1 The diagrams show connected wires which carry currents I_1, I_2, I_3 and I_4.
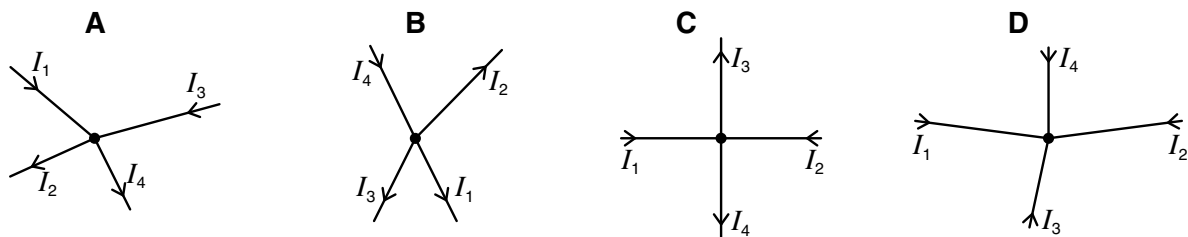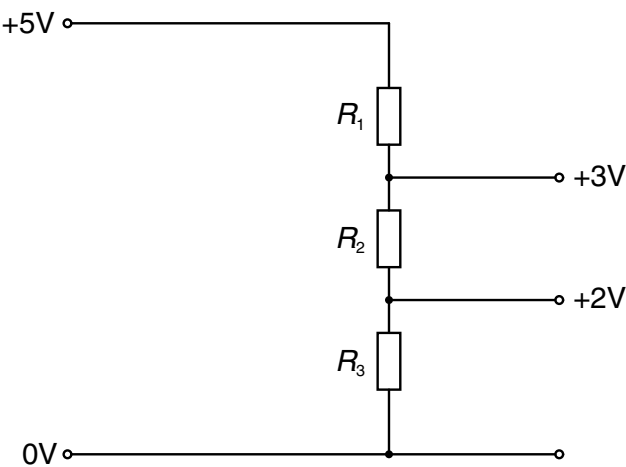
The currents are related by the equation $I_1 + I_2 = I_3 + I_4$.

To which diagram does this equation apply?

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

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

	$R_1/\text{k}\Omega$	$R_2/\text{k}\Omega$	$R_3/\text{k}\Omega$
A	2	1	5
B	3	2	2
C	4	2	4
D	4	6	10

3 When four identical lamps P, Q, R and S are connected as shown in diagram 1, they have normal brightness.
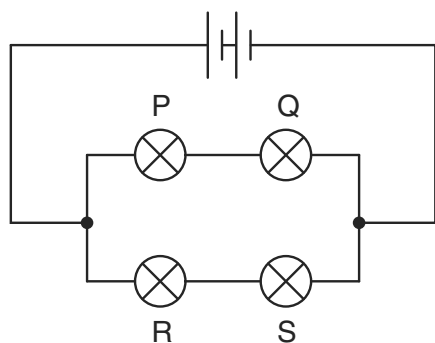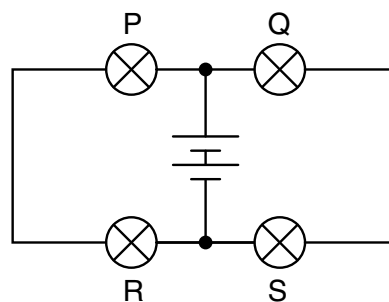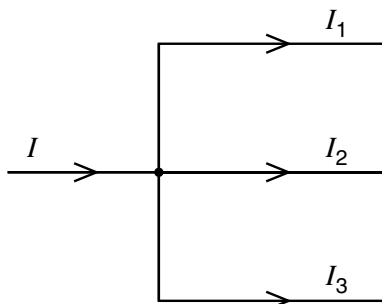
diagram 1   diagram 2

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

A   The lamps do not light.

B   The lamps are less bright than normal.

C   The lamps have normal brightness.

D   The lamps are brighter than normal.

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

These currents are related by the equation

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

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

A   Kirchhoff's first law based on conservation of charge

B   Kirchhoff's first law based on conservation of energy

C   Kirchhoff's second law based on conservation of charge

D   Kirchhoff's second law based on conservation of energy

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

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

Which statement is used in the derivation of this formula?

**A** The currents through the two resistors are equal.

B The potential difference across each resistor is the same.

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

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

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

Which of the following is correct?

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

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

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

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

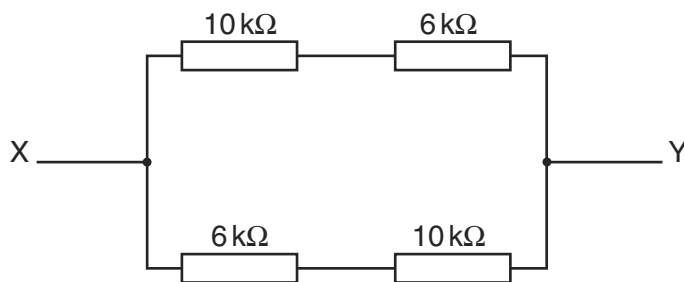**7** Six resistors, each of resistance 5 Ω, are connected to a 2 V cell of negligible internal resistance.
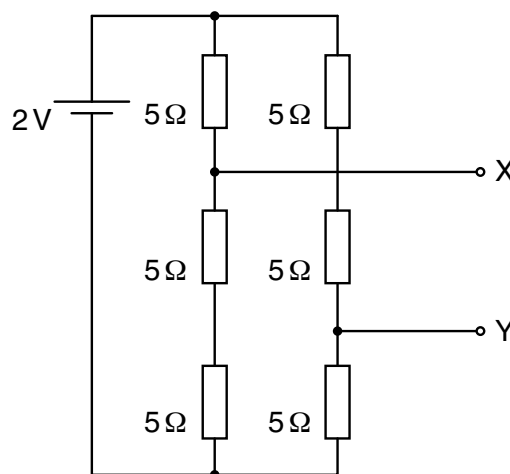
What is the potential difference between terminals X and Y?

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

8 The diagram shows an arrangement of four resistors.

What is the resistance between X and Y?

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

9 The diagram shows a potential divider connected to a 9.0 V supply of negligible internal resistance.
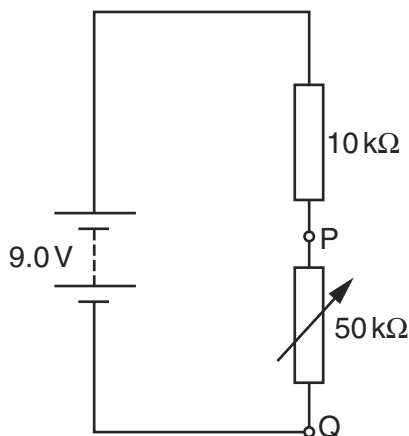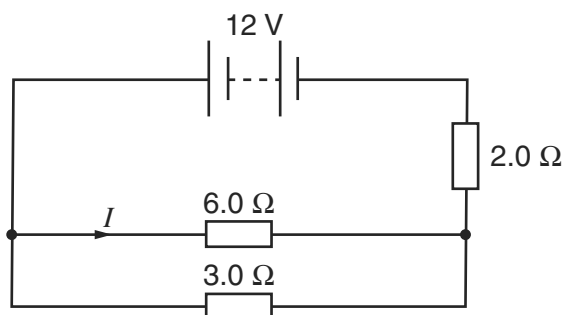
What range of voltages can be obtained between P and Q?

A   zero to 1.5 V

B   zero to 7.5 V

C   1.5 V to 7.5 V

D   1.5 V to 9.0 V

10 The diagram shows a circuit in which the battery has negligible internal resistance.
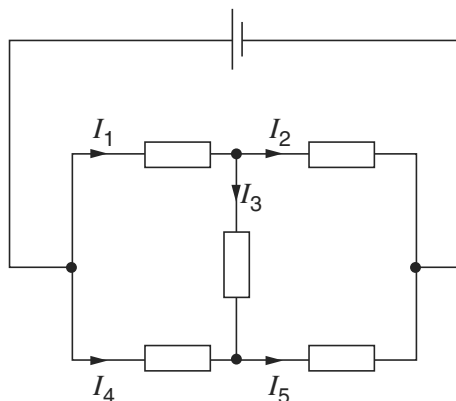
What is the value of the current I?

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

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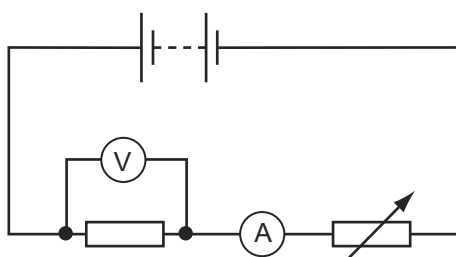

Which one of the following is correct?

A $I_1 = I_2 + I_3$

B $I_2 = I_1 + I_3$

C $I_3 = I_4 + I_5$

D $I_4 = I_5 + I_3$

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

A voltmeter is connected across the fixed resistor.

The value of the variable resistor is reduced.

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

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

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

On which conservation laws do Kirchhoff's laws depend?

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

14 The diagram shows a parallel combination of three resistors. The total resistance of the combination is $3\,\Omega$.
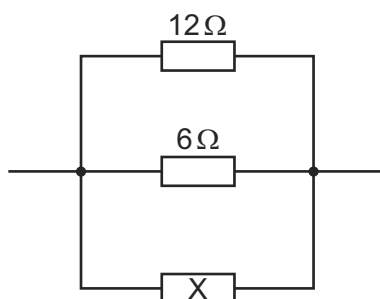
What is the resistance of resistor X?

A $2\,\Omega$ **B** $3\,\Omega$ **C** $6\,\Omega$ **D** $12\,\Omega$

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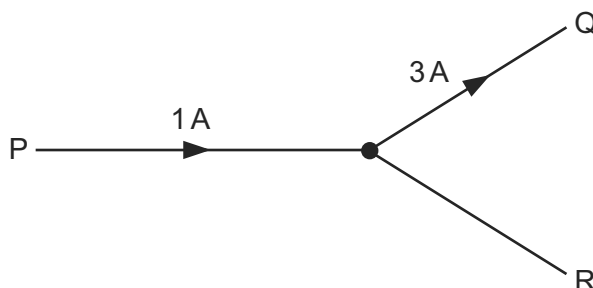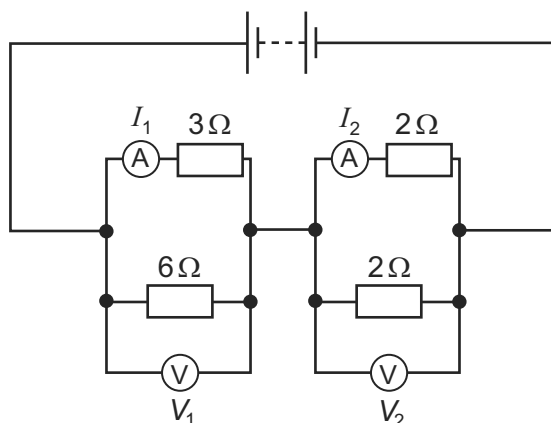

How many coulombs of charge pass a given point in wire R in 5 seconds?

