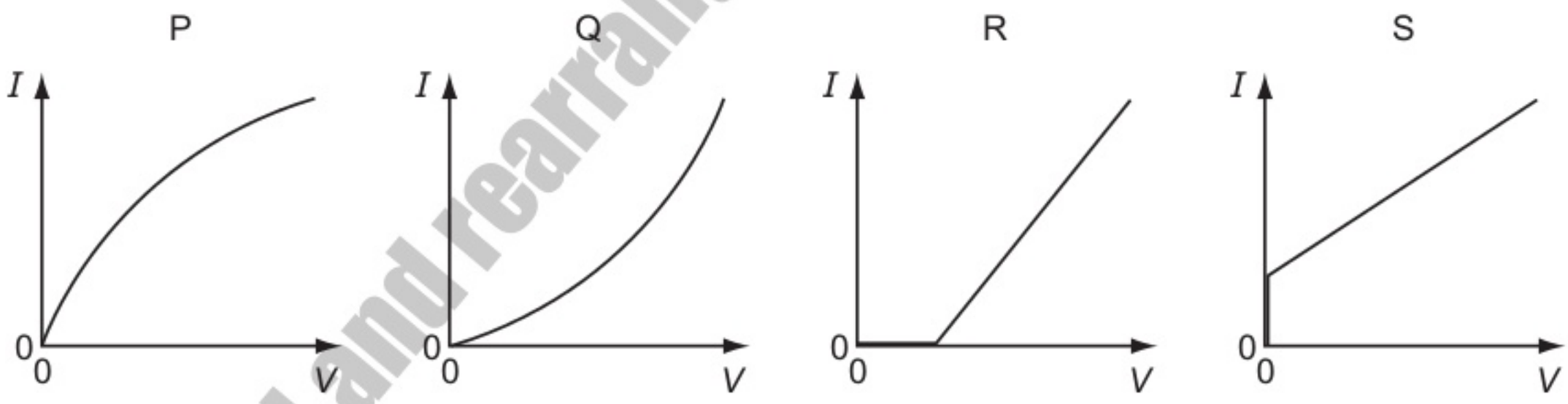
Light is shone on the LDR.

What happens to the potential differences across the two components?

	p.d. across resistor	p.d. across LDR
A	decreased	increased
B	increased	decreased
C	no change	increased
D	no change	decreased

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

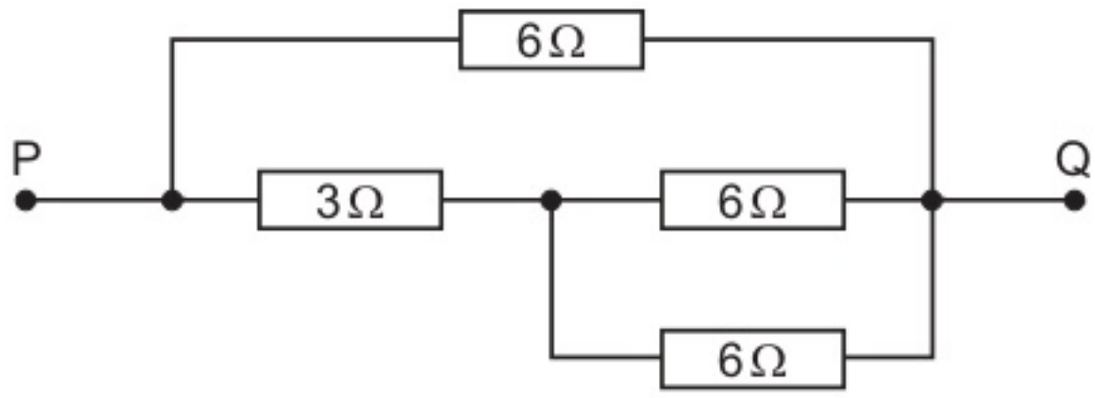
9702/13/M/J/11



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

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

38 The diagram shows a d.c. circuit. 9702/12/M/J/11



What is the resistance between the points P and Q due to the resistance network?

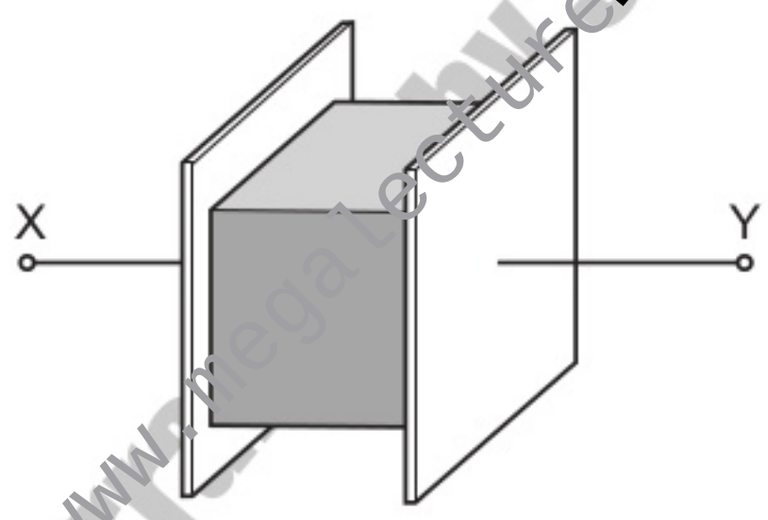
A 0.47Ω **B** 2.1Ω **C** 3.0Ω **D** 21Ω

32 A copper wire of cross-sectional area 2.0 mm^2 carries a current of 10 A. 9702/13/M/J/11

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}

35 The resistance of a metal cube is measured by placing it between two parallel plates, as shown. 9702/13/M/J/11



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** $\frac{\rho}{V^{\frac{2}{3}}}$

35 Which statement is **not** valid? 9702/11/O/N/11

A Current is the speed of the charged particles that carry it.

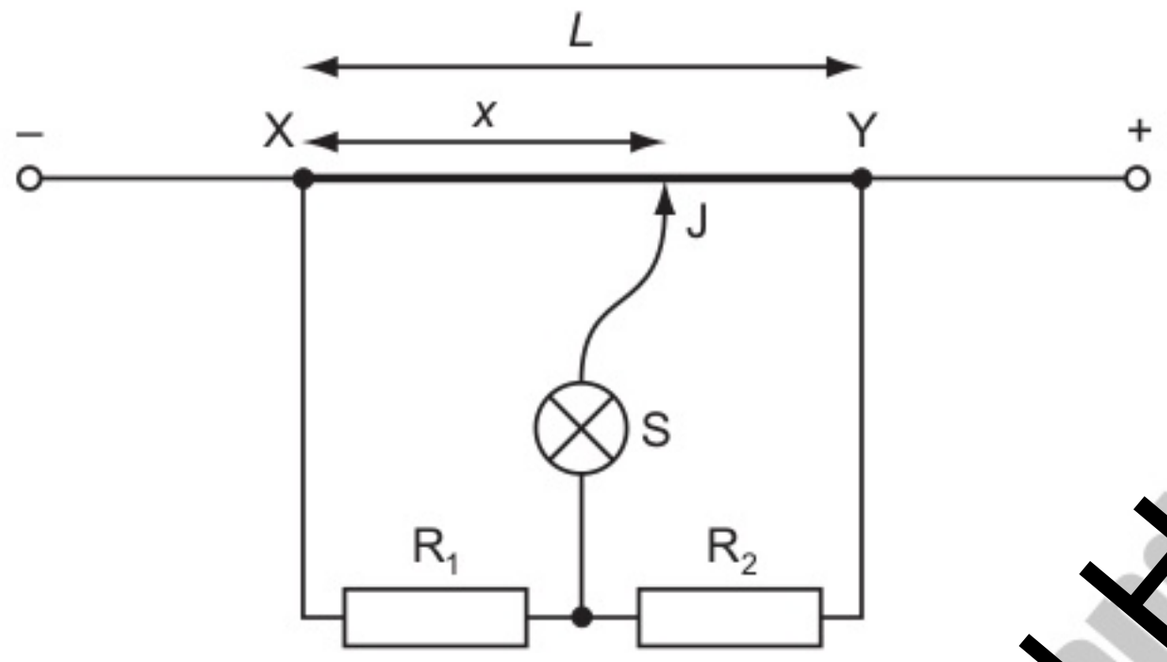
B Electromotive force (e.m.f.) is the energy converted to electrical energy from other forms, per unit charge.

C The potential difference (p.d.) between two points is the work done in moving unit charge from one point to the other.

D The resistance between two points is the p.d. between the two points, per unit current.

36 In the circuit shown, XY is a length *L* of uniform resistance wire. R_1 and R_2 are unknown resistors. J is a sliding contact that joins the junction of R_1 and R_2 to points on XY through a small signal lamp S.

9702/13/M/J/11



To determine the ratio $\frac{V_1}{V_2}$ of the potential differences across R_1 and R_2, a point is found on XY at which the lamp is off. This point is at a distance *x* from X.

What is the value of the ratio $\frac{V_1}{V_2}$?

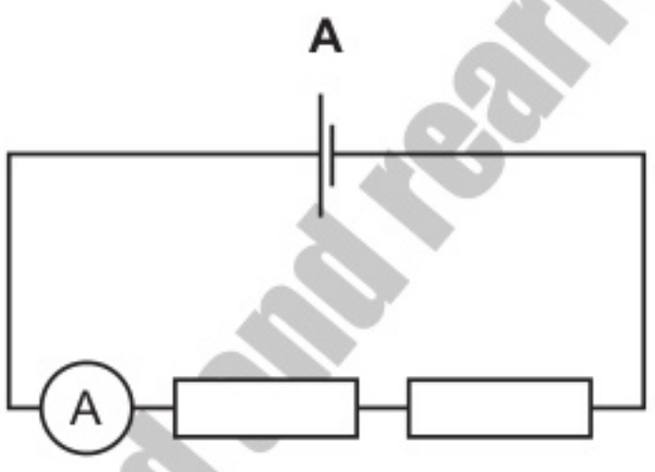
A $\frac{L}{x}$ **B** $\frac{x}{L}$ **C** $\frac{L-x}{x}$ **D** $\frac{x}{L-x}$

37 A cell, two resistors of equal resistance and an ammeter are used to construct four circuits. The resistors are the only parts of the circuits that have resistance.

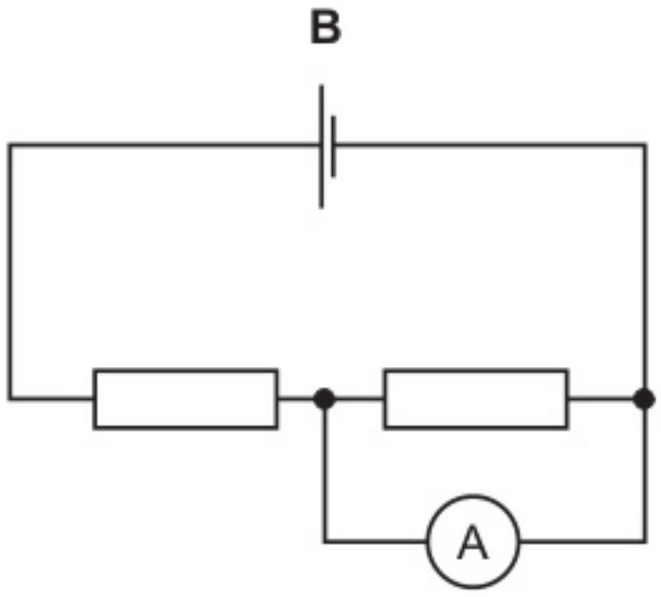
9702/11/O/N/11

In which circuit will the ammeter show the greatest reading?