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

16 In the circuit shown, the ammeters have negligible resistance and the voltmeters have infinite resistance.
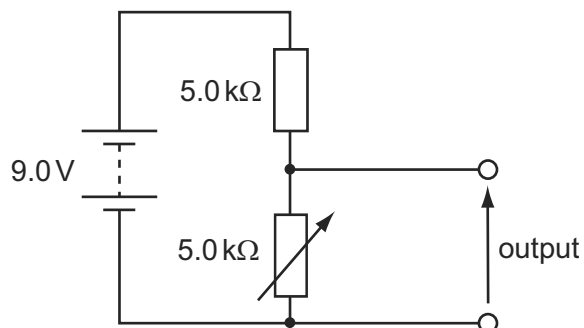
The readings on the meters are I_1, I_2, V_1 and V_2, as labelled on the diagram.
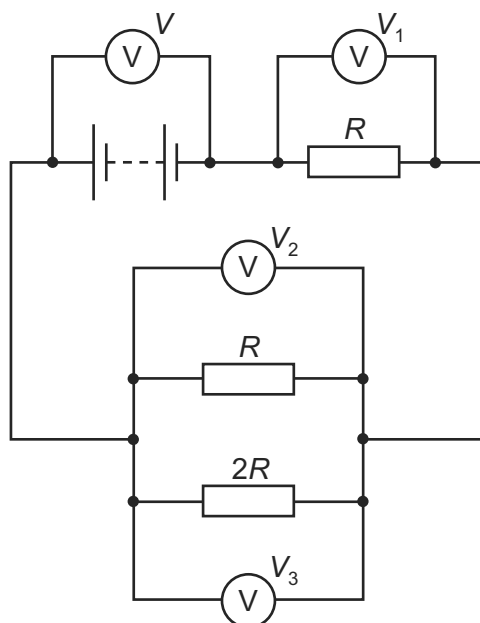
Which is correct?

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

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

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

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

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

Which gives the available range of output p.d?

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

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

Which equation relating the voltmeter readings must be true?

A $V = V_1 + V_2 + V_3$

B $V + V_1 = V_2 + V_3$

C $V_3 = 2(V_2)$

D $V - V_1 = V_3$

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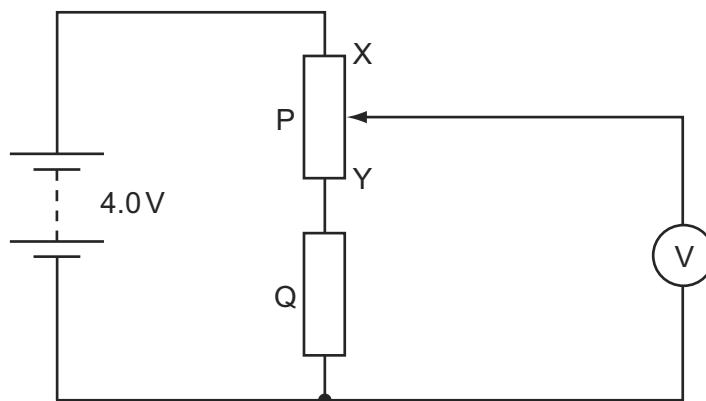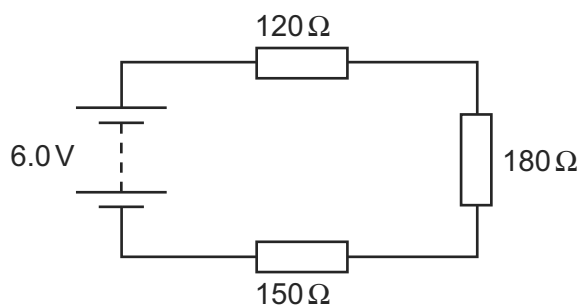
Which graph is obtained?

A

B

C

D
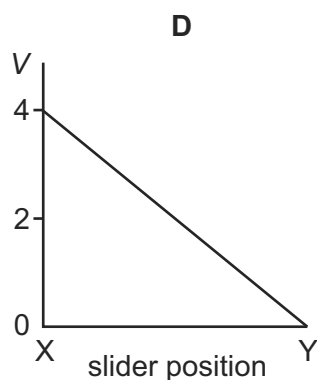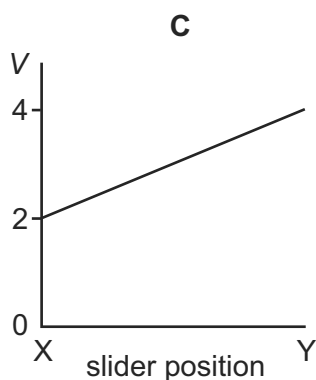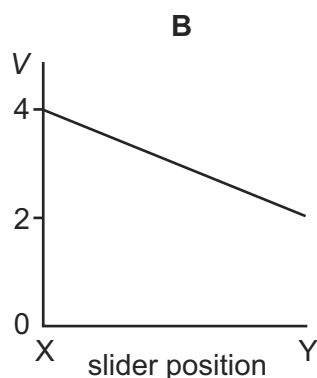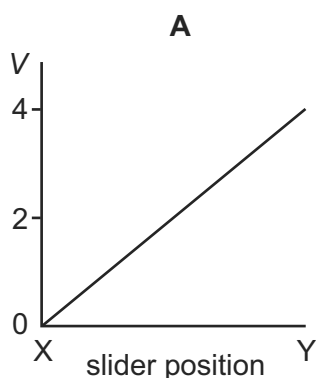
20 Three resistors are connected in series with a battery as shown in the diagram. The battery has negligible internal resistance.
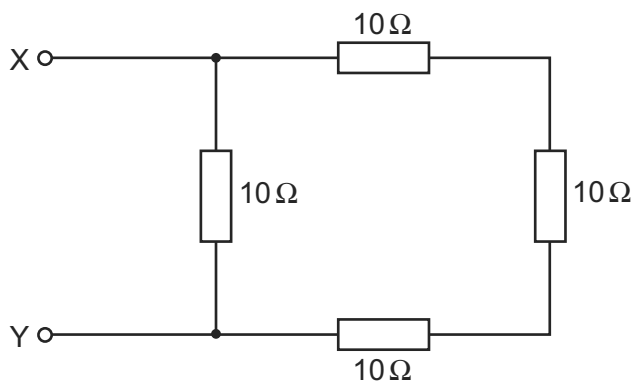
What is the potential difference across the 180 Ω resistor?

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

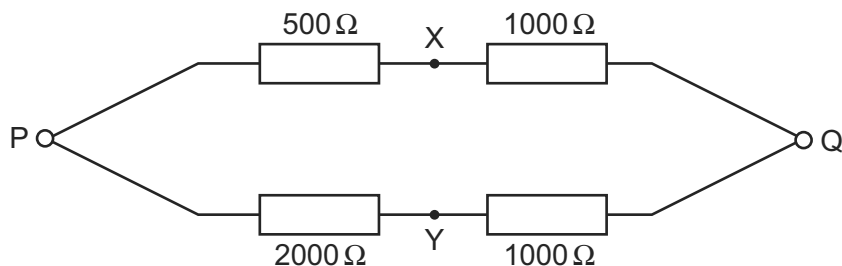**21** The diagram shows an arrangement of resistors.

What is the total electrical resistance between X and Y?

A less than $1\,\Omega$

B between $1\,\Omega$ and $10\,\Omega$

C between $10\,\Omega$ and $30\,\Omega$

D $40\,\Omega$

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

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

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

23 A battery of electromotive force (e.m.f.) 6.0 V and negligible internal resistance is connected in series with a resistor of resistance $6.0\,\Omega$ and a variable resistor of resistance from zero to $4.0\,\Omega$. A voltmeter is connected across the variable resistor. The resistance of the variable resistor is changed.
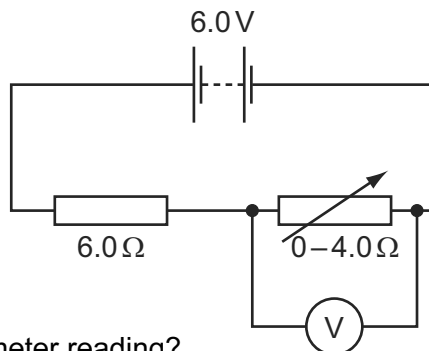
What is the range of the voltmeter reading?

A 0 V – 2.4 V

B 0 V – 3.6 V

C 2.4 V – 6.0 V

D 3.6 V – 6.0 V

24 The diagram represents a circuit.

Some currents have been shown on the diagram.

What are the currents I_1 and I_2?

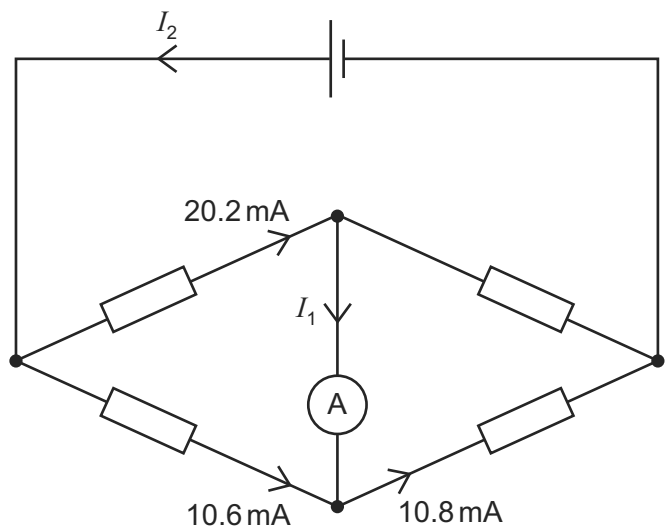|	I_1	I_2
A	0.2 mA	10.8 mA
B	0.2 mA	30.8 mA
C	−0.2 mA	20.0 mA
D	−0.2 mA	30.8 mA

25 The diagram shows a potentiometer and a fixed resistor connected across a 12 V battery of negligible internal resistance.
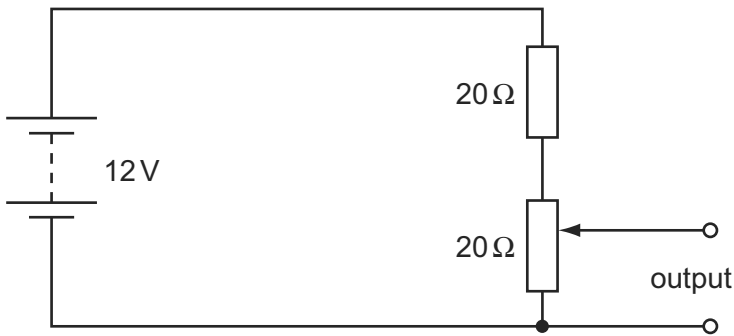
The fixed resistor and the potentiometer each have resistance 20 Ω. The circuit is designed to provide a variable output voltage.

What is the range of output voltages?

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

26 Which circuit has a resistance of $40\,\Omega$ between the terminals?

A

B

C

D
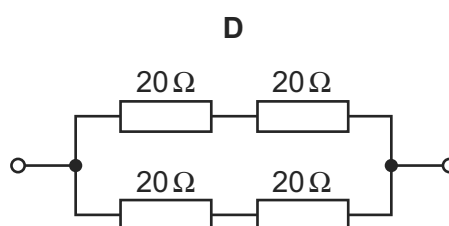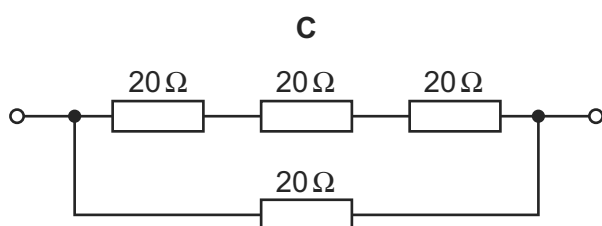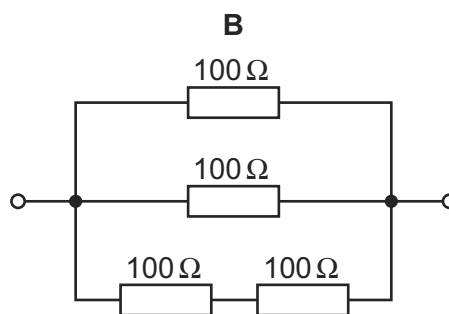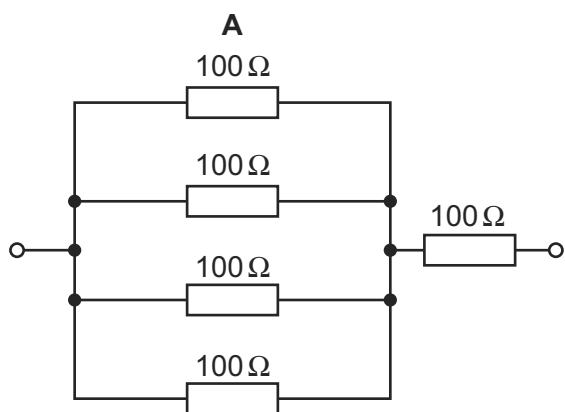
27 A cell of e.m.f. 2.0 V and negligible internal resistance is connected to the network of resistors shown.
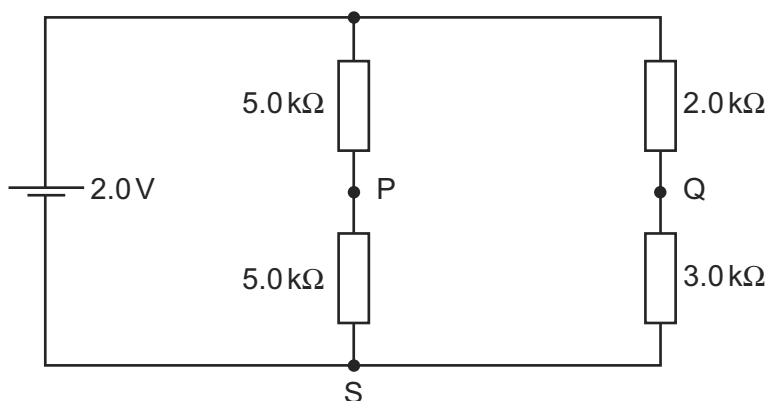
V_1 is the potential difference between S and P. V_2 is the potential difference between S and Q.