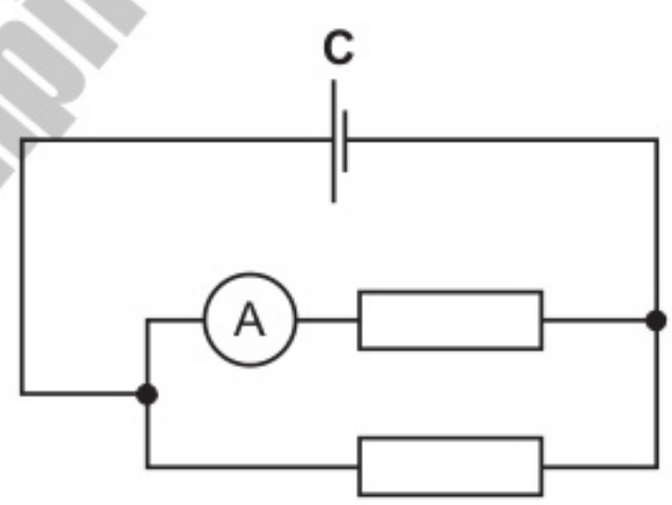
A



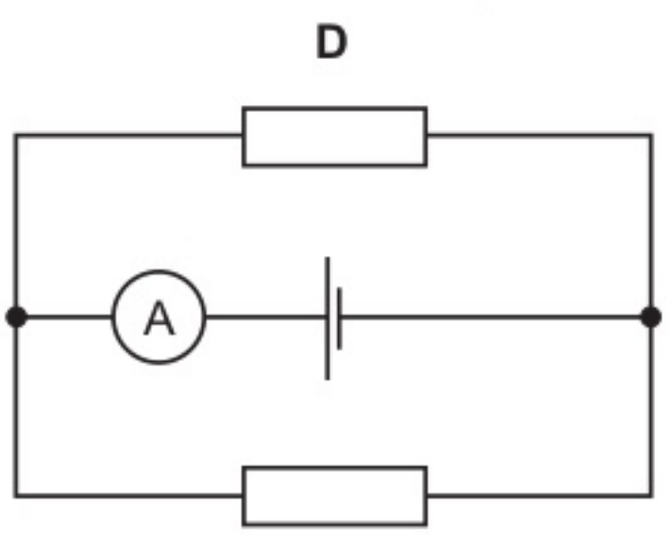
B



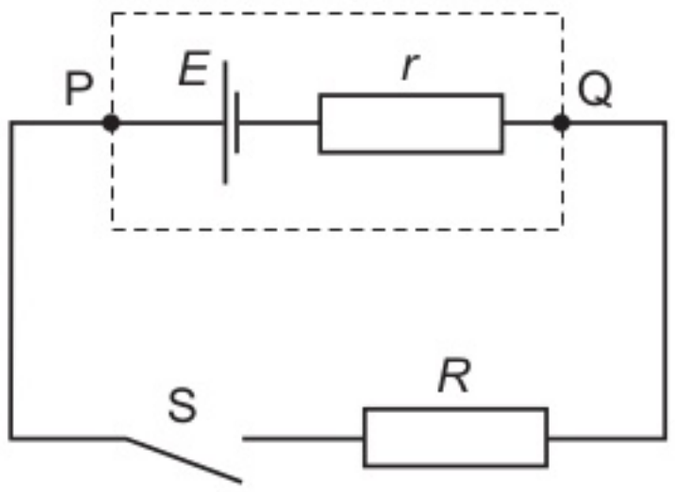
C



D



36 A cell of e.m.f. E and internal resistance r is connected in series with a switch S and an external resistor of resistance R. 9702/11/O/N/11



The p.d. between P and Q is V.

When S is closed,

A V decreases because there is a p.d. across R.

B V decreases because there is a p.d. across r.

C V remains the same because the decrease of p.d. across r is balanced by the increase of p.d. across R.

D V remains the same because the sum of the p.d.s across r and R is still equal to E.

34 Which of the equations that link some of the following terms is correct? 9702/11/O/N/11

potential difference (p.d.)	V
current	I
resistance	R
charge	Q
energy	E
power	P
time	t

A $P = \frac{Q^2R}{t}$

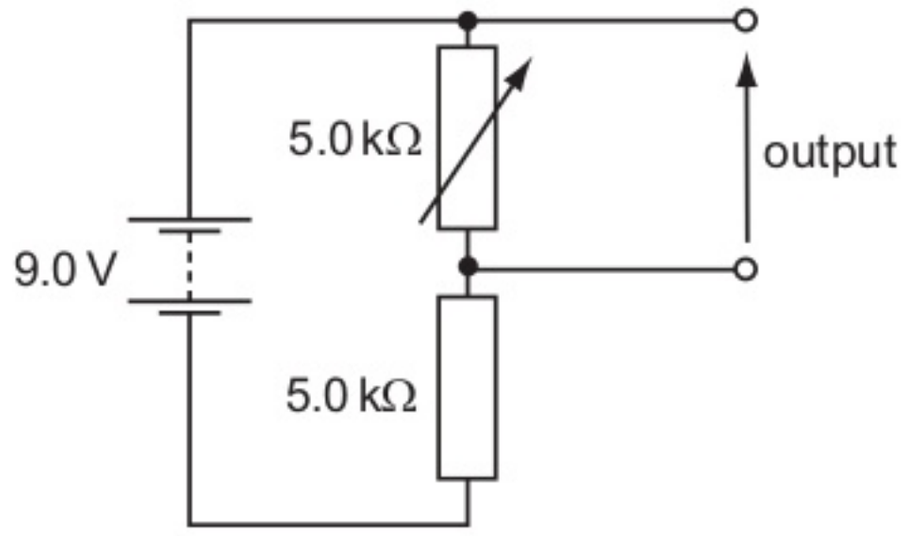
B $ER^2 = V^2t$

C $\frac{VI}{P} = t$

D $PQ = EI$

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

9702/11/O/N/11

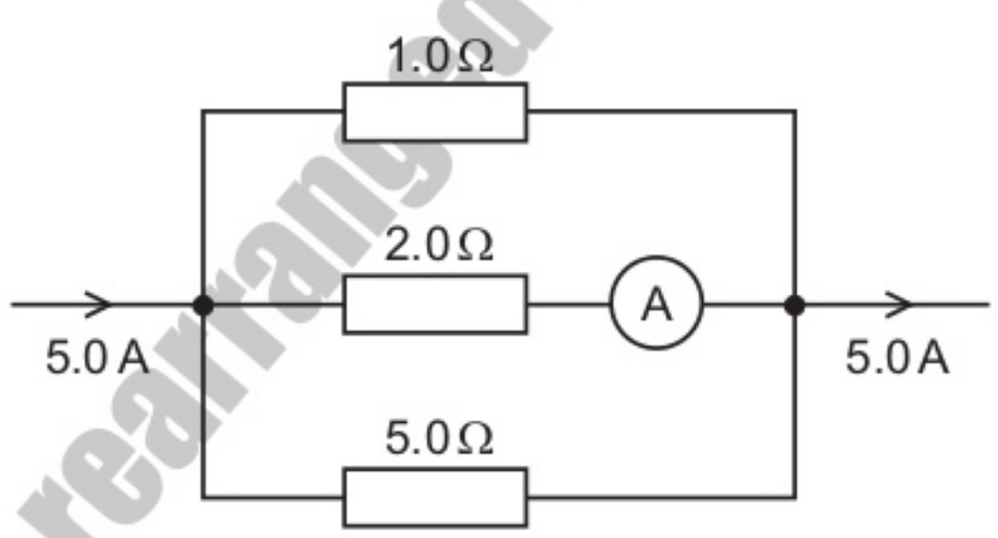


Which row gives the available range of output p.d.?

	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

37 The diagram shows part of a current-carrying circuit. The ammeter has negligible internal resistance.

9702/13/M/J/11



What is the reading on the ammeter?

A 0.7 A **B** 1.3 A **C** 1.5 A **D** 1.7 A

33 There is a current of 10 mA in a conductor for half an hour.

9702/11/M/J/12

How much charge passes a point in the conductor in this time?

A 0.3 C **B** 5 C **C** 18 C **D** 300 C

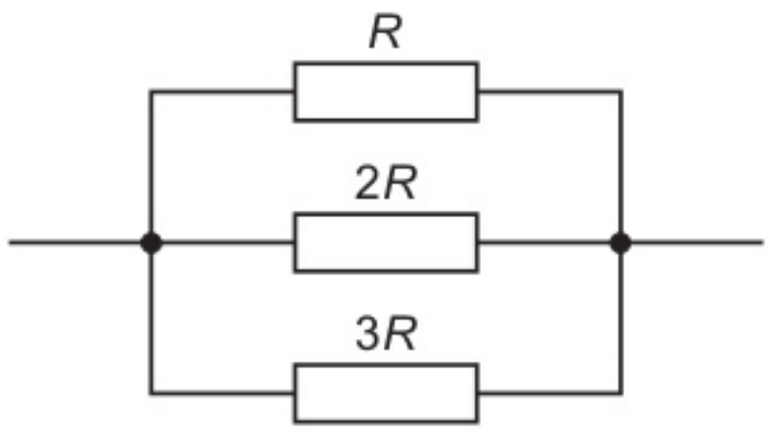
32 A charge of 8.0 C passes through a resistor of resistance 30 Ω at a constant rate in a time of 20 s.

9702/12/O/N/11

What is the potential difference across the resistor?

A 0.40 V **B** 5.3 V **C** 12 V **D** 75 V

38 Three resistors of resistance R, $2R$ and $3R$ are connected in parallel. 9702/11/O/N/11



Using I to represent the current through the resistor of resistance R, which row represents the relationships between the currents through the resistors?

	resistor resistance		
	R	$2R$	$3R$
A	I	$\frac{1}{3}I$	$\frac{1}{2}I$
B	I	$\frac{1}{2}I$	$\frac{1}{3}I$
C	I	$\frac{2}{3}I$	$\frac{1}{3}I$
D	I	$2I$	$3I$

34 An iron wire has length 8.0 m and diameter 0.50 mm. The wire has resistance R. 9702/11/M/J/12

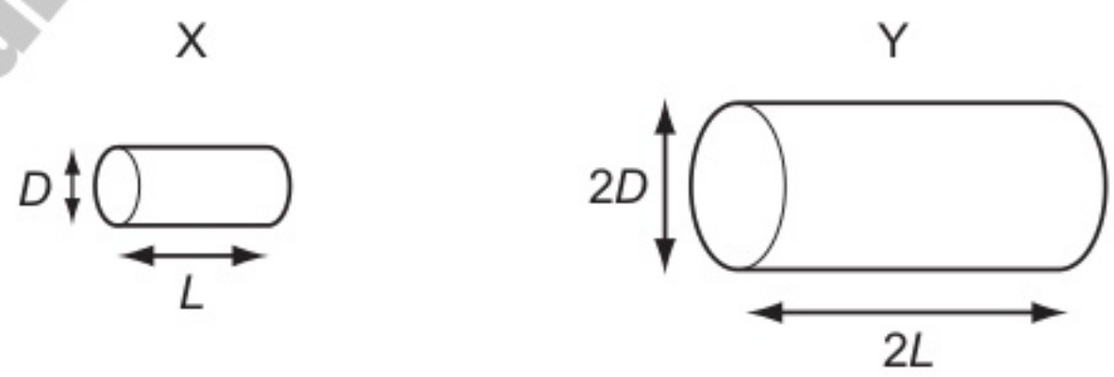
A second iron wire has length 2.0 m and diameter 1.0 mm.

What is the resistance of the second wire?

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

34 Two electrically-conducting cylinders X and Y are made from the same material. 9702/12/O/N/11

Their dimensions are as shown.



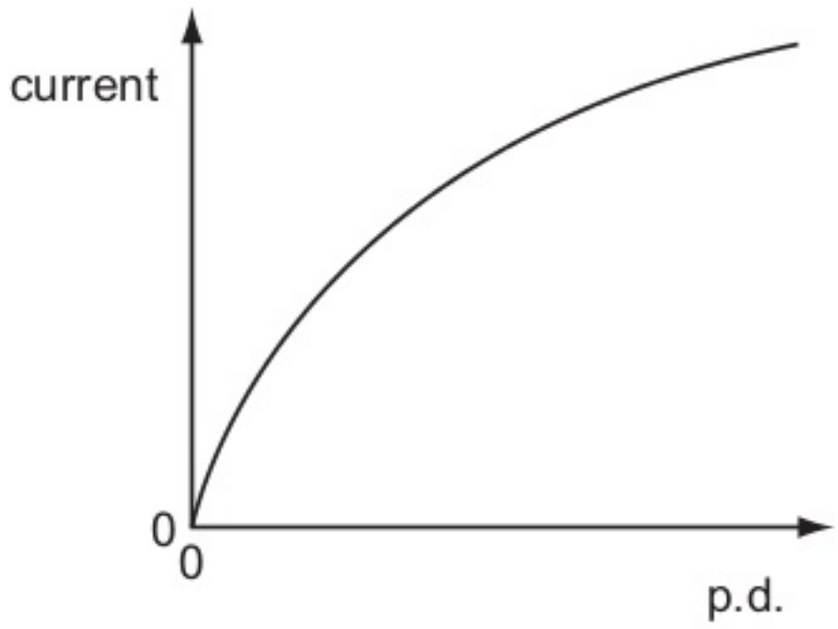
The resistance of each cylinder is measured between its ends.

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

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

33 The graph shows the variation with potential difference (p.d.) of the current in a lamp filament.

9702/12/O/N/11



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.

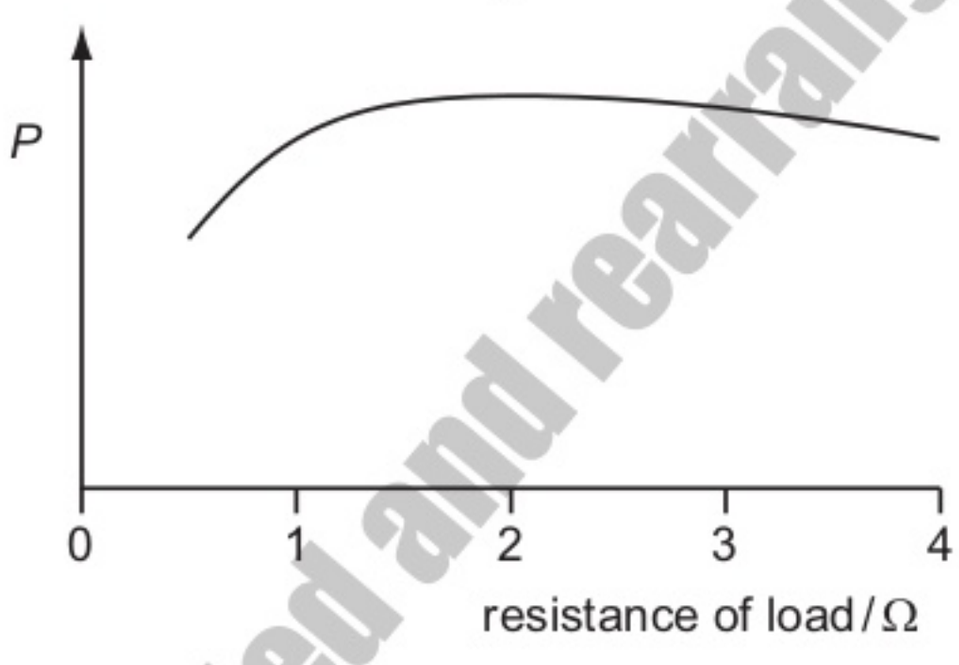
C The power output of the filament is proportional to the square of the current in it.

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

35 A power supply of electromotive force (e.m.f.) 12 V and internal resistance 2 Ω is connected in series with a load resistor. The value of the load resistor is varied from 0.5 Ω to 4 Ω. 9702/12/O/N/11

Which graph shows how the power *P* dissipated in the load resistor varies with the resistance of the load resistor?

A

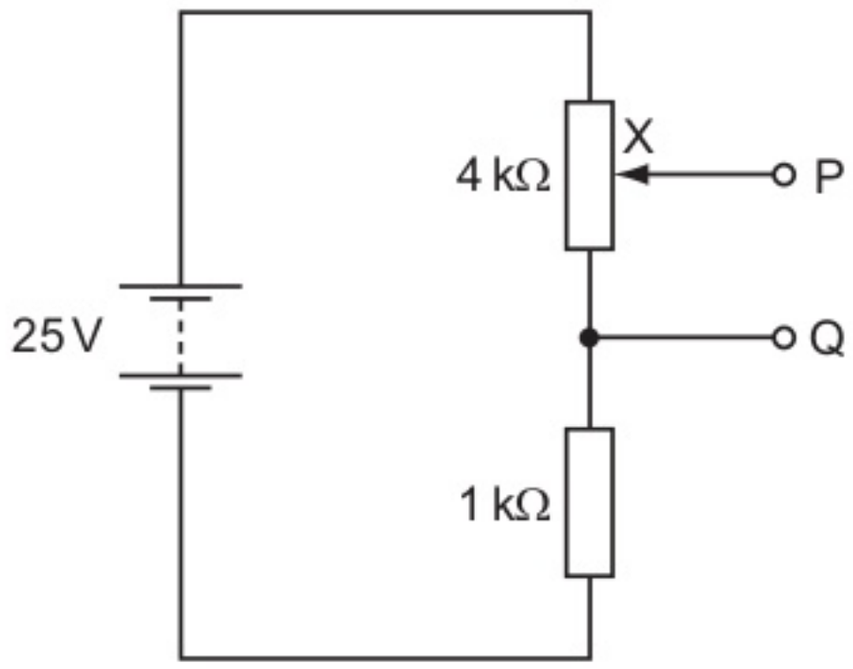


B

C

D

37 The diagram shows a potential divider circuit which, by adjustment of the contact X, can be used to provide a variable potential difference between the terminals P and Q. 9702/12/O/N/11



What are the limits of this potential difference?

A 0 and 5 V **B** 0 and 20 V **C** 0 and 25 V **D** 5 V and 25 V

36 Each of Kirchhoff's laws is linked to the conservation of a physical quantity. 9702/12/O/N/11

Which physical quantities are assumed to be conserved in the formulation of Kirchhoff's first law and of Kirchhoff's second law?

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

33 Which statement about electrical resistivity is correct? 9702/11/O/N/11

A The resistivity of a material is numerically equal to the resistance in ohms of a cube of that material, the cube being of side length one metre and the resistance being measured between opposite faces.

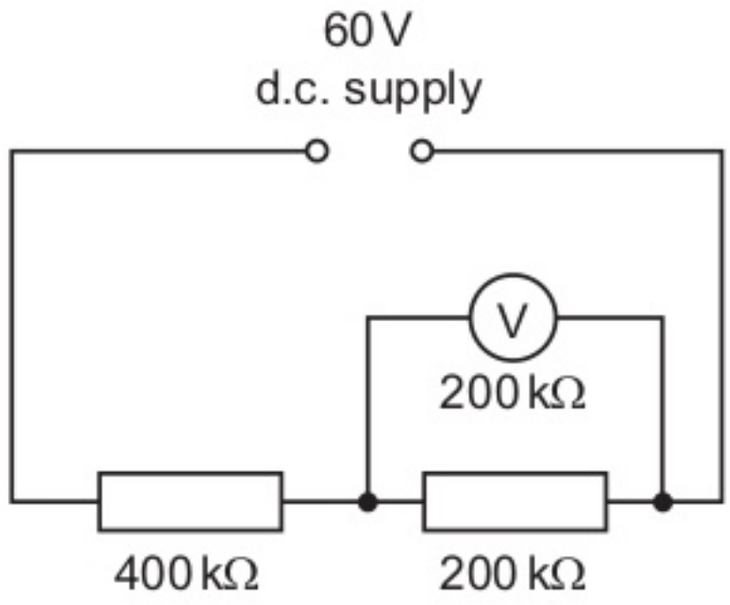
B The resistivity of a material is numerically equal to the resistance in ohms of a one metre length of wire of that material, the area of cross-section of the wire being one square millimetre and the resistance being measured between the ends of the wire.

C The resistivity of a material is proportional to the cross-sectional area of the sample of the material used in the measurement.

D The resistivity of a material is proportional to the length of the sample of the material used in the measurement.

38 A constant 60 V d.c. supply is connected across two resistors of resistance 400 kΩ and 200 kΩ.

9702/12/O/N/11



What is the reading on a voltmeter, also of resistance 200 kΩ, when connected across the 200 kΩ resistor as shown in the diagram?

A 12 V **B** 15 V **C** 20 V **D** 30 V

34 Which statement is **not** valid?

9702/13/O/N/11

A Current is the speed of the charged particles that carry it.

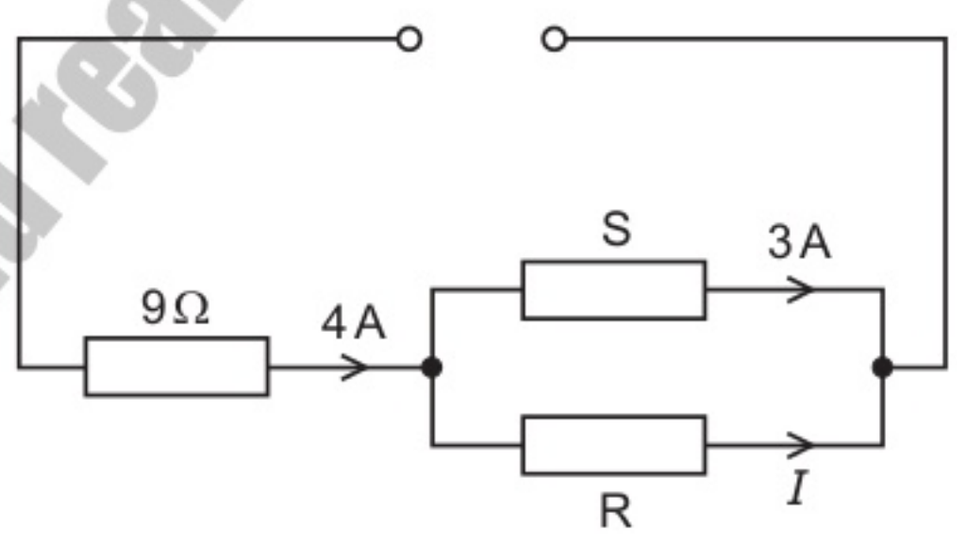
B Electromotive force (e.m.f.) is the energy converted to electrical energy from other forms, per unit charge.

C The potential difference (p.d.) between two points is the work done in moving unit charge from one point to the other.

D The resistance between two points is the p.d. between the two points, per unit current.

38 The circuit below has a current I in the resistor R.

9702/11/M/J/12



What must be known in order to determine the value of I?

A e.m.f. of the power supply

B resistance of resistor S

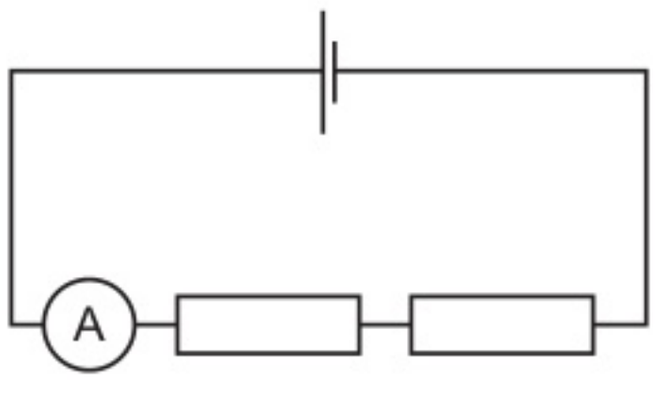
C Kirchhoff's first law

D Kirchhoff's second law

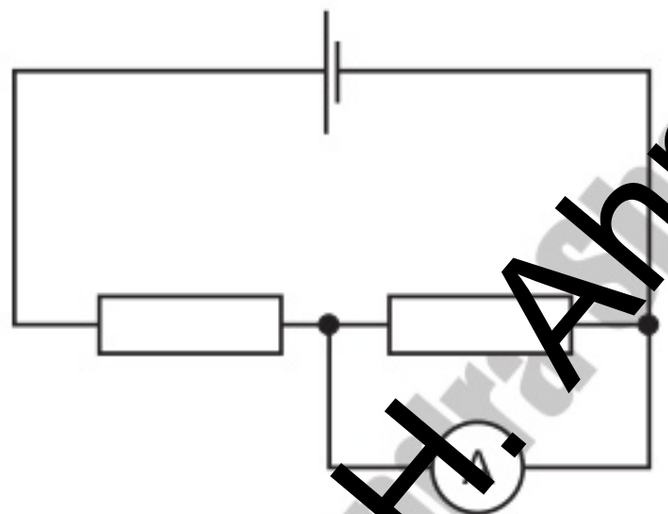
36 A cell, two resistors of equal resistance and an ammeter are used to construct four circuits. The resistors are the only parts of the circuits that have resistance. 9702/13/O/N/11

In which circuit will the ammeter show the greatest reading?