What is the value of $V_1 - V_2$?

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

28 A potential divider consists of resistors of resistance R_1 and R_2 connected in series across a source of potential difference V_0. The potential difference across R_1 is V_{out}.
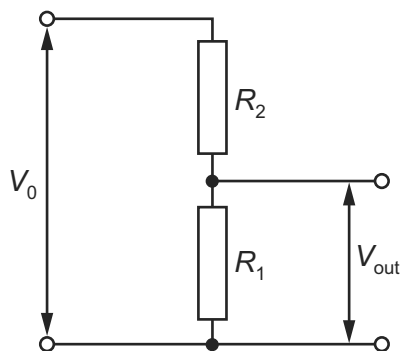
Which changes to R_1 and R_2 will increase the value of V_{out}?

	R_1	R_2
A	doubled	doubled
B	doubled	halved
C	halved	doubled
D	halved	halved

29 A battery of negligible internal resistance is connected to two $10\,\Omega$ resistors in series.

6.0 V

$10\,\Omega$ $10\,\Omega$
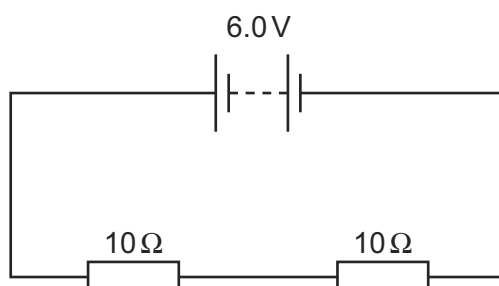
What charge flows through each of the $10\,\Omega$ resistors in 1 minute?

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

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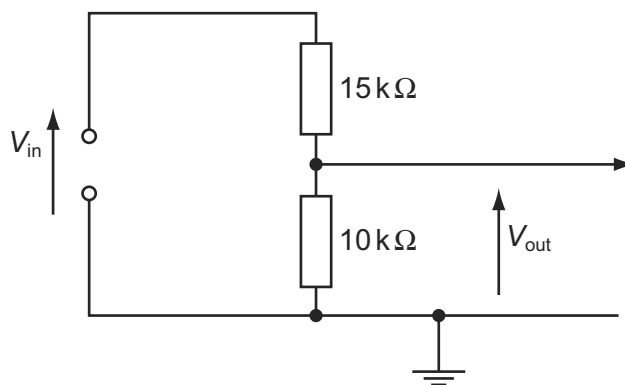
V_{out} is equal to 4.8 V.

What is the input voltage V_{in}?

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

31 When four identical resistors are connected as shown in diagram 1, the ammeter reads 1.0 A and the voltmeter reads zero.
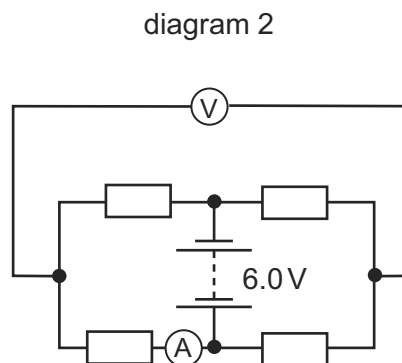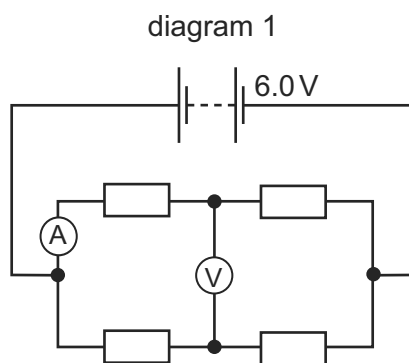
diagram 1 diagram 2

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

What are the meter readings in diagram 2?

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

32 In the circuit shown, the 6.0 V battery has negligible internal resistance. Resistors R_1 and R_2 and the voltmeter have resistance $100 \, k\Omega$.

6.0 V

R_1

R_2

$100 \, k\Omega$

$100 \, k\Omega$

V

$100 \, k\Omega$
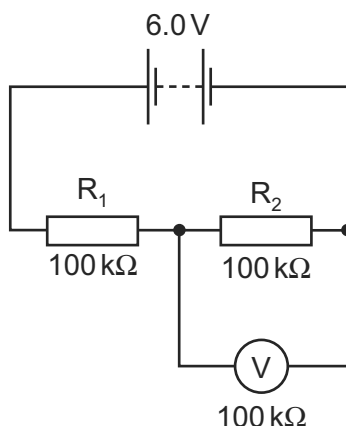
What is the current in the resistor R_2?

A $20 \, \mu A$ **B** $30 \, \mu A$ **C** $40 \, \mu A$ **D** $60 \, \mu A$

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

12 V

A

$10 \, \Omega$

$10 \, \Omega$

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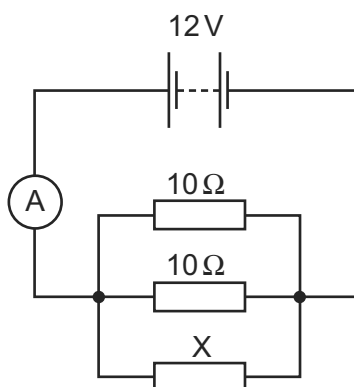
The battery has e.m.f. 12 V and negligible internal resistance. The ammeter reading is 3.2 A.

What is the resistance of X?

A $2.1 \, \Omega$ **B** $4.6 \, \Omega$ **C** $6.0 \, \Omega$ **D** $15 \, \Omega$

34 Two cells of e.m.f. 3.0 V and 1.2 V and negligible internal resistance are connected to resistors of resistance $9.0 \, \Omega$ and $18 \, \Omega$ as shown.

3.0 V   1.2 V

I $9.0 \, \Omega$

$18 \, \Omega$
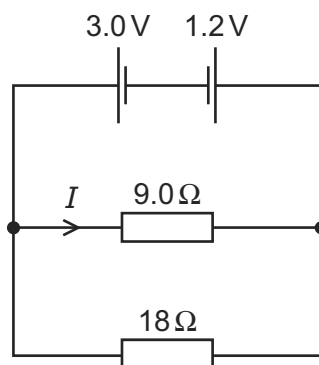
What is the value of the current I in the $9.0 \, \Omega$ resistor?

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

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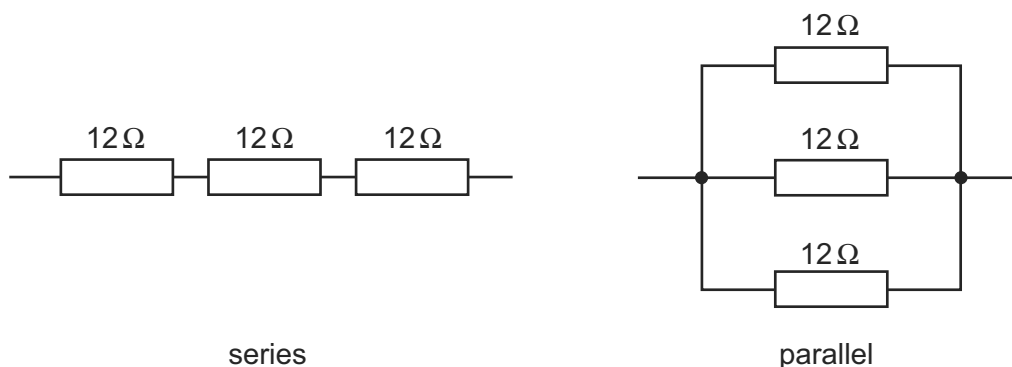
series   parallel

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

36 Each of Kirchhoff's two laws presumes that some quantity is conserved.

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

37 A network of resistors consists of two $3.0\,\Omega$ resistors and three $6.0\,\Omega$ resistors.
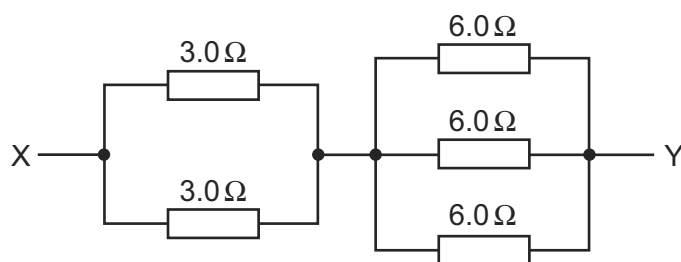
What is the combined resistance of this network between points X and Y?

A $0.86\,\Omega$ **B** $1.2\,\Omega$ **C** $3.5\,\Omega$ **D** $24\,\Omega$

38 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.
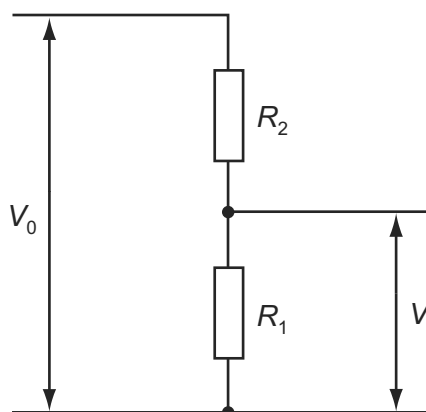
What is the value of V?

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

39 A potential divider circuit consists of fixed resistors of resistance $2.0\,\Omega$ and $4.0\,\Omega$ connected in series with a $3.0\,\Omega$ resistor fitted with a sliding contact. These are connected across a battery of e.m.f. $9.0\,V$ and zero internal resistance, as shown.

$4.0\,\Omega$

$9.0\,V$ $3.0\,\Omega$

output
voltage

$2.0\,\Omega$

What are the maximum and the minimum output voltages of this potential divider circuit?

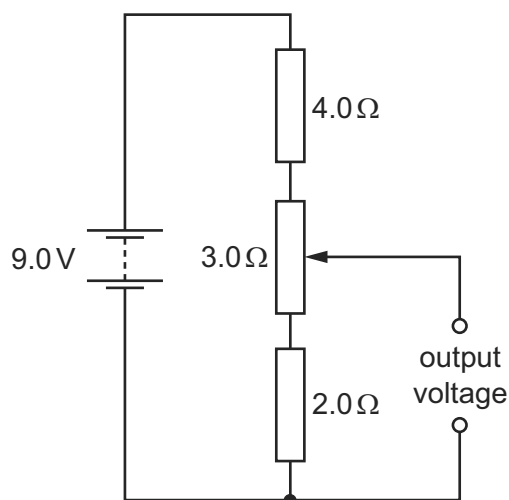|	maximum voltage / V	minimum voltage / V
A	4.0	2.0
B	5.0	2.0
C	9.0	0
D	9.0	2.0

40 A cell of e.m.f. $2.0\,V$ and negligible internal resistance is connected to a network of resistors as shown.

$2.0\,V$

$2.0\,\Omega$

$4.0\,\Omega$

$2.0\,\Omega$

I $4.0\,\Omega$
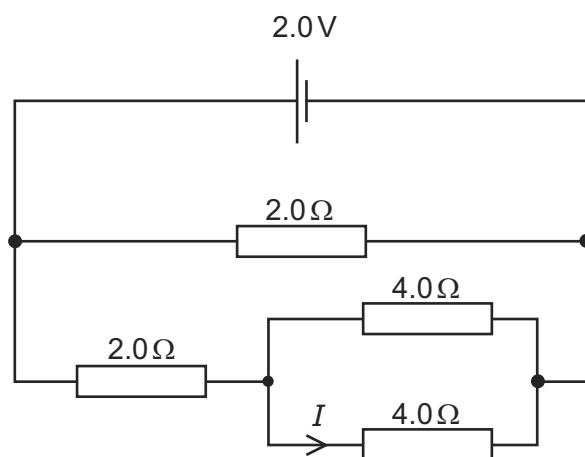
What is the current I?

A   0.25 A   **B**   0.33 A   **C**   0.50 A   **D**   1.5 A

41 The resistors P, Q and R in the circuit have equal resistance.

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

42 In deriving a formula for the combined resistance of three different resistors in series, Kirchhoff's laws are used.
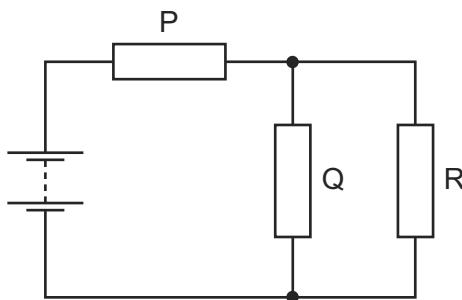
Which physics principle is involved in this derivation?

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

43 In each arrangement of resistors, the ammeter has a resistance of 2 Ω.

Which arrangement gives the largest reading on the ammeter when the same potential difference is applied between points P and Q?
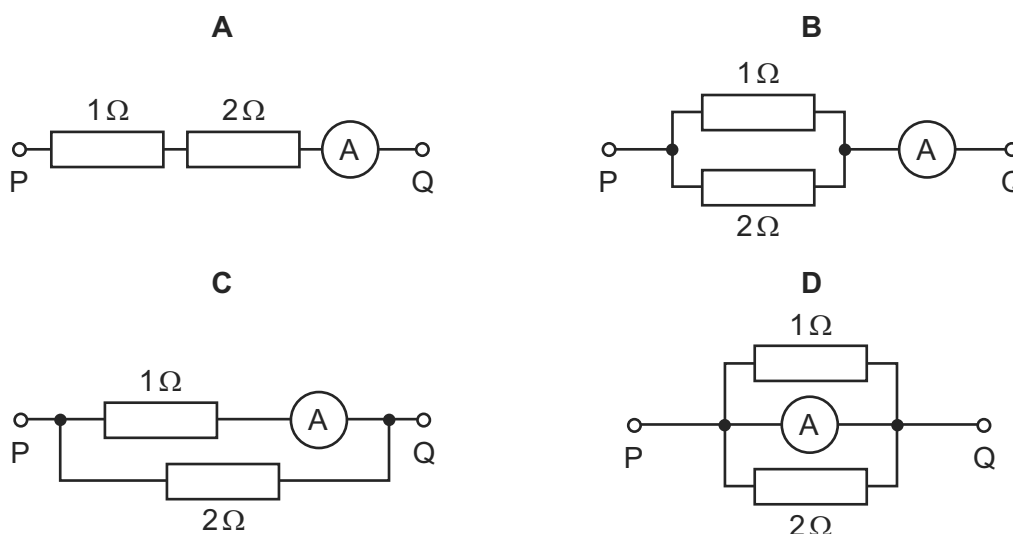
44 The diagrams show two different circuits.

The cells in each circuit have the same electromotive force and zero internal resistance. The three resistors each have the same resistance R.

In the circuit on the left, the power dissipated in the resistor is P.

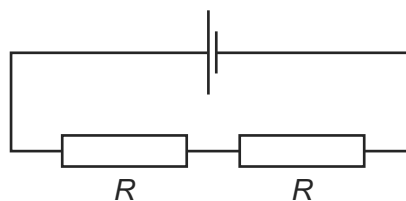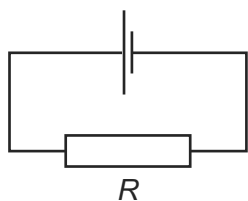What is the total power dissipated in the circuit on the right?

A $\dfrac{P}{4}$ **B** $\dfrac{P}{2}$ **C** P **D** $2P$

45 Six resistors, each of resistance R, are connected as shown.
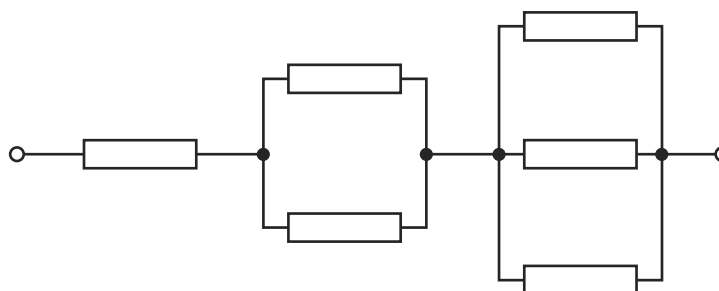
The combined resistance is $66\,k\Omega$.

What is the value of R?

A $11\,k\Omega$ **B** $18\,k\Omega$ **C** $22\,k\Omega$ **D** $36\,k\Omega$

46 The diagram shows part of a circuit.
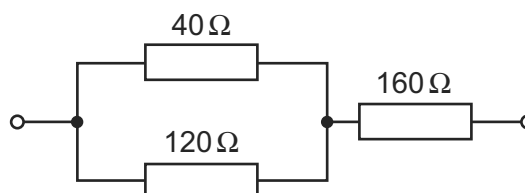
What is the total resistance of the combination of the three resistors?

A $320\,\Omega$ **B** $240\,\Omega$ **C** $190\,\Omega$ **D** $80\,\Omega$

47 The diagram shows part of a circuit.
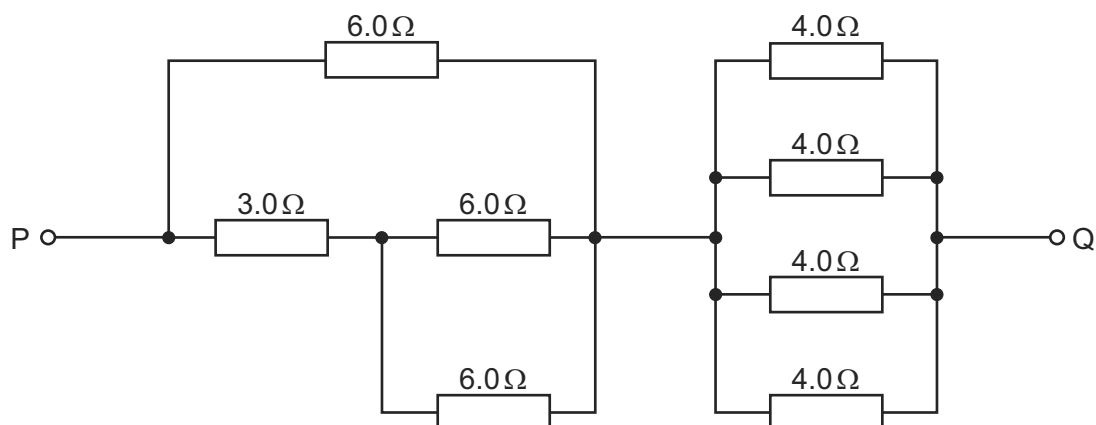
What is the resistance between the points P and Q due to the resistance network?

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

48 What is the total resistance between points P and Q in this network of resistors?   9702/11/M/J/14

A 8 Ω   **B** 16 Ω   **C** 24 Ω   **D** 32 Ω
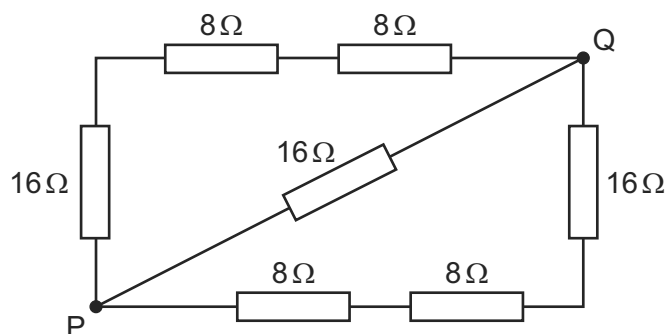
49 A relay is required to operate 800 m from its power supply. The power supply has negligible internal resistance. The relay requires 16.0 V and a current of 0.60 A to operate.   9702/13/O/N/10

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

50 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.

In which circuit will the ammeter show the greatest reading?

51 An extension lead is used to connect a 240 V electrical supply to a heater as shown.

extension lead

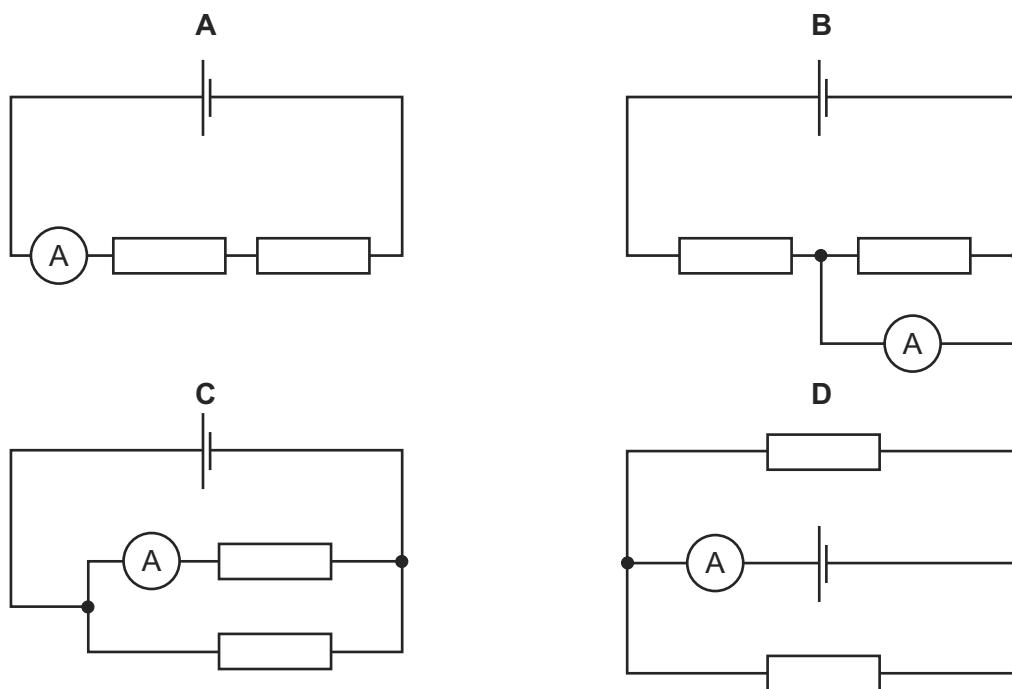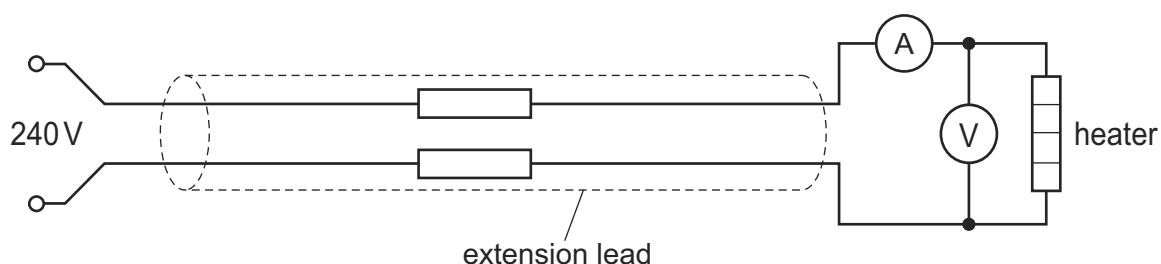A voltmeter measures the potential difference (p.d.) across the heater as 216 V and an ammeter measures the current through the heater as 7.7 A.