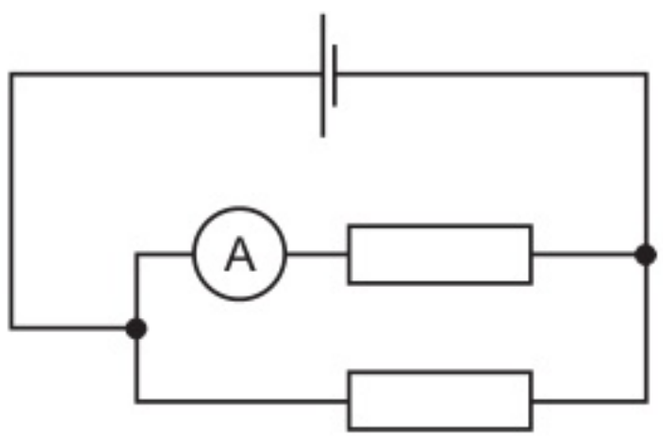
A



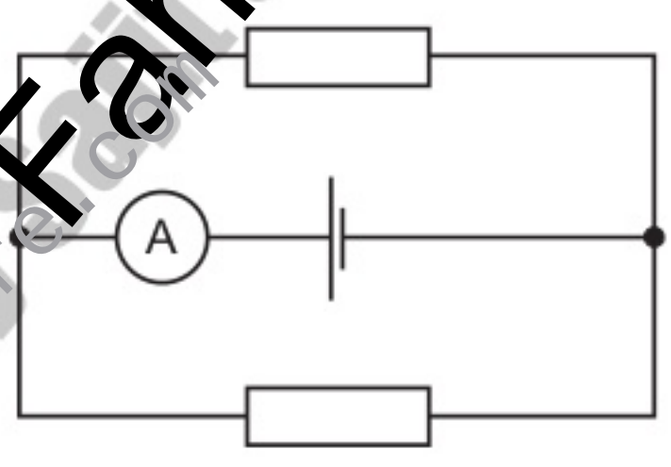
B



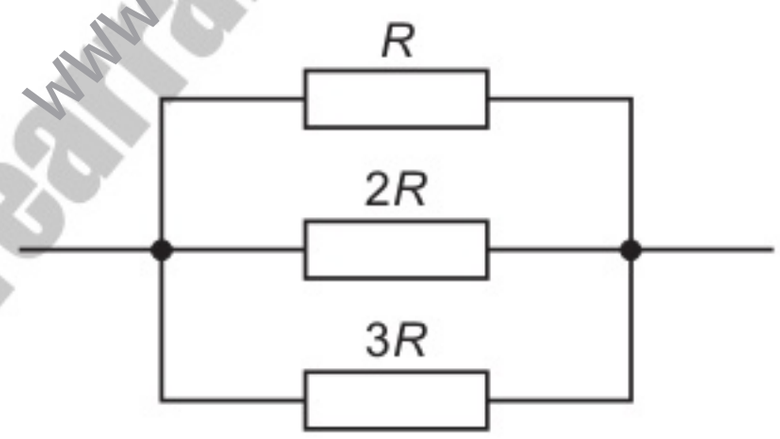
C



D



37 Three resistors of resistance R, $2R$ and $3R$ are connected in parallel. 9702/13/O/N/11

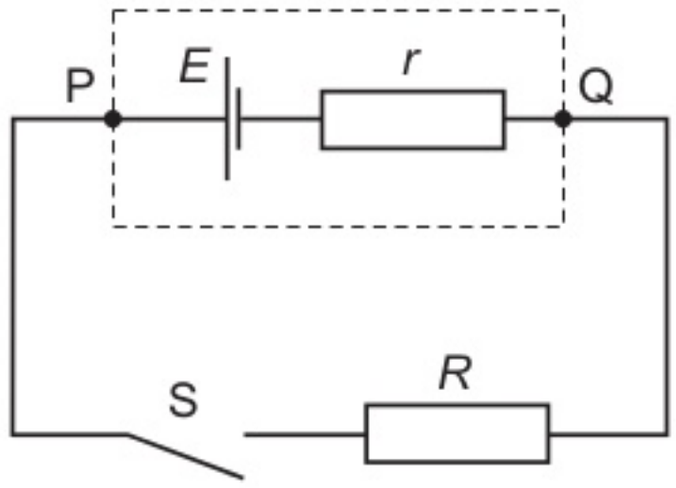


Using I to represent the current through the resistor of resistance R, which row represents the relationships between the currents through the resistors?

	resistor resistance		
	R	$2R$	$3R$
A	I	$\frac{1}{3}I$	$\frac{1}{2}I$
B	I	$\frac{1}{2}I$	$\frac{1}{3}I$
C	I	$\frac{2}{3}I$	$\frac{1}{3}I$
D	I	$2I$	$3I$

38 A cell of e.m.f. E and internal resistance r is connected in series with a switch S and an external resistor of resistance R.

9702/13/O/N/11



The p.d. between P and Q is V.

When S is closed,

A V decreases because there is a p.d. across R.

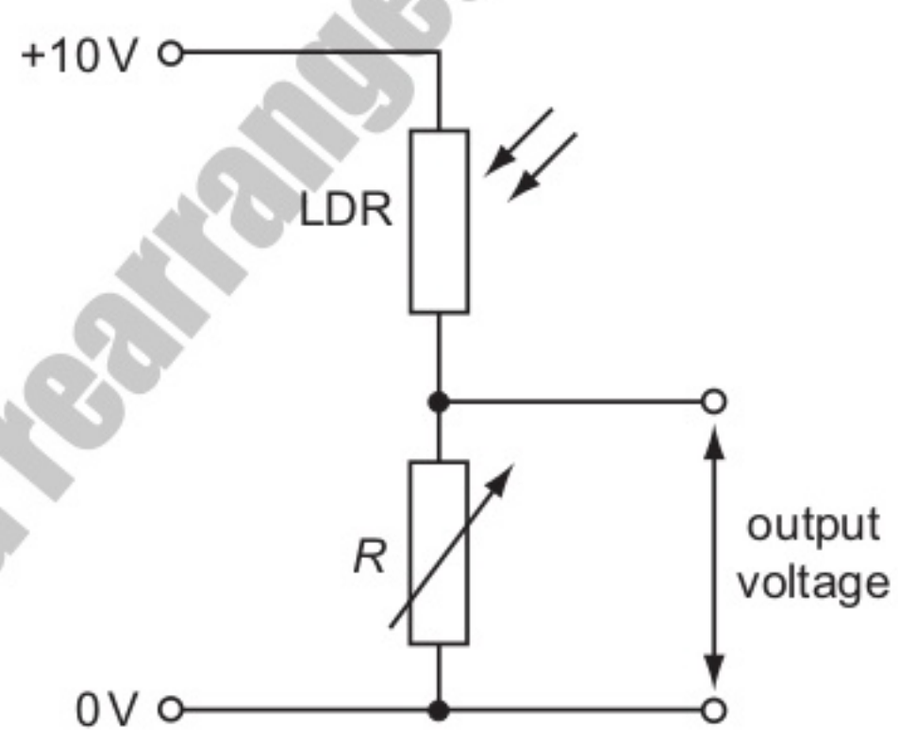
B V decreases because there is a p.d. across r.

C V remains the same because the decrease of p.d. across r is balanced by the increase of p.d. across R.

D V remains the same because the sum of the p.d.s across r and R is still equal to E.

37 A potential divider consists of a light-dependent resistor (LDR) in series with a variable resistor of resistance R. The resistance of the LDR decreases when the light level increases. The variable resistor can be set at either high resistance or low resistance.

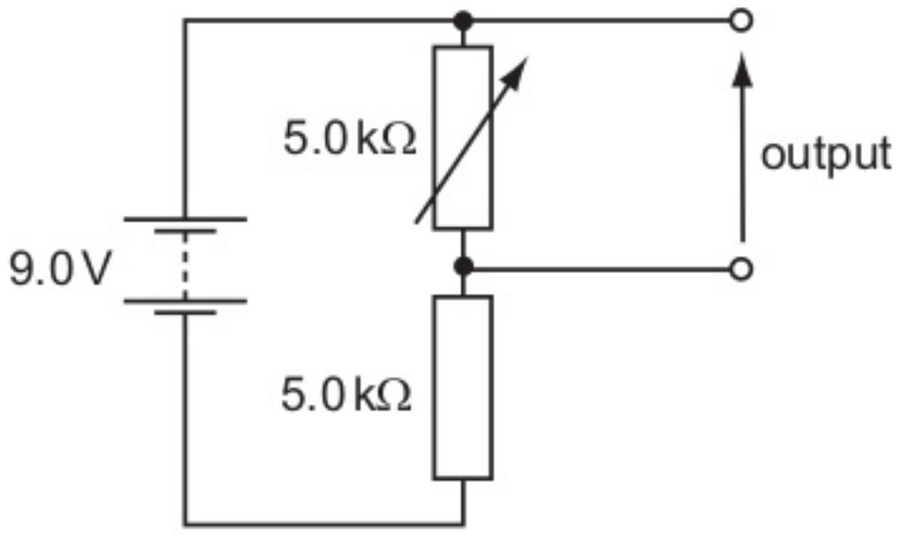
9702/11/M/J/12



Which situation gives the largest output voltage?

	light level at LDR	R
A	high	high
B	high	low
C	low	high
D	low	low

40 The diagram shows a potential divider circuit designed to provide a variable output p.d. 9702/13/O/N/11



Which row 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

33 Two copper wires of the same length but different diameters carry the same current. 9702/12/M/J/12

Which statement about the flow of charged particles through the wires is correct?

A Charged particles are provided by the power supply. Therefore the speed at which they travel depends only on the voltage of the supply.

B The charged particles in both wires move with the same average speed because the current in both wires is the same.

C The charged particles move faster through the wire with the larger diameter because there is a greater volume through which to flow.

D The charged particles move faster through the wire with the smaller diameter because it has a larger potential difference applied to it.

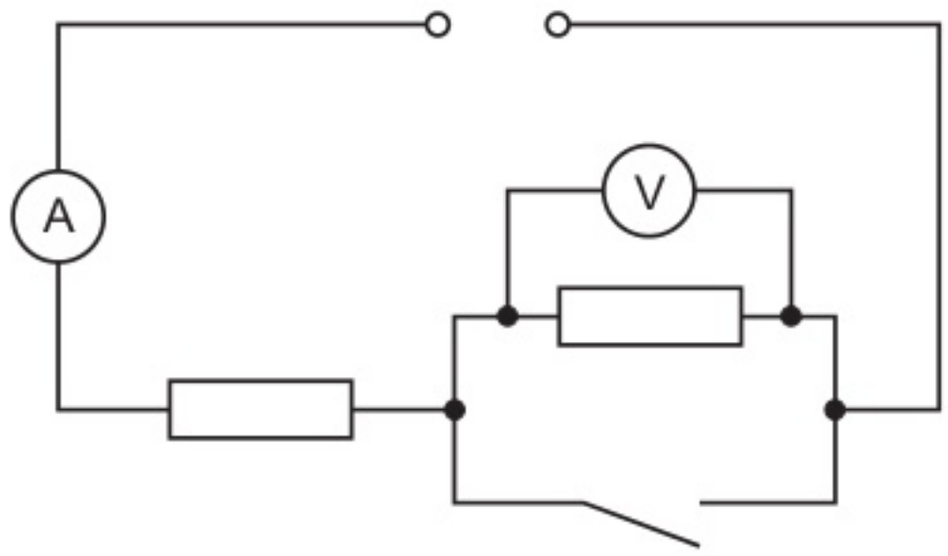
34 A power cable X has resistance R and carries current I. 9702/12/M/J/12

A second cable Y has resistance $2R$ 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

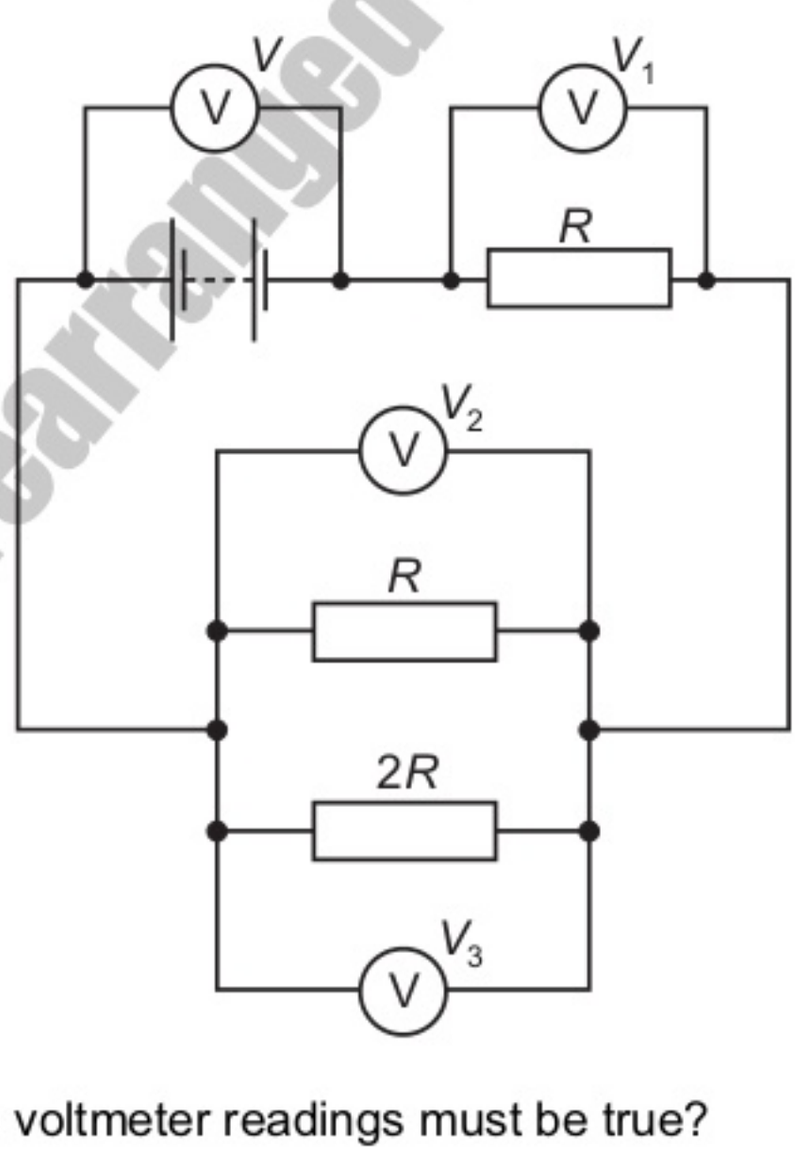
36 In the circuit below, the ammeter reading is I and the voltmeter reading is V. 9702/11/M/J/12



When the switch is closed, which row describes what happens to I and V?