What is the total resistance of the extension lead?

A $3.1\,\Omega$ **B** $6.2\,\Omega$ **C** $28\,\Omega$ **D** $31\,\Omega$

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

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

53 What is the current in the 40 Ω resistor of the circuit shown?
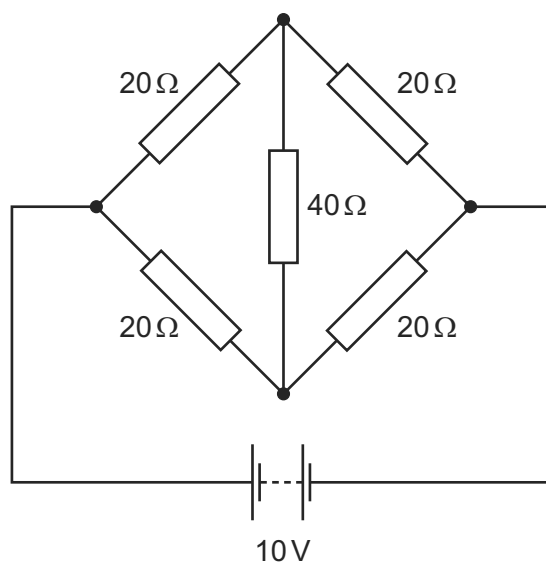
A zero   **B** 0.13 A   **C** 0.25 A   **D** 0.50 A

54 A 2 Ω resistor and a 4 Ω resistor are connected to a cell.
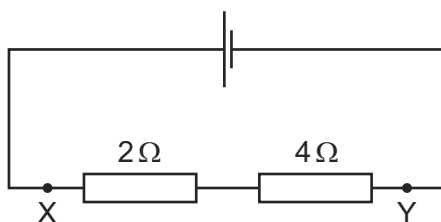
Which graph shows how the potential *V* varies with distance between X and Y?

A

B

C

D
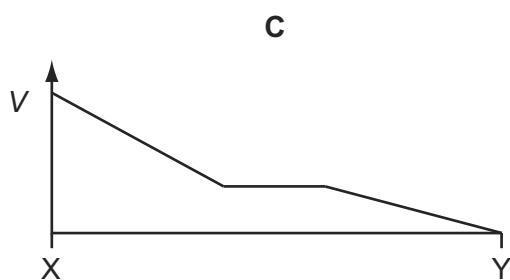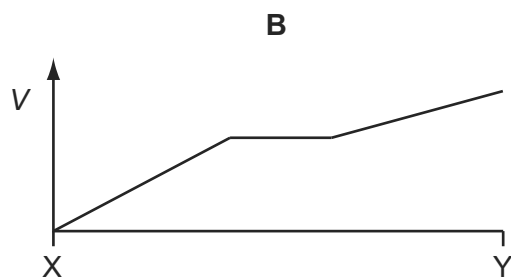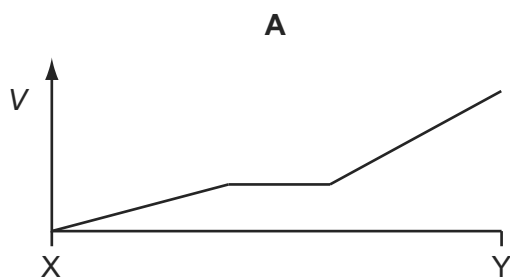
55 The diagram shows part of a current-carrying circuit. The ammeter has negligible internal resistance.
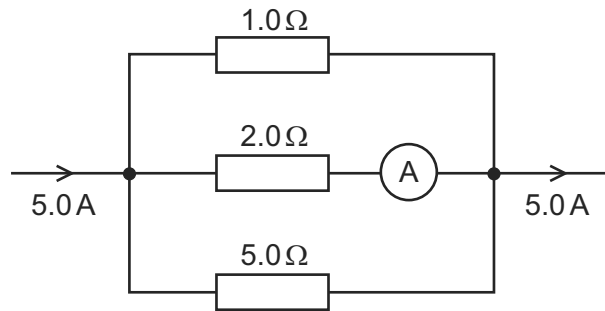
What is the reading on the ammeter?

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

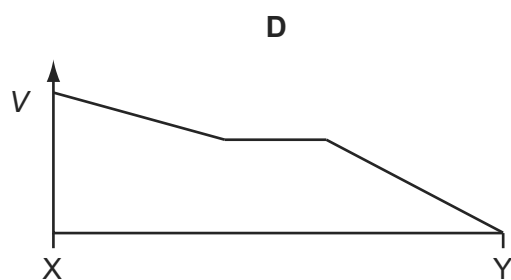**56** Four resistors of equal value are connected as shown.
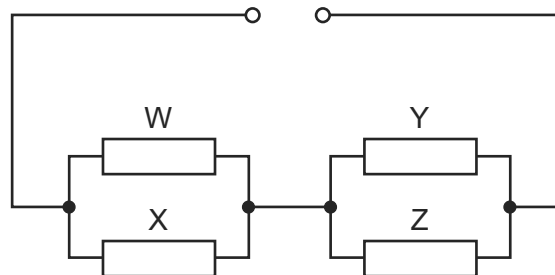
How will the powers to the resistors change when resistor W is removed?

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.

57 A wire RST is connected to another wire XY as shown.
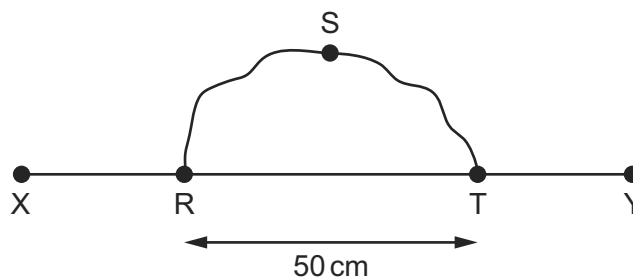
Each wire is 100 cm long with a resistance per unit length of $10\,\Omega\,m^{-1}$.

What is the total resistance between X and Y?

A $3.3\,\Omega$ **B** $5.0\,\Omega$ **C** $8.3\,\Omega$ **D** $13.3\,\Omega$

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

In the diagram, switches P, Q, R, S and T control the current through a green lamp.
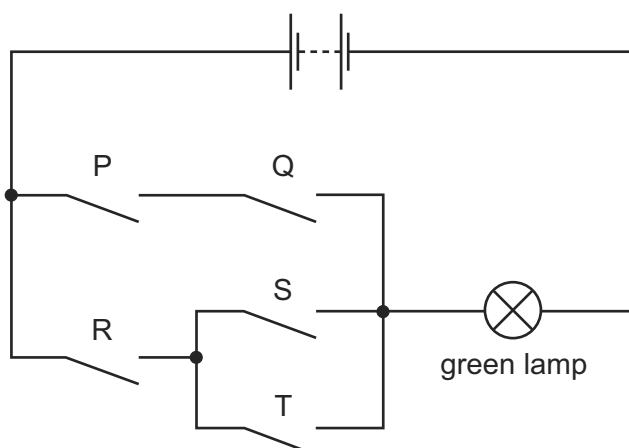
Which row does **not** allow the green lamp to light?

	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

59 A box with four terminals P, Q, R and S contains two identical resistors.
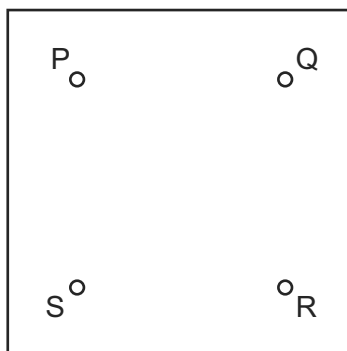
When a battery of electromotive force (e.m.f.) E and negligible internal resistance is connected across PS, a high-resistance voltmeter connected across QR reads $\dfrac{E}{2}$.

Which diagram shows the correct arrangement of the two resistors inside the box?

A

B

C

D

60 The diagram shows a d.c. circuit.
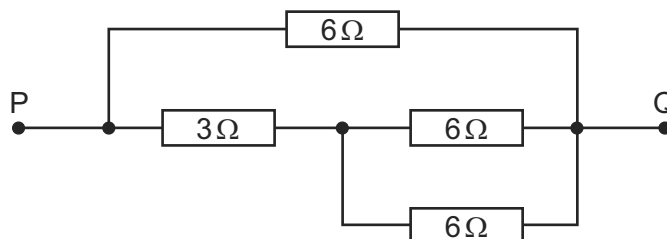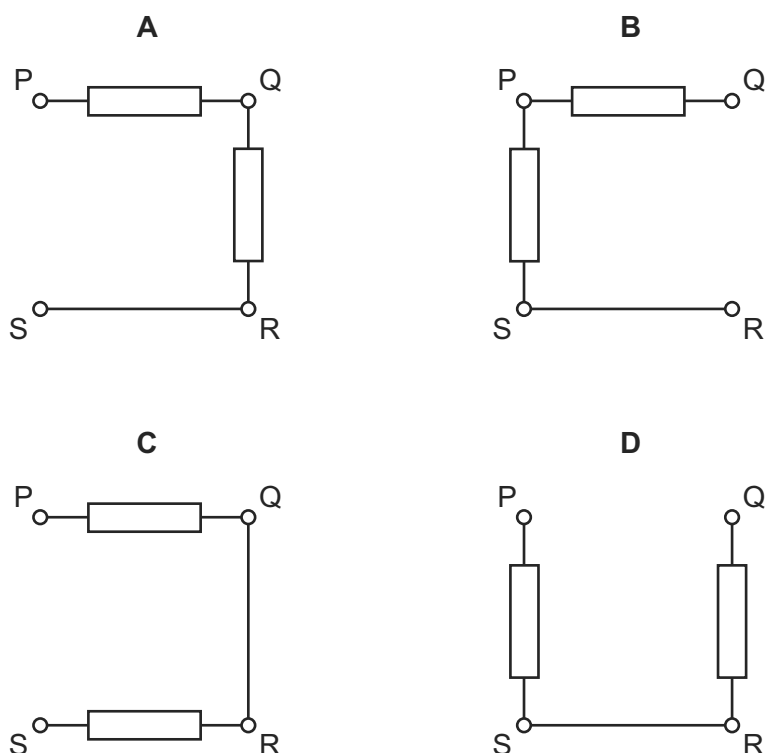
What is the resistance between the points P and Q due to the resistance network?

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

61 In the circuit shown, all the resistors are identical and all the ammeters have negligible resistance.
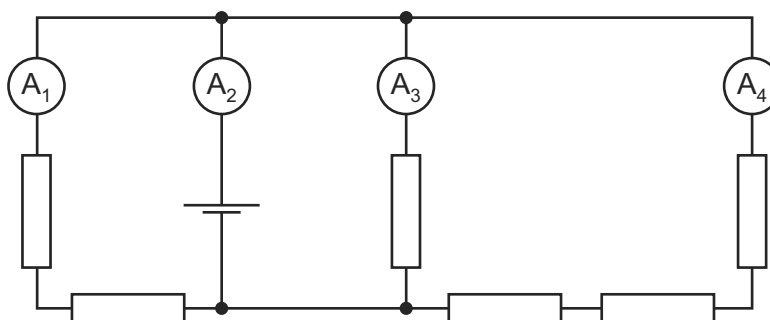
The reading on ammeter A_1 is 0.6 A.

What are the readings on the other ammeters?

	reading on ammeter A_2/A	reading on ammeter A_3/A	reading on ammeter A_4/A
A	1.0	0.3	0.1
B	1.4	0.6	0.2
C	1.8	0.9	0.3
D	2.2	1.2	0.4

62 The diagrams show the same cell, ammeter, potentiometer and fixed resistor connected in different ways.

W

X

Y

Z
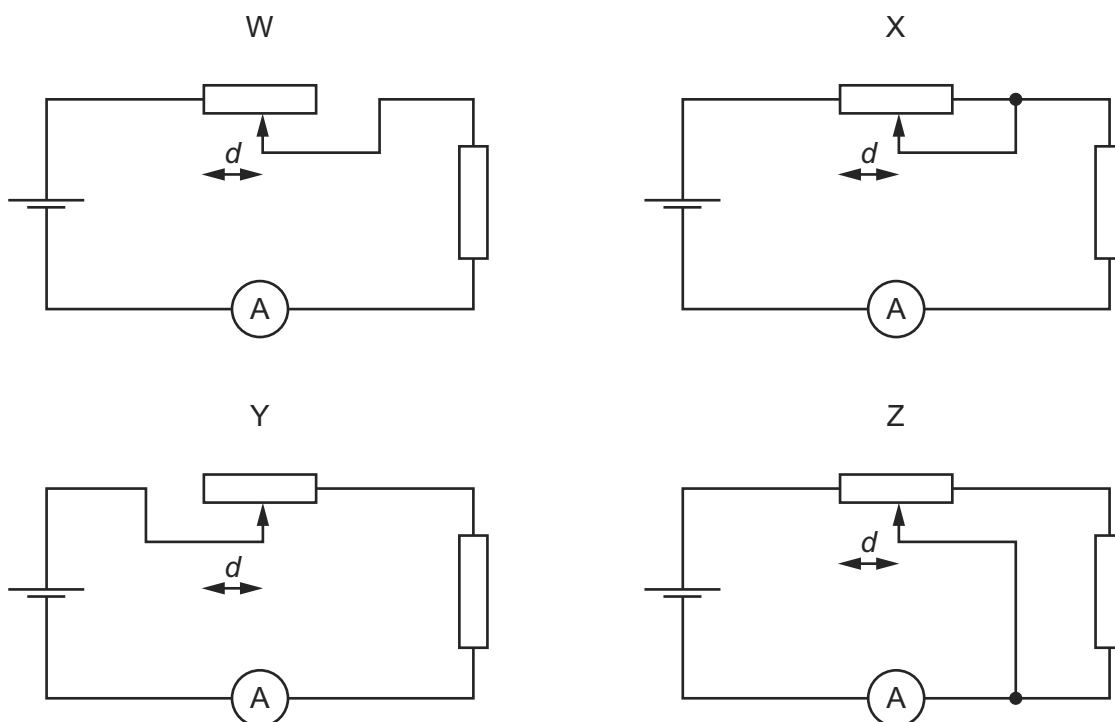
The distance d between the sliding contact and a particular end of the potentiometer is varied. The current measured is then plotted against the distance d.

For which two circuits will the graphs be identical?

A W and X **B** W and Y **C** X and Y **D** Y and Z

63 A battery of negligible internal resistance is connected to a resistor network, an ammeter and a switch S, as shown.
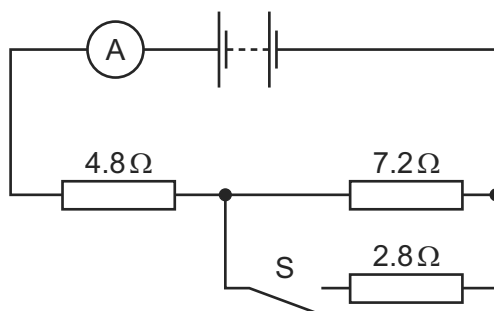
When S is open, the reading on the ammeter is 250 mA.

When S is closed, what is the **change** in the reading on the ammeter?

A 1.07 A   **B** 1.32 A   **C** 190 mA   **D** 440 mA

64 Three resistors of resistance R, $2R$ and $3R$ are connected in parallel.
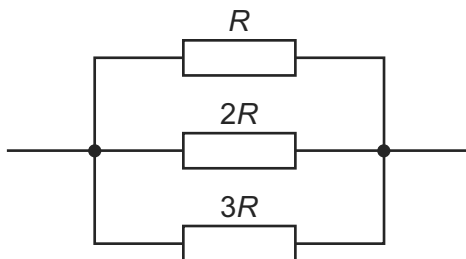
Using I to represent the current through the resistor of resistance R, which row represents the relationships between the currents through the resistors?

	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	$2I$	$3I$

65 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.
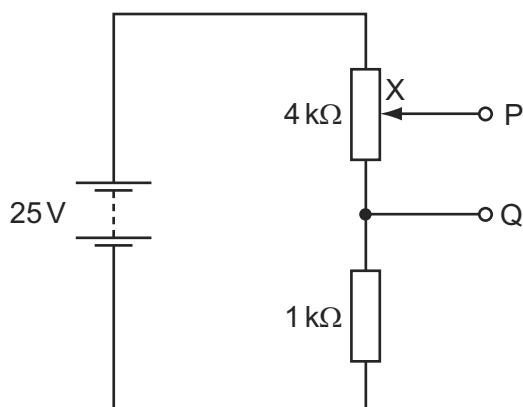
What are the limits of this potential difference?

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

66 Each of Kirchhoff's laws is linked to the conservation of a physical quantity.

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

67 A constant 60 V d.c. supply is connected across two resistors of resistance 400 kΩ and 200 kΩ.
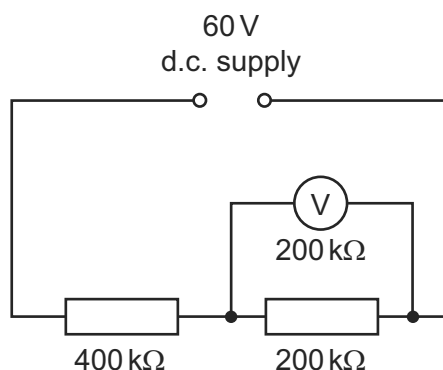
What is the reading on a voltmeter, also of resistance 200 kΩ, when connected across the 200 kΩ resistor as shown in the diagram?

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

68 The circuit below has a current I in the resistor R.
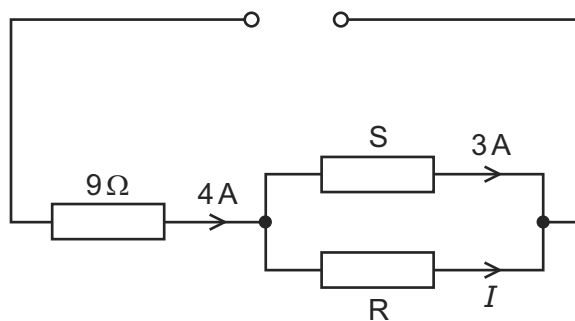
What must be known in order to determine the value of I?

A e.m.f. of the power supply

B resistance of resistor S

C Kirchhoff's first law

D Kirchhoff's second law

69 In the circuit shown, all the resistors are identical.
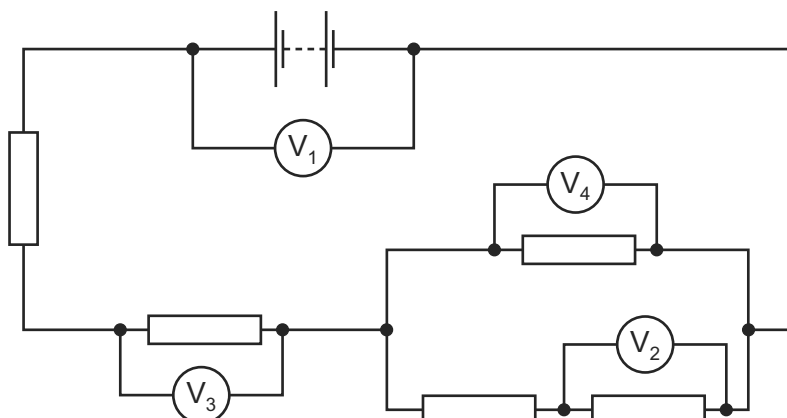
The reading on voltmeter V_1 is 8.0 V and the reading on voltmeter V_2 is 1.0 V.

What are the readings on the other voltmeters?

	reading on voltmeter V_3/V	reading on voltmeter V_4/V
A	1.5	1.0
B	3.0	2.0
C	4.5	3.0
D	6.0	4.0

70 A 12 V battery is in series with an ammeter, a 2 Ω fixed resistor and a 0−10 Ω variable resistor. High-resistance voltmeters P and Q are connected across the variable resistor and the fixed resistor respectively, as shown.
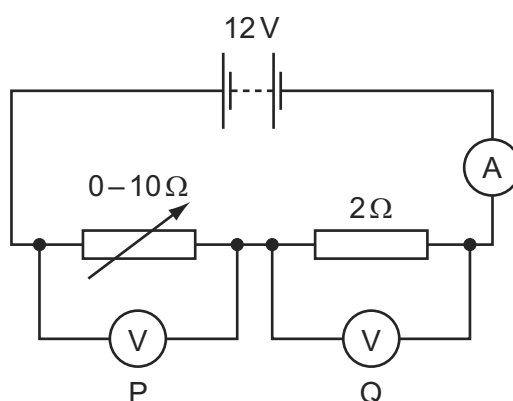
The resistance of the variable resistor is changed from its maximum value to zero.

Which graph shows the variation with current of the voltmeter readings?

71 In the circuit below, the ammeter reading is I and the voltmeter reading is V.
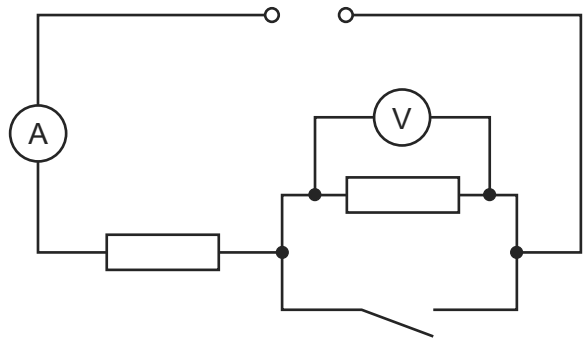
When the switch is closed, which row describes what happens to I and V?

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

72 The diagram shows an incorrectly connected circuit. The ammeter has a resistance of $0.1\,\Omega$ and the voltmeter has a resistance of $1\,M\Omega$.

Which statement is correct?

A The ammeter reads 2 mA.

B The ammeter reads 20 A.

C The voltmeter reads zero.