	I	V
A	decreases	decreases to zero
B	increases	decreases to zero
C	increases	stays the same
D	stays the same	increases

35 The diagram shows a circuit with four voltmeter readings V, V_1, V_2 and V_3. 9702/12/M/J/12



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 $V - V_1 = V_3$

35 Which statement about electrical resistivity is correct? 9702/13/O/N/11

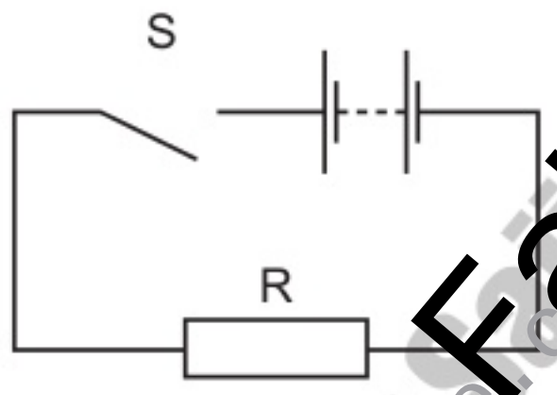
A The resistivity of a material is numerically equal to the resistance in ohms of a cube of that material, the cube being of side length one metre and the resistance being measured between opposite faces.

B The resistivity of a material is numerically equal to the resistance in ohms of a one metre length of wire of that material, the area of cross-section of the wire being one square millimetre and the resistance being measured between the ends of the wire.

C The resistivity of a material is proportional to the cross-sectional area of the sample of the material used in the measurement.

D The resistivity of a material is proportional to the length of the sample of the material used in the measurement.

35 The diagram shows a simple circuit. 9702/11/M/J/12



Which statement is correct?

A When switch S is closed, the electromotive force (e.m.f.) of the battery falls because work is done against the internal resistance of the battery.

B When switch S is closed, the e.m.f. of the battery falls because work is done against the resistance R.

C When switch S is closed, the potential difference across the battery falls because work is done against the internal resistance of the battery.

D When switch S is closed, the potential difference across the battery falls because work is done against the resistance R.

32 An iron wire has length 8.0 m and diameter 0.50 mm. The wire has resistance R. 9702/13/M/J/12

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

34 There is a current of 10 mA in a conductor for half an hour. 9702/13/M/J/12

How much charge passes a point in the conductor in this time?

A 0.3 C **B** 5 C **C** 18 C **D** 300 C

39 Which of the equations that link some of the following terms is correct? 9702/13/O/N/11

potential difference (p.d.)	V
current	I
resistance	R
charge	Q
energy	E
power	P
time	t

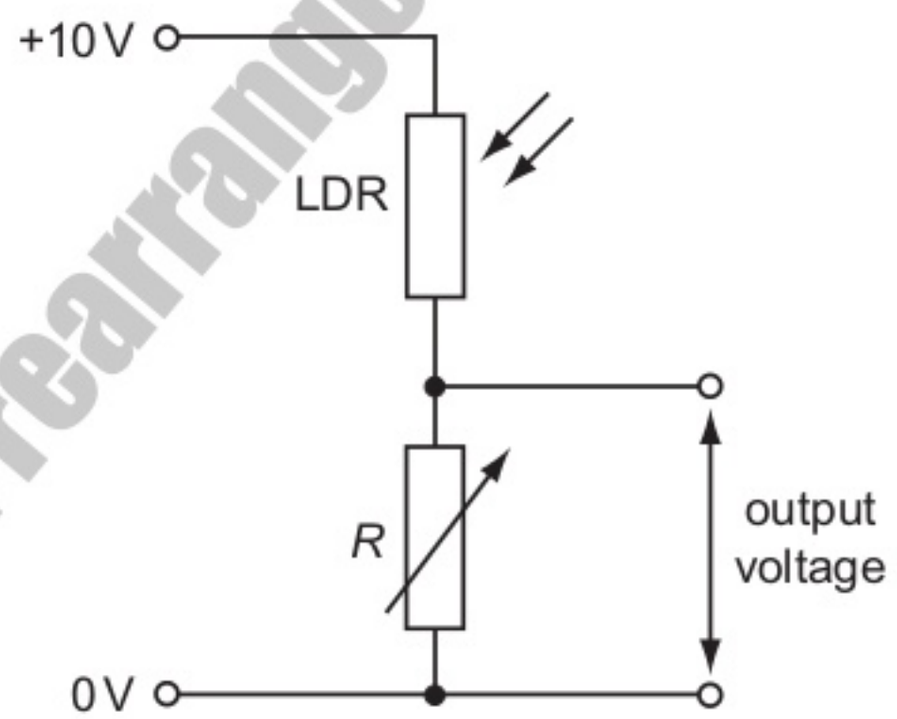
A $P = \frac{Q^2R}{t}$

B $ER^2 = V^2t$

C $\frac{VI}{P} = t$

D $PQ = EI$

38 A potential divider consists of a light-dependent resistor (LDR) in series with a variable resistor of resistance R. The resistance of the LDR decreases when the light level increases. The variable resistor can be set at either high resistance or low resistance. 9702/13/M/J/12

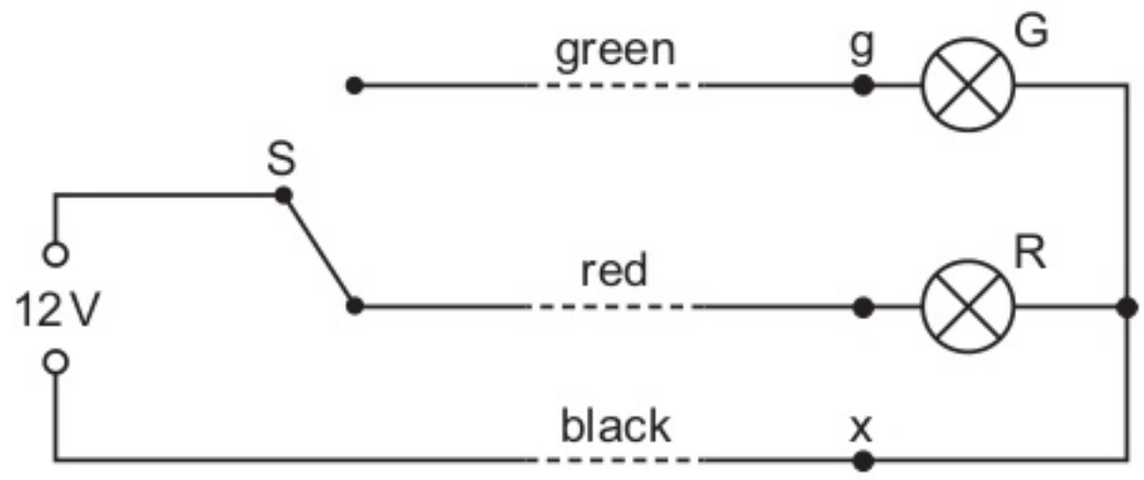


Which situation gives the largest output voltage?

	light level at LDR	R
A	high	high
B	high	low
C	low	high
D	low	low

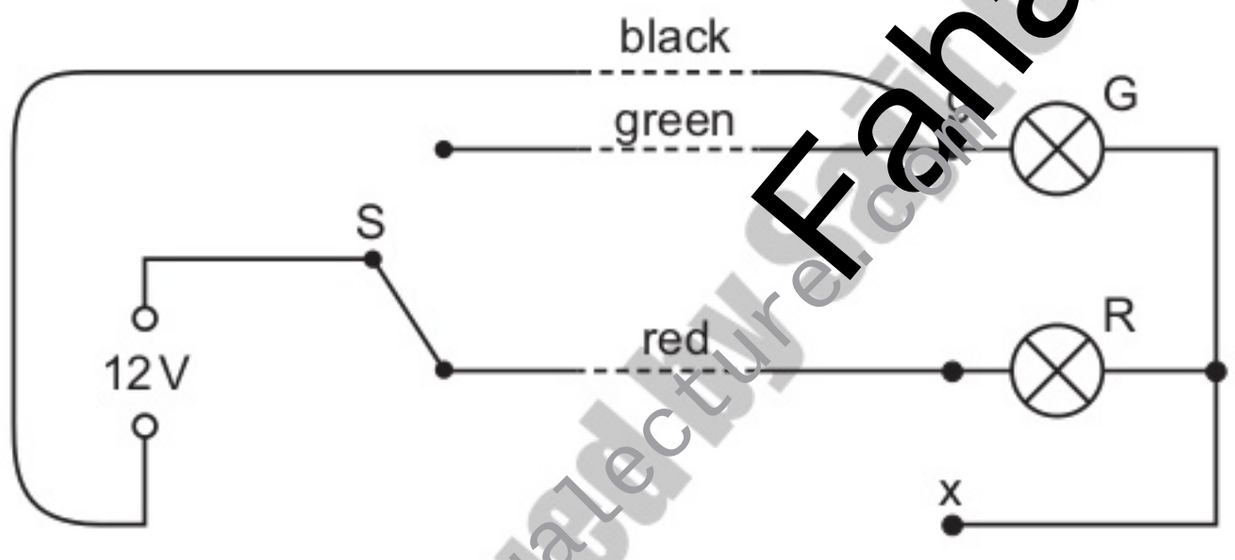
37 The diagram shows the circuit for a signal to display a green or a red light. It is controlled by the switch S.

9702/12/M/J/12



The signal is some way from S to which it is connected by a cable with green, red and black wires. At the signal, the green and red wires are connected to the corresponding lamp and the black wire is connected to a terminal x to provide a common return. The arrangement is shown correctly connected and with the switch set to illuminate the red lamp.

During maintenance, the wires at the signal are disconnected and, when reconnected, the black wire is connected in error to the green lamp (terminal g) instead of terminal x. The red wire is connected correctly to its lamp and connections at S remain as in the diagram.



When the system is tested with the switch connection to the red wire, what does the signal show?

A the green lamp illuminated normally

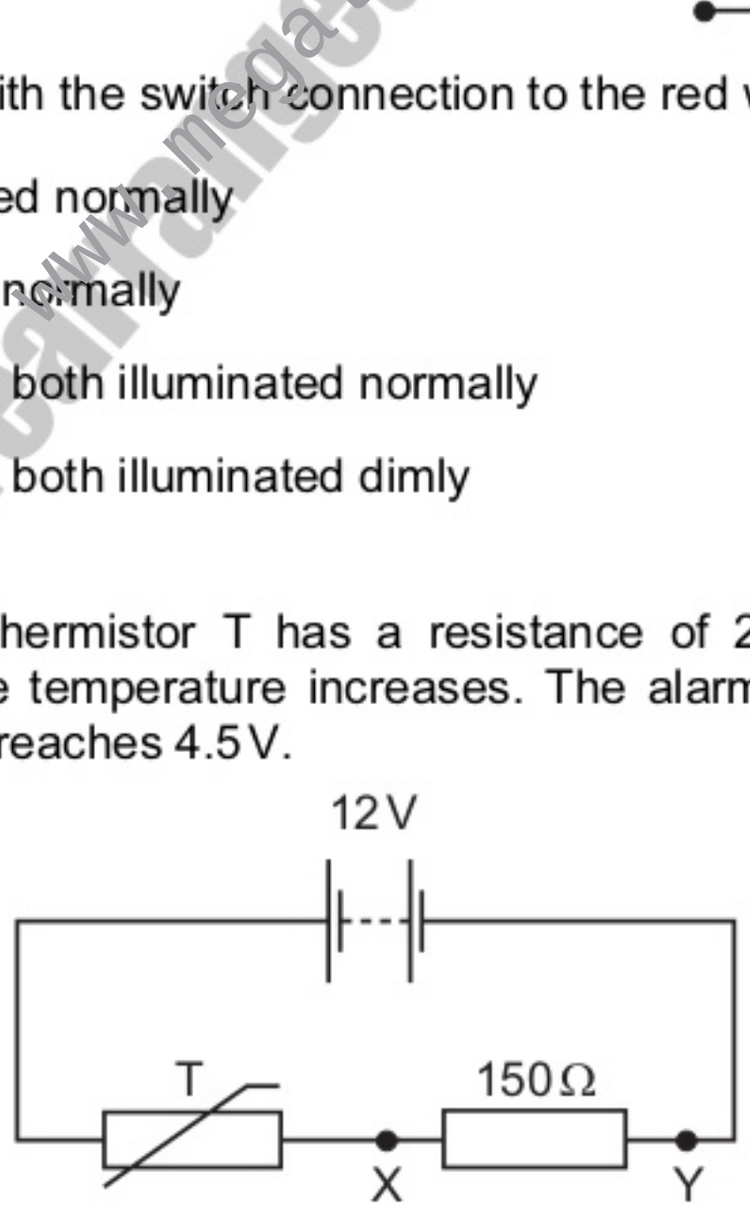
B the red lamp illuminated normally

C the red and green lamps both illuminated normally

D the red and green lamps both illuminated dimly

35 In a fire alarm system, a thermistor T has a resistance of 2000 Ω at room temperature. Its resistance decreases as the temperature increases. The alarm is triggered when the potential difference between X and Y reaches 4.5 V.