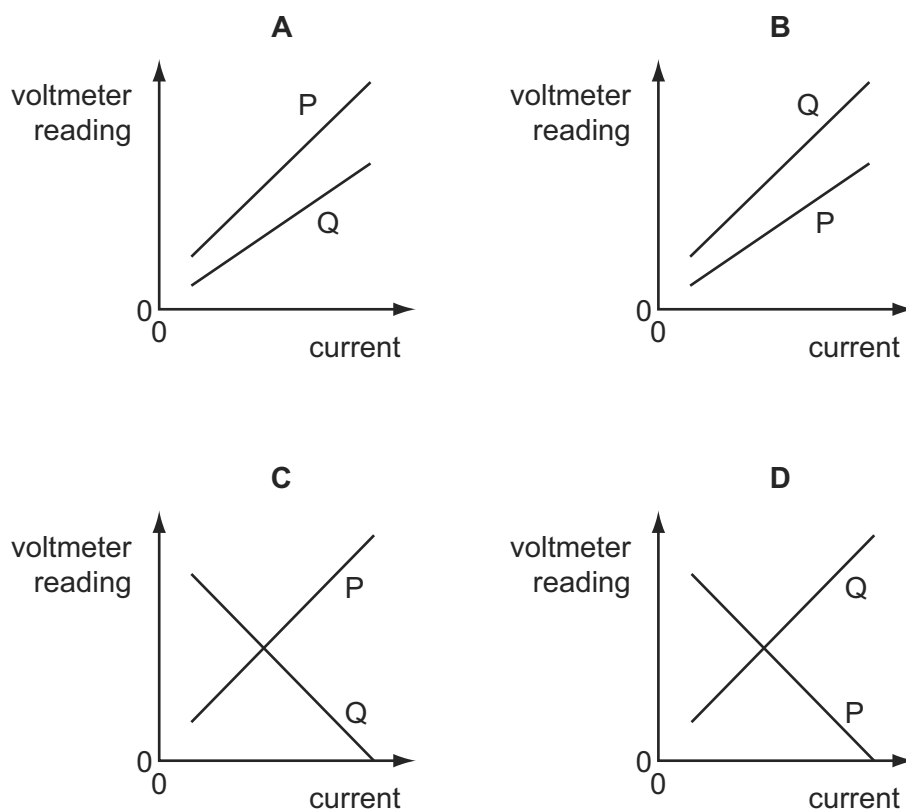**D** The voltmeter reads 2 V.
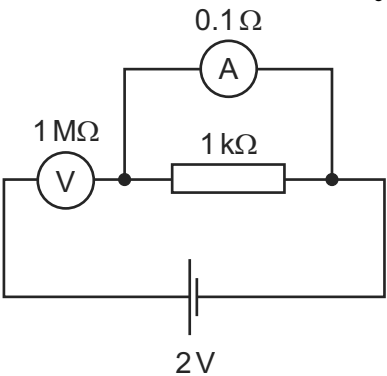
73 Four identical resistors are connected in the three networks below.
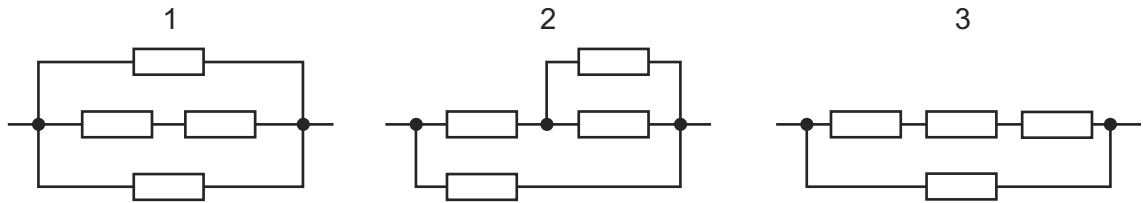
Which arrangement has the highest total resistance and which has the lowest?

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

74 The diagram shows the electric motor for a garden pump connected to a 24 V power supply by an insulated two-core cable.

The motor does not work so, to find the fault, the negative terminal of a voltmeter is connected to the negative terminal of the power supply and its other end is connected in turn to terminals X and Y at the motor.

Which row represents two readings and a correct conclusion?

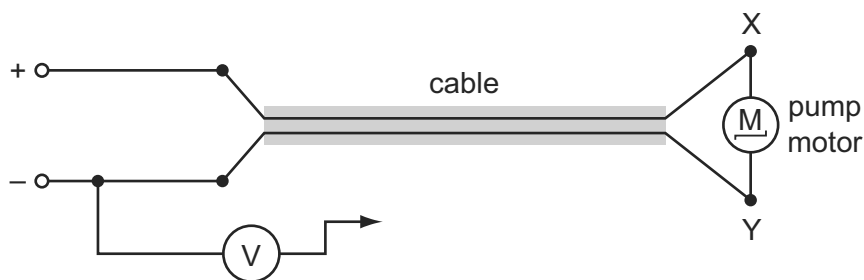|	voltmeter reading when connected to X / V	voltmeter reading when connected to Y / V	conclusion
A	24	0	break in positive wire of cable
B	24	12	break in negative wire of cable
C	24	24	break in connection within the motor
D	24	24	break in negative wire of cable

75 A battery of electromotive force (e.m.f.) V and negligible internal resistance is connected to a 1 kΩ resistor, as shown.
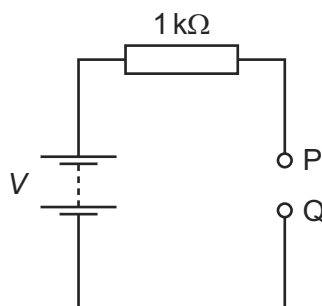
A student attempts to measure the potential difference (p.d.) between points P and Q using two voltmeters, one at a time. The first voltmeter has a resistance of 1 kΩ and the second voltmeter has a resistance of 1 MΩ.

What are the readings of the voltmeters?

	reading on voltmeter with 1 kΩ resistance	reading on voltmeter with 1 MΩ resistance
A	$\dfrac{V}{2}$	$\dfrac{V}{2}$
B	$\dfrac{V}{2}$	V
C	V	$\dfrac{V}{2}$
D	V	V

76 The diagram shows an electric pump for a garden fountain connected by an 18 m cable to a 230 V mains electrical supply.
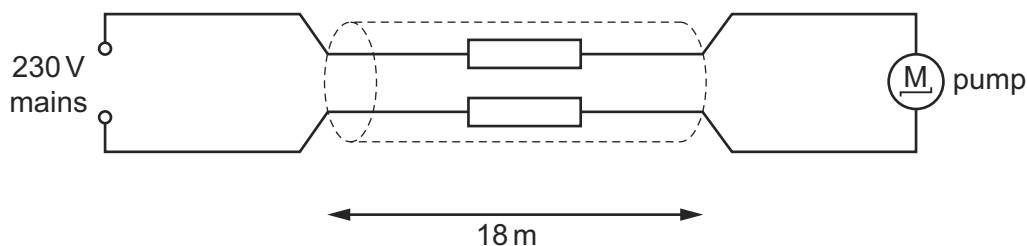
The performance of the pump is acceptable if the potential difference (p.d.) across it is at least 218 V. The current through it is then 0.83 A.

What is the maximum resistance per metre of each of the two wires in the cable if the pump is to perform acceptably?

A $0.40 \, \Omega \, m^{-1}$ **B** $0.80 \, \Omega \, m^{-1}$ **C** $1.3 \, \Omega \, m^{-1}$ **D** $1.4 \, \Omega \, m^{-1}$

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

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 correspond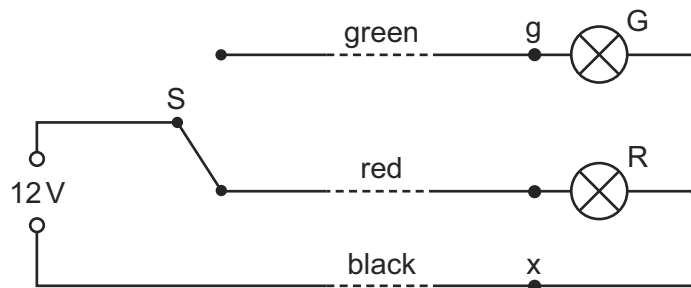ing lamp and the black wire is connected to a terminal x to provide a common return. The arrangement is shown correctly connected and with the switch set to illuminate the red lamp.

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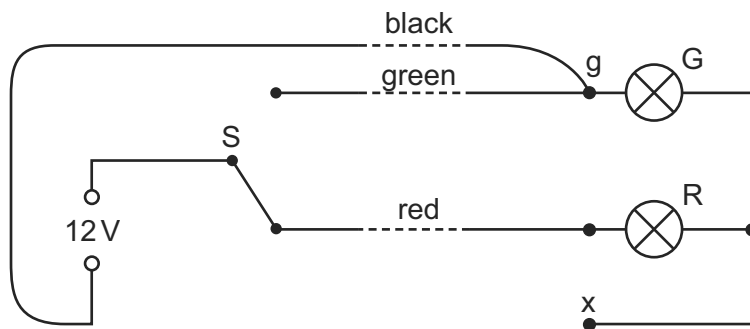
When the system is tested with the switch connection to the red wire, what does the signal show?

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

78 A 20 V d.c. supply is connected to a circuit consisting of five resistors L, M, N, P and Q.

There is a potential drop of 7 V across L and a further 4 V potential drop across N.

What are the potential drops across M, P and Q?
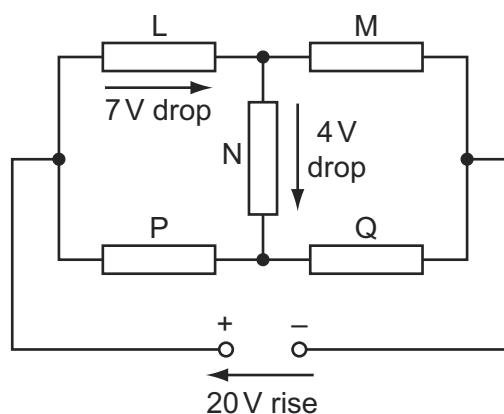
	potential drop across M/V	potential drop across P/V	potential drop across Q/V
A	9	7	13
B	13	7	13
C	13	11	9
D	17	3	17

79 Two lamps are connected in series to a 250 V power supply. One lamp is rated 240 V, 60 W and the other is rated 10 V, 2.5 W.

Which statement most accurately describes what happens?

A Both lamps light at less than their normal brightness.

B Both lamps light normally.

C Only the 60 W lamp lights.

D The 10 V lamp blows.

80 An electrical device of fixed resistance 20 Ω is connected in series with a variable resistor and a battery of electromotive force (e.m.f.) 16 V and negligible internal resistance.
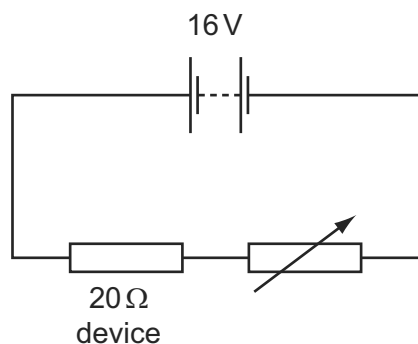
What is the resistance of the variable resistor when the power dissipated in the electrical device is 4.0 W?

A 16 Ω   **B** 36 Ω   **C** 44 Ω   **D** 60 Ω

81 The principles of conservation of which two quantities are associated with Kirchhoff's first and second laws?

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

82 The ammeter reading in the circuit below is I.
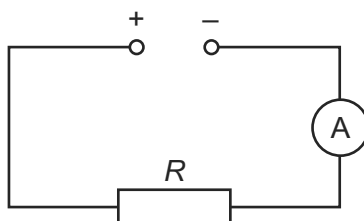
Another circuit containing the same voltage supply, two switches, an ammeter and two resistors each of resistance R, is shown.
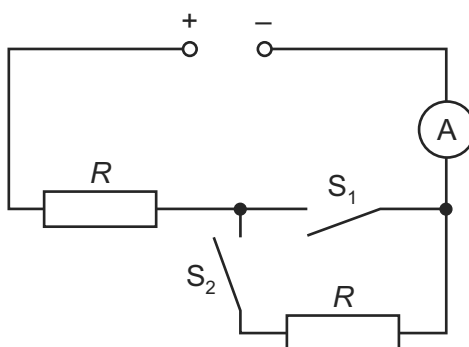
Which row is **not** correct?

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

83 The diagram shows a four-terminal box connected to a battery and two ammeters.

The currents in the two meters are identical. Which circuit, within the box, will give this result?

A   B   C   D

84 The diagram shows a resistor network. The potential difference across the network is V.
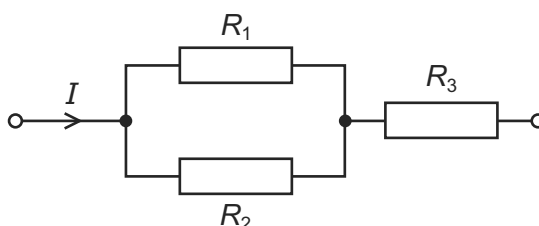
Is the equation shown below correct for the network?

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

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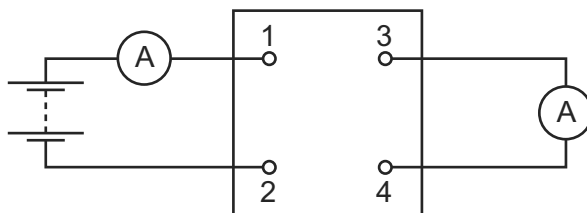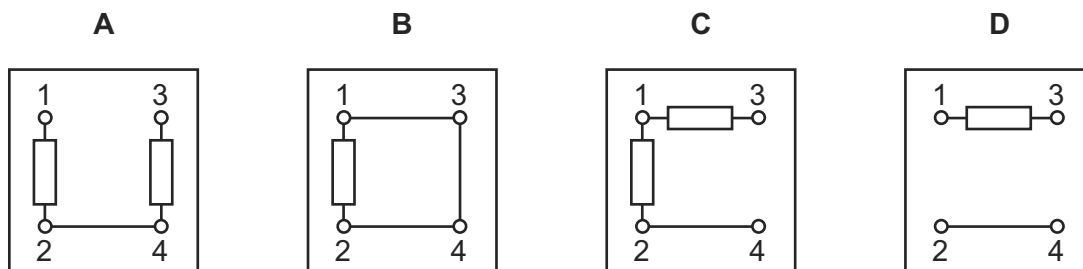
B   Yes, it correctly combines two parallel resistors with one series resistor, and correctly uses Ohm's Law.

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.

85 Five resistors are connected as shown.
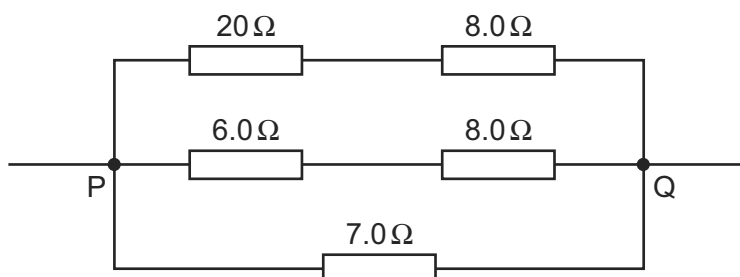
What is the total resistance between P and Q?

A   0.25 Ω   B   0.61 Ω   C   4.0 Ω   D   16 Ω

86 A circuit is set up as shown, supplied by a 3 V battery. All resistances are 1 kΩ.
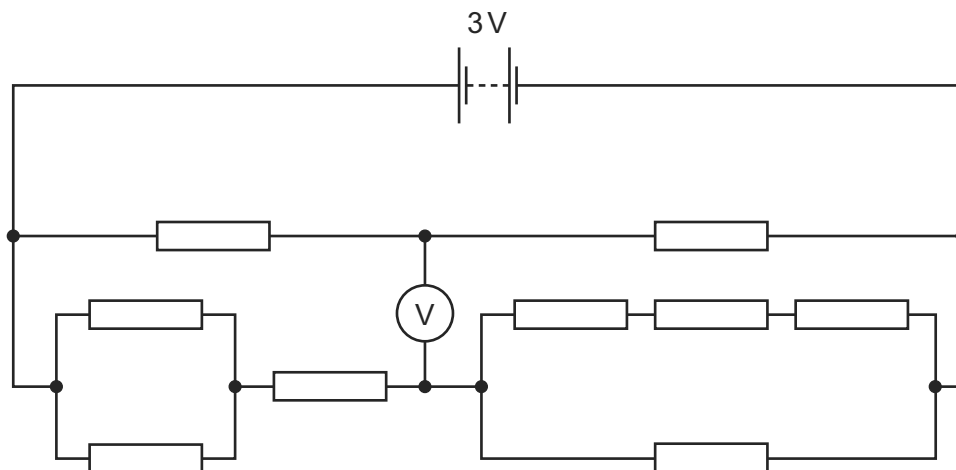
What will be the reading on the voltmeter?

A   0   **B**   0.5 V   **C**   1.0 V   **D**   1.5 V

87 A 12 V battery is in series with an ammeter, a 2 Ω fixed resistor and a 0 – 10 Ω variable resistor. A high-resistance voltmeter is connected across the variable resistor.
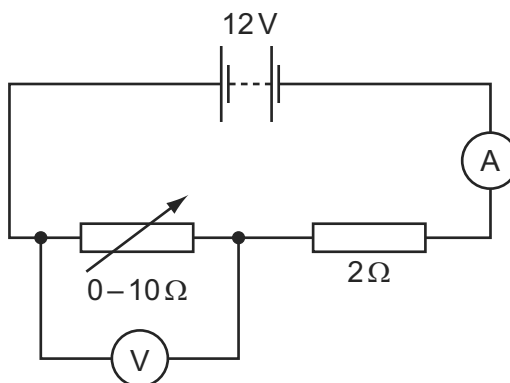
The resistance of the variable resistor is changed from zero to its maximum value.

Which graph shows how the potential difference (p.d.) measured by the voltmeter varies with the current measured by the ammeter?
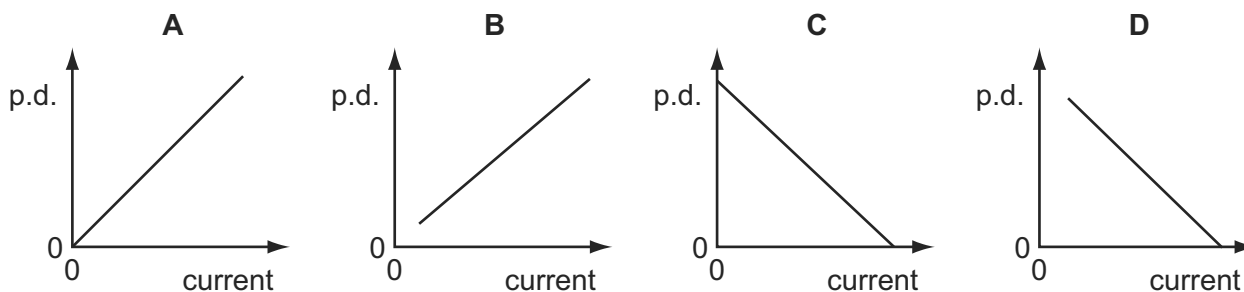
88 In the circuit shown, the battery and ammeter each have negligible resistance.

12 V

X   Y   A
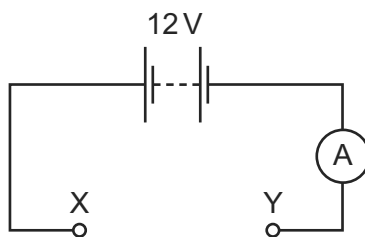
The following combinations of resistors are placed in turn between the terminals X and Y of the circuit.

Which combination would give an ammeter reading of 8 A?

A

2 Ω

1 Ω

3 Ω

B

1 Ω

2 Ω

3 Ω

C

1 Ω   2 Ω

3 Ω

D

2 Ω

1 Ω

3 Ω
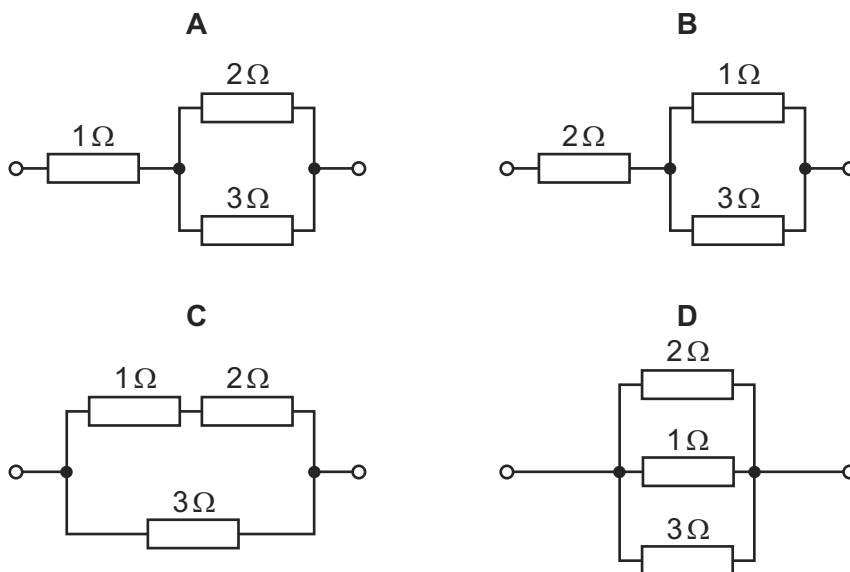
89 Four resistors of resistance R, 2R, 3R and 4R are connected to form a network.

A battery of negligible internal resistance and a voltmeter are connected to the resistor network as shown.

3R

4R   V   2R

R
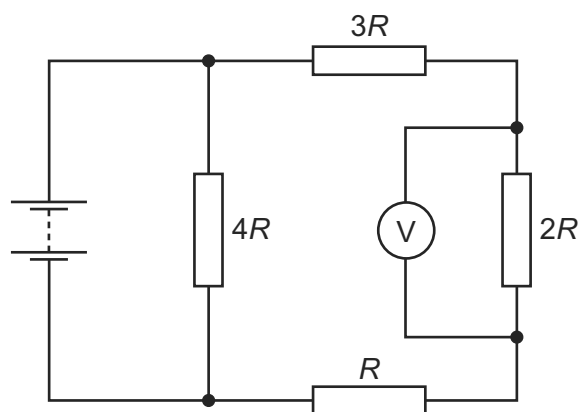
The voltmeter reading is 2 V.

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

A 2 V   **B** 4 V   **C** 6 V   **D** 10 V

90 The diagram shows a length of track from a model railway connected to a battery, a resistor and
a relay coil.   9702/13/M/J/13

With no train present, there is a current in the relay coil which operates a switch to turn on a light.

When a train occupies the section of track, most of the current flows through the wheels and
axles of the train in preference to the relay coil. The switch in the relay turns off the light.

Why is a resistor placed between the battery and the track?

A   to limit the heating of the wheels of the train

B   to limit the energy lost in the relay coil when a train is present
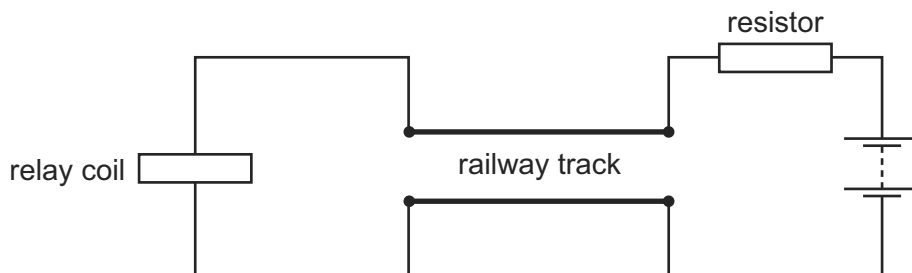
C   to prevent a short circuit of the battery when a train is present

D   to protect the relay when a train is present

91 A network of electrical components is connected across a battery of negligible internal resistance,
as shown.   9702/11/O/N/12
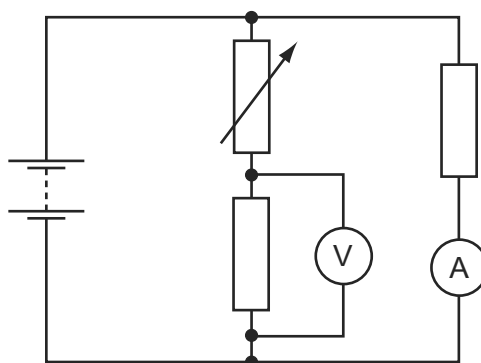
The resistance of the variable resistor is increased.

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

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91														