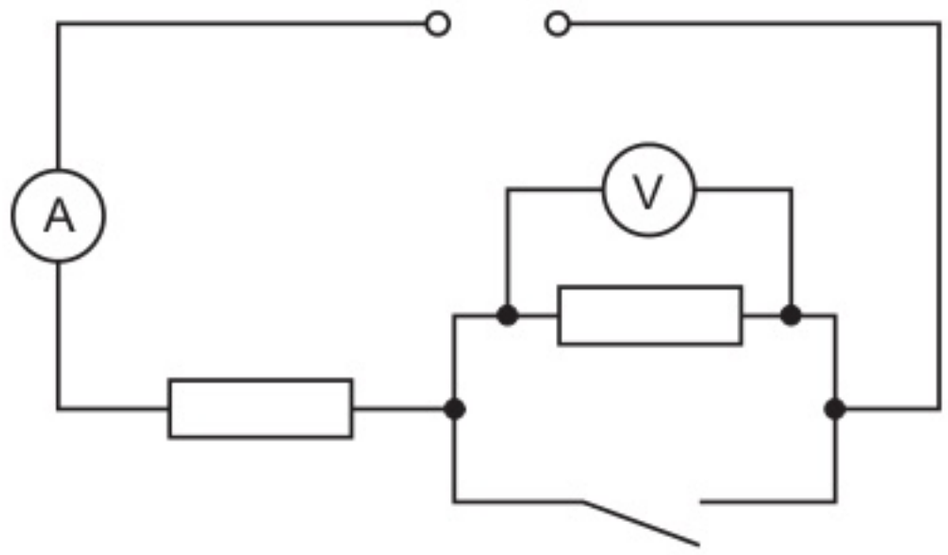
9702/11/O/N/12



What is the resistance of the thermistor when the alarm is triggered?

A 90 Ω **B** 150 Ω **C** 250 Ω **D** 1300 Ω

35 In the circuit below, the ammeter reading is I and the voltmeter reading is V. 9702/13/M/J/12

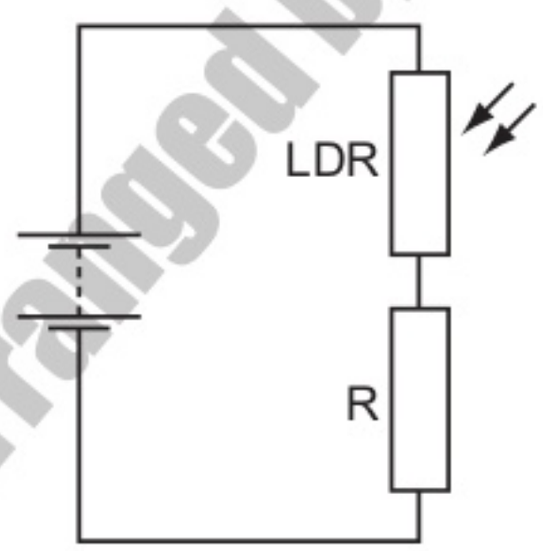


When the switch is closed, which row describes what happens to I and V?

	I	V
A	decreases	decreases to zero
B	increases	decreases to zero
C	increases	stays the same
D	stays the same	increases

36 A light-dependent resistor (LDR) is connected in series with a resistor R and a battery.

9702/12/M/J/12



The resistance of the LDR is equal to the resistance of R when no light falls on the LDR.

When the light intensity falling on the LDR increases, which statement is correct?

A The current in R decreases.

B The current in the LDR decreases.

C The p.d. across R decreases.

D The p.d. across the LDR decreases.

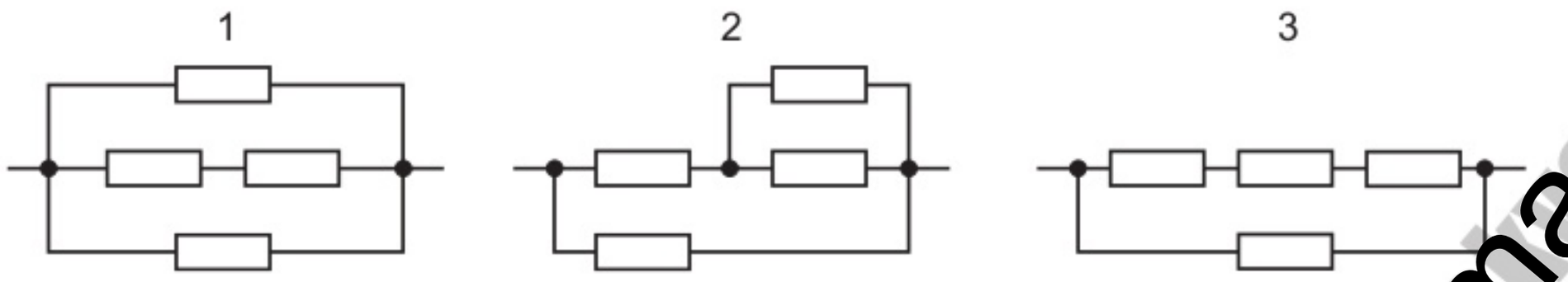
32 The potential difference between point X and point Y in a circuit is 20V. The time taken for charge carriers to move from X to Y is 15 s. In this time, the energy of the charge carriers changes by 12 J.

9702/11/O/N/12

What is the current between X and Y?

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

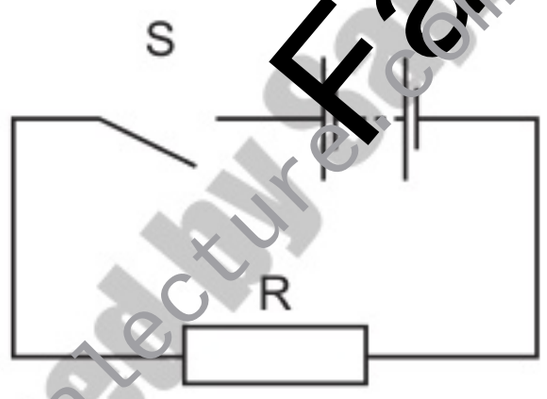
38 Four identical resistors are connected in the three networks below. 9702/12/M/J/12



Which arrangement has the highest total resistance and which has the lowest?

	highest	lowest
A	1	2
B	1	3
C	3	1
D	3	2

36 The diagram shows a simple circuit. 9702/13/M/J/12



Which statement is correct?

A When switch S is closed, the electromotive force (e.m.f.) of the battery falls because work is done against the internal resistance of the battery.

B When switch S is closed, the e.m.f. of the battery falls because work is done against the resistance R.

C When switch S is closed, the potential difference across the battery falls because work is done against the internal resistance of the battery.

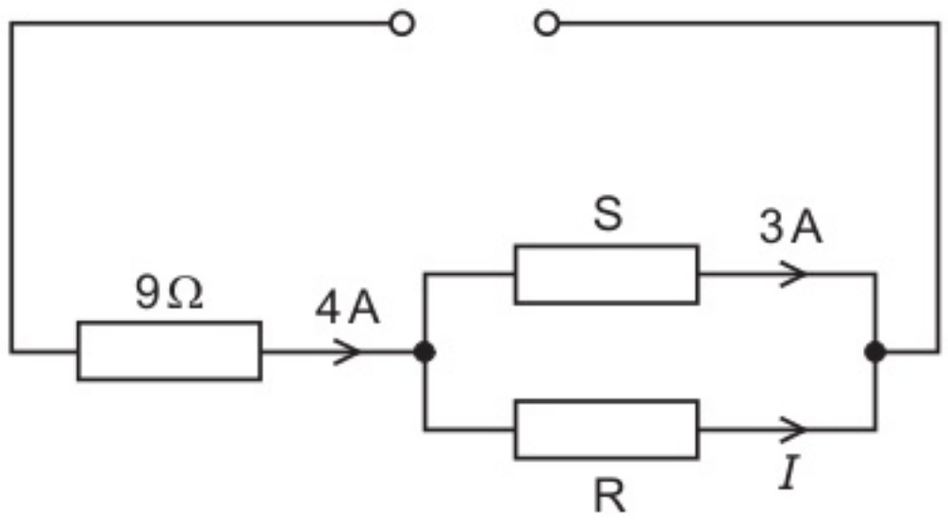
D When switch S is closed, the potential difference across the battery falls because work is done against the resistance R.

33 A cylindrical wire of length 10 m and diameter 2.0 mm has a resistance of 0.050 Ω. 9702/11/O/N/12

From which material is the wire made?

	material	resistivity / Ω m
A	bronze	1.6×10^{-7}
B	nichrome	1.6×10^{-6}
C	silver	1.6×10^{-8}
D	zinc	6.3×10^{-8}

37 The circuit below has a current I in the resistor R. 9702/13/M/J/12



What must be known in order to determine the value of I?

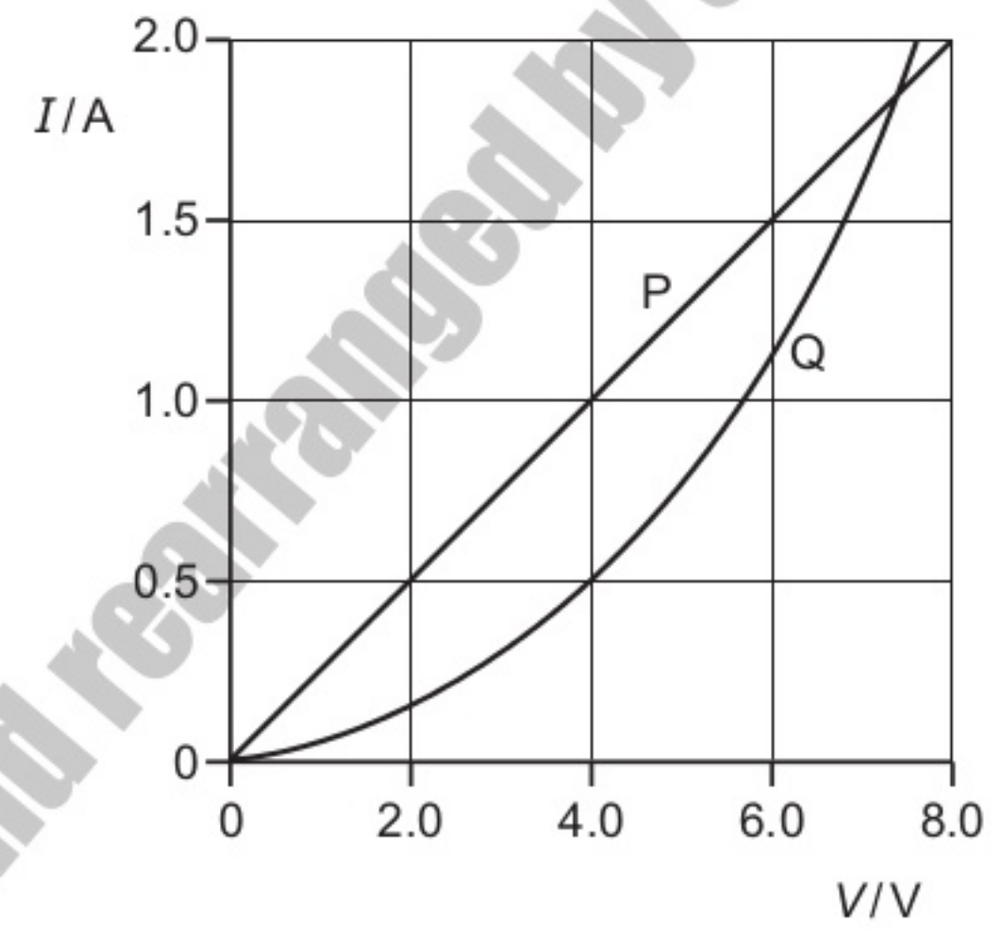
A e.m.f. of the power supply

B resistance of resistor S

C Kirchhoff's first law

D Kirchhoff's second law

34 The I-V characteristics of two electrical components P and Q are shown below. 9702/11/O/N/12



Which statement is correct?

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

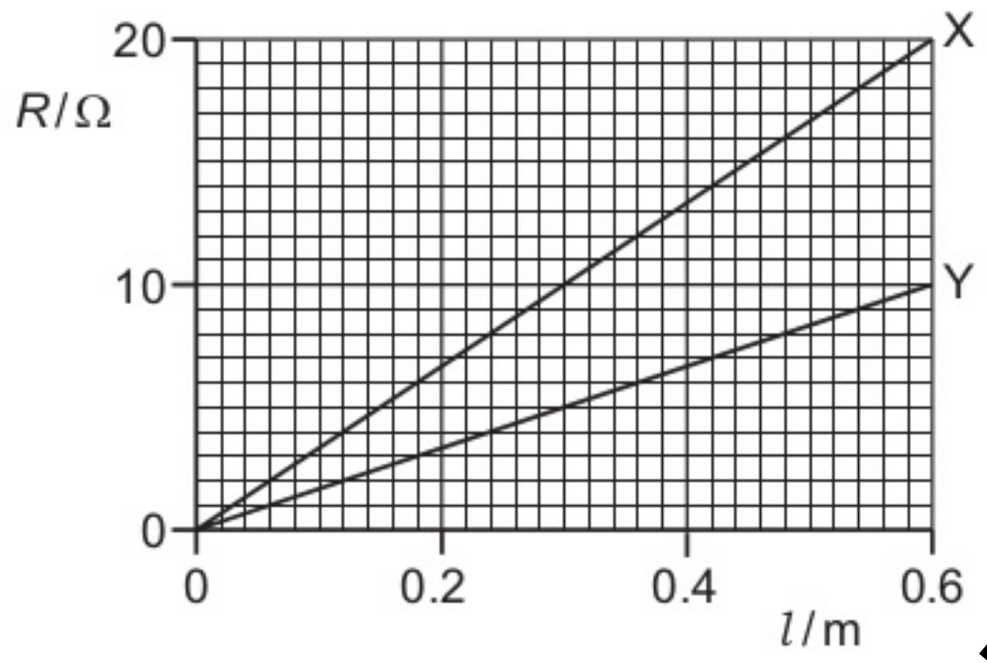
B The resistance of Q increases as the current in it increases.

C For a current of 1.9 A, the resistance of Q is approximately half that of P.

D For a current of 0.5 A, the power dissipated in Q is double that in P.

34 The graph shows the variation with length l of resistance R for two wires X and Y made from the same material.

9702/12/O/N/12



What does the graph show?

A cross-sectional area of X = 2 × cross-sectional area of Y

B resistivity of X = 2 × resistivity of Y

C when equal lengths of X and Y are connected in series to a battery, power in X = 2 × power in Y

D when equal lengths of X and Y are connected in parallel to a battery, current in X = 2 × current in Y

35 A cell of internal resistance 2.0 Ω and electromotive force (e.m.f.) 1.5 V is connected to a resistor of resistance 3.0 Ω.

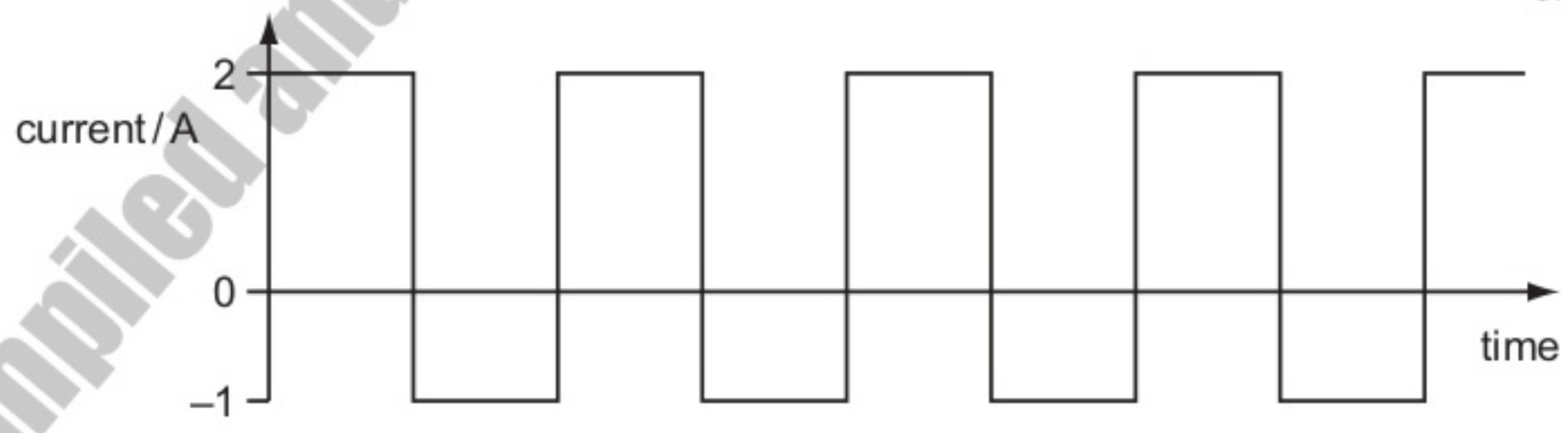
9702/12/O/N/12

What is the potential difference across the 3.0 Ω resistor?

A 1.5 V **B** 1.2 V **C** 0.9 V **D** 0.6 V

36 A 100 Ω resistor conducts a current with changing direction and magnitude, as shown.

9702/12/O/N/12

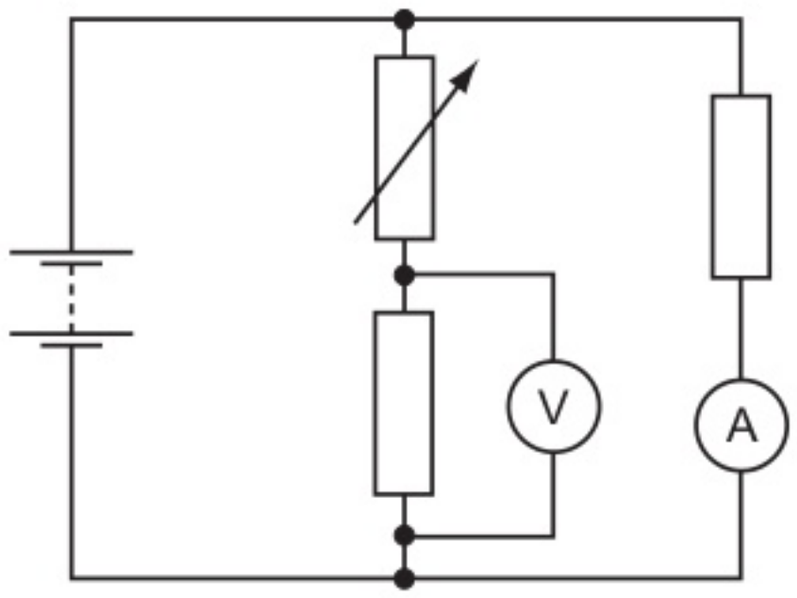


What is the mean power dissipated in the resistor?

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

36 A network of electrical components is connected across a battery of negligible internal resistance, as shown.

9702/11/O/N/12



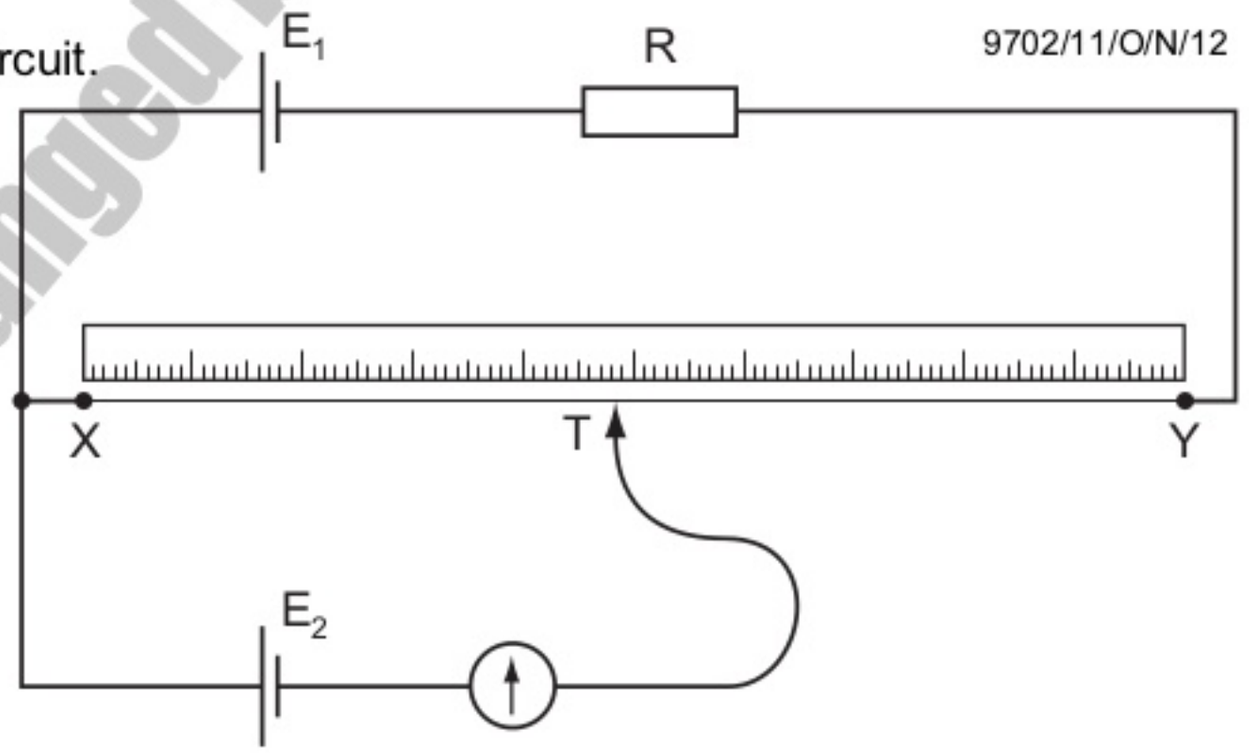
The resistance of the variable resistor is increased.

What is the effect on the readings of the ammeter and voltmeter?

	ammeter	voltmeter
A	decreases	increases
B	increases	decreases
C	unchanged	decreases
D	unchanged	increases

37 The diagram shows a potentiometer circuit.

9702/11/O/N/12



The contact T is placed on the wire and moved along the wire until the galvanometer reading is zero. The length XT is then noted.

In order to calculate the potential difference per unit length of the wire XY, which value must also be known?

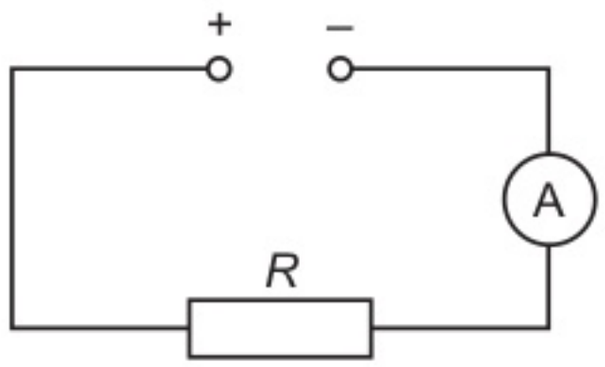
A the e.m.f. of the cell E_1

B the e.m.f. of the cell E_2

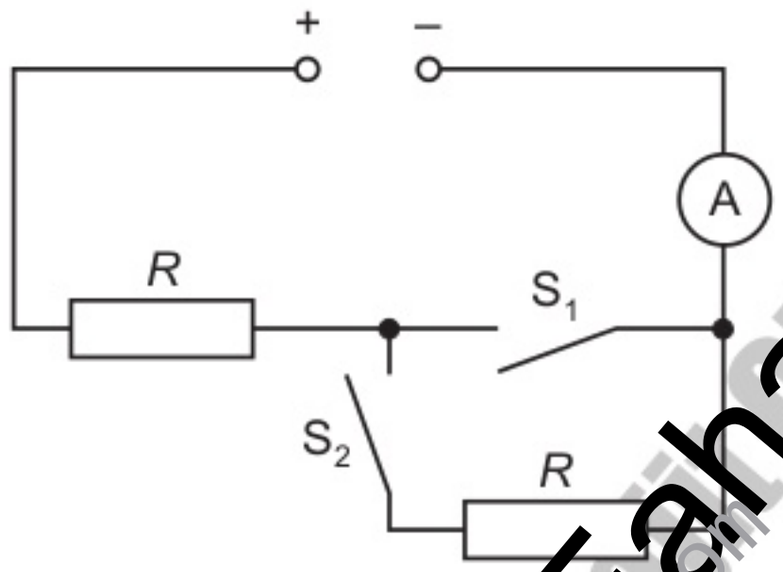
C the resistance of resistor R

D the resistance of the wire XY

37 The ammeter reading in the circuit below is I.



Another circuit containing the same voltage supply, two switches, an ammeter and two resistors each of resistance R, is shown.

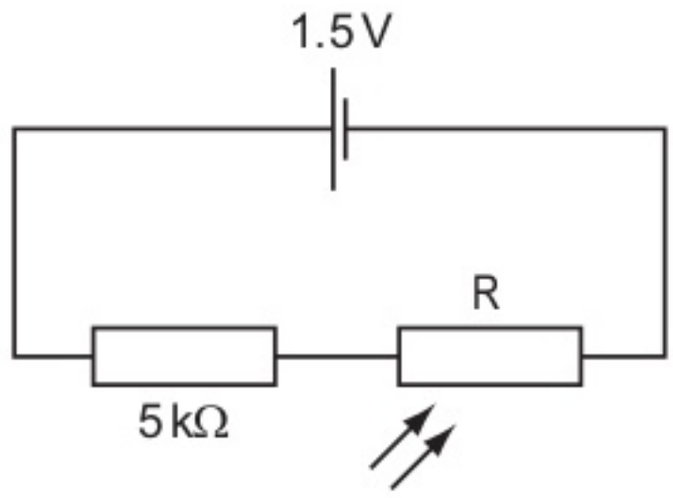


Which row is **not** correct?

	S_1	S_2	ammeter reading
A	closed	closed	I
B	closed	open	I
C	open	closed	I
D	open	open	0

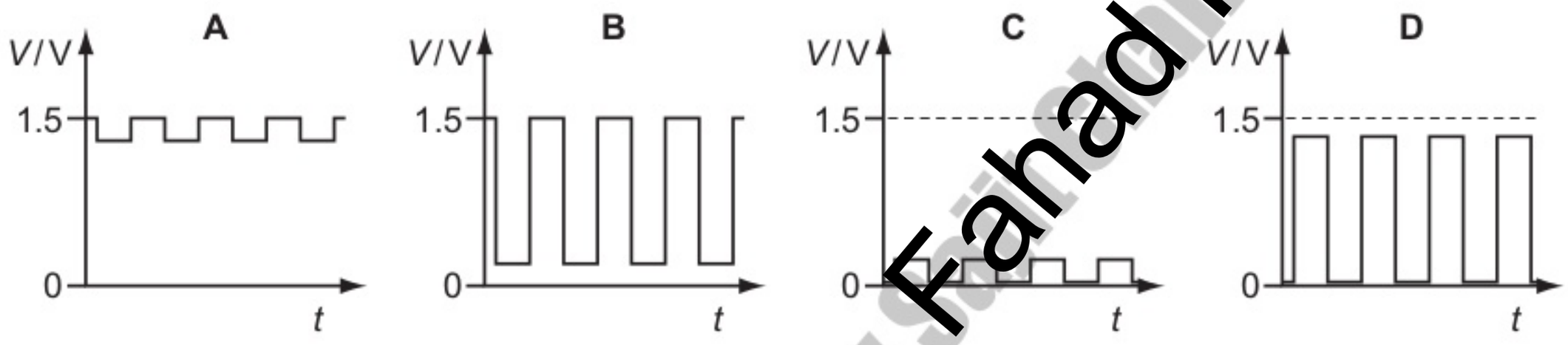
38 A light-dependent resistor R has resistance of about 1 MΩ in the dark and about 1 kΩ when illuminated. It is connected in series with a 5 kΩ resistor to a 1.5 V cell of negligible internal resistance.

9702/12/O/N/12



The light-dependent resistor is illuminated (in an otherwise dark room) by a flashing light.

Which graph best shows the variation with time *t* of potential difference *V* across R?



33 A copper wire is stretched so that its diameter is reduced from 1.0 mm to a uniform 0.5 mm.

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The resistance of the unstretched copper wire is 0.2 Ω.

What will be the resistance of the stretched wire?

A 0.4 Ω **B** 0.8 Ω **C** 1.6 Ω **D** 3.2 Ω

34 Four statements about potential difference or electromotive force are listed.

9702/12/O/N/12

1 It involves changing electrical energy into other forms.

2 It involves changing other energy forms into electrical energy.

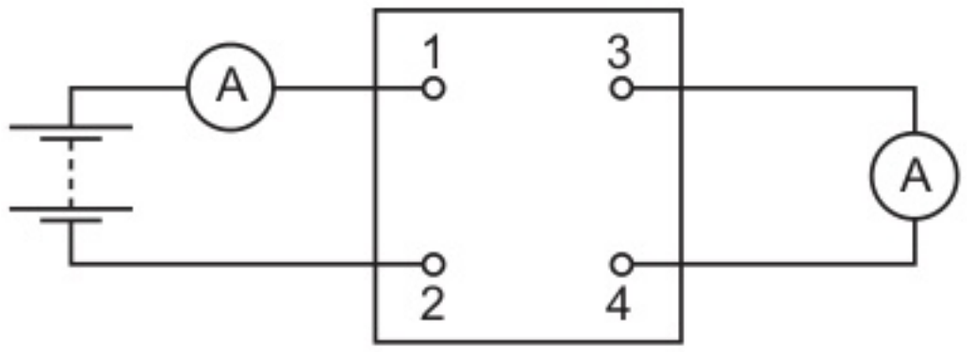
3 It is the energy per unit charge to move charge right round a circuit.

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

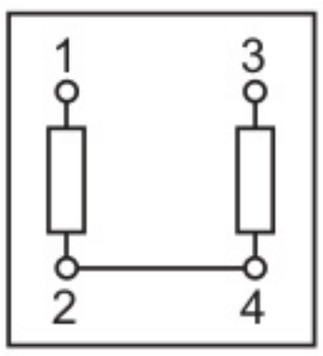
35 The diagram shows a four-terminal box connected to a battery and two ammeters. 9702/12/O/N/12



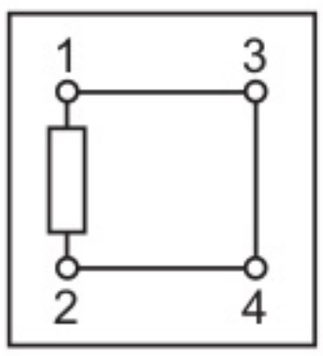
The currents in the two meters are identical.

Which circuit, within the box, will give this result?

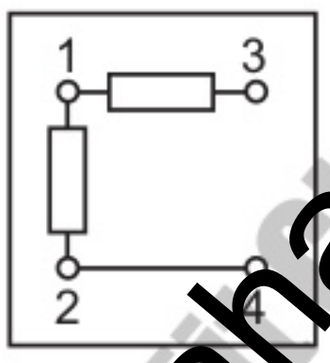
A



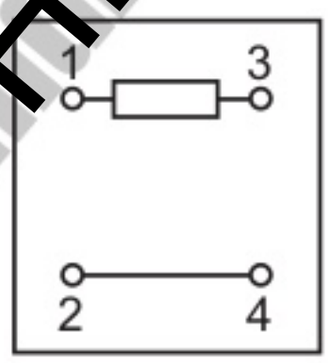
B



C



D



37 The diagram shows a resistor network. The potential difference across the network is V.

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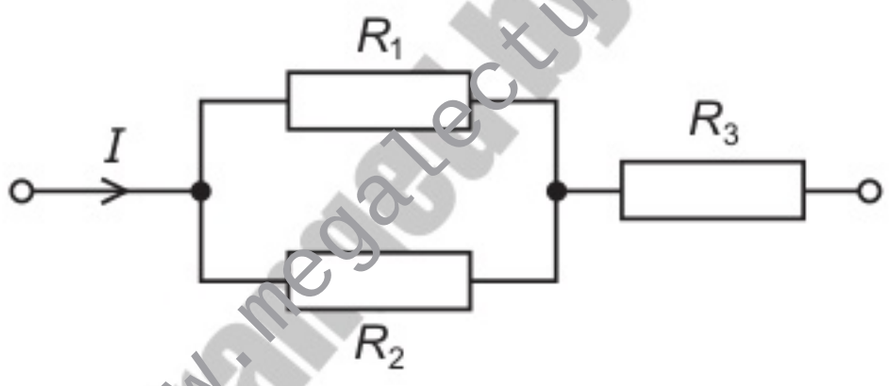

Is the equation shown below correct for the network?

$$V = I(1/R_1 + 1/R_2 + R_3)$$

A Yes, it correctly combines two series resistors with one parallel resistor, and correctly uses Ohm's Law.

B Yes, it correctly combines two parallel resistors with one series resistor, and correctly uses Ohm's Law.

C No, because it should read $V = I \div (1/R_1 + 1/R_2 + R_3)$.

D No, because the terms $1/R_2$ and R_3 have different units and cannot be added.

36 In the circuit below, P is a potentiometer of total resistance 10Ω and Q is a fixed resistor of resistance 10Ω. The battery has an e.m.f. of 4.0 V and negligible internal resistance. The voltmeter has a very high resistance.

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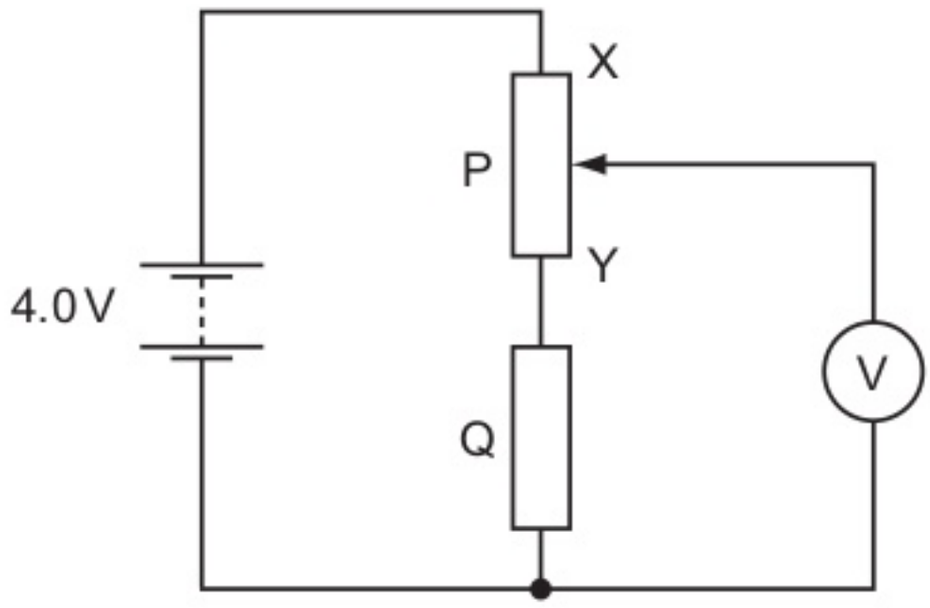
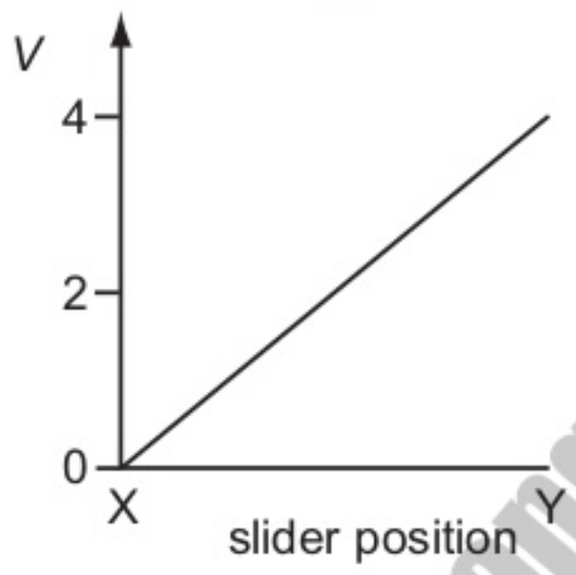


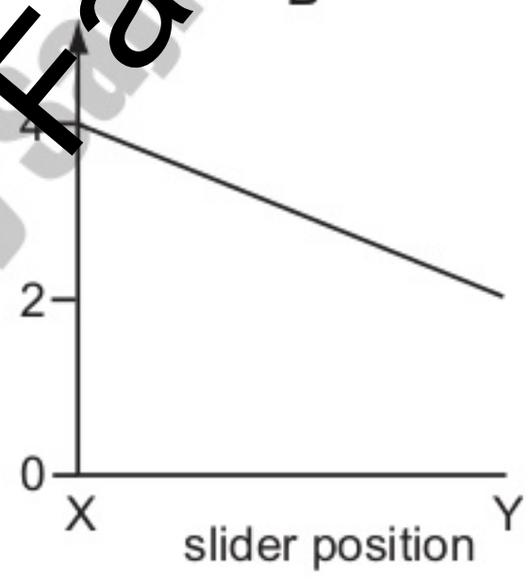
The slider on the potentiometer is moved from X to Y and a graph of voltmeter reading *V* is plotted against slider position.

Which graph is obtained?

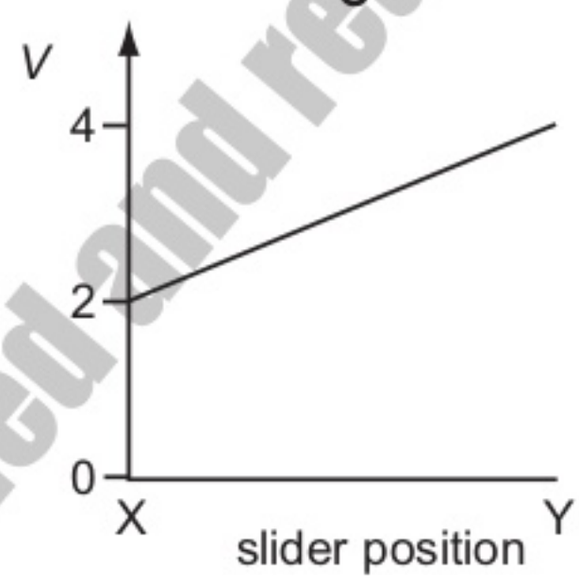
A



B



C



D