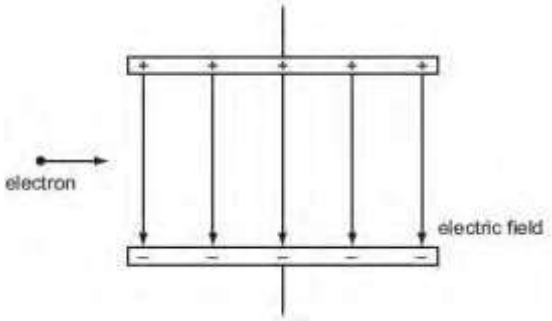
DC Circuits

TOPIC QUESTIONS (1)

Level	A Level
Subject	Physics
Exam Board	CIE
Paper Type	Multiple Choice

Time Allowed : 1hour 10min

1. An electron, travelling horizontally at constant speed in a vacuum, enters a vertical electric field between two charged parallel plates as shown.



What are the horizontal and vertical components of the motion ofthis electron when it is in the field?

	horizontal component of motion	vertical component of motion
A	constant speed	acceleration upwards
B	constant speed	acceleration downwards
C	acceleration to the right	acceleration downwards
D	acceleration to the right	acceleration upwards

2. The electric field strength between a pair of parallel plates is E. The separation of the plates is doubled and the potential difference between the plates is increased by a factor of four.What is the new electric field strength?

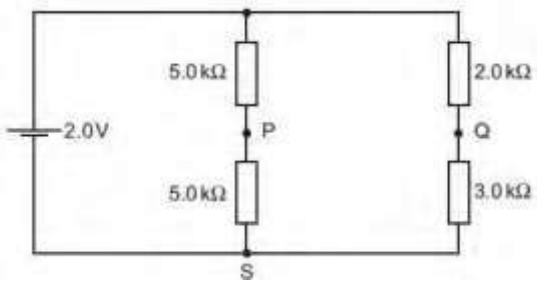
A E B 2E C 4E D 8E

3. What is a correct statement of Ohm's law?

A The potential difference across a component equals the current providing the resistance and other physical conditionsstay constant.
B The potential difference across a component equals thecurrent multiplied by the resistance.
C The potential difference across a component is proportional toits resistance.
D The potential difference across a component is proportional tothe current in it providing physical conditions stay constant.

4. The current in a resistor is 8.0 mA.
What charge flows through the resistor in 0.020 s?
A 0.16 mC B 1.6 mC C 4.0 mC D 0.40 C

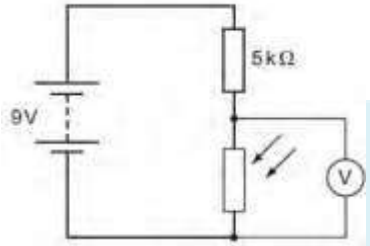
5. A cell of e.m.f. 2.0 V and negligible internal resistance isconnected to the network of resistors shown.



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

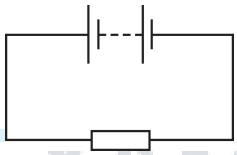
6. A circuit is set up with an LDR and a fixed resistor as shown.



The voltmeter reads 4 V. The light intensity is increased. What is a possible voltmeter reading?

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

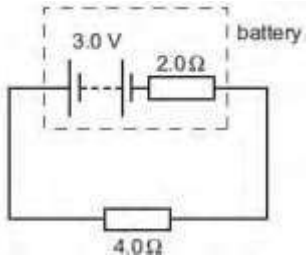
7. In the circuit below, the battery converts an amount E of chemical energy to electrical energy when charge Q passes through the resistor in time t.



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

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

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

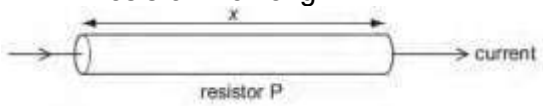


The battery is connected to a load of 4.0 Ω.

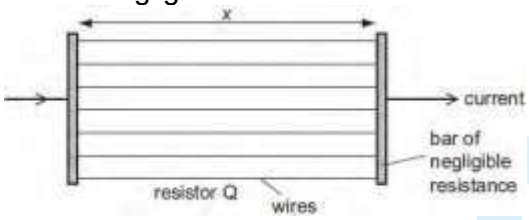
What are the terminal potential difference V and output power P?

	V/V	P/W
A	1.0	0.50

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

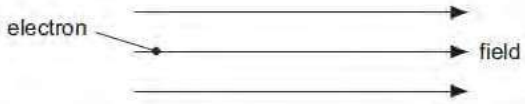


All of the second piece is made into uniform wires each of the same length x which he connects between two bars of negligibleresistance to form a resistor Q.



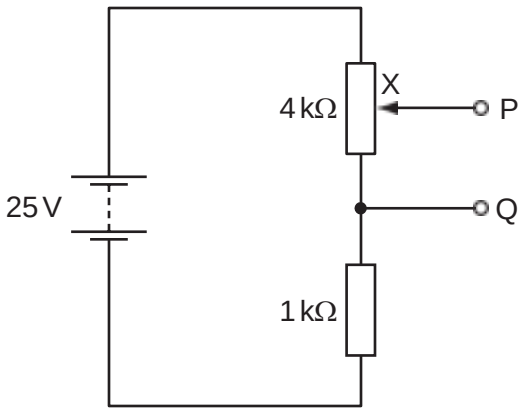
How do the electrical resistances of P and Q compare?
A P has a larger resistance than Q.
B Q has a larger resistance than P.
C P and Q have equal resistance.
D Q may have a larger or smaller resistance than P, dependingon the number of wires made.

10. An electron is situated in a uniform electric field as shownin the diagram.



What is the direction of the electric force acting on the electron?
A downwards into the paper B upwards out of the paper C to the left D to the right

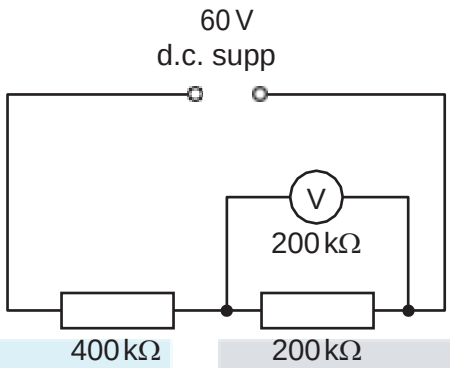
11. The diagram shows a potential divider circuit which, by adjustment of the contact X, can be usedto provide a variable potential difference between the terminals P and Q.



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

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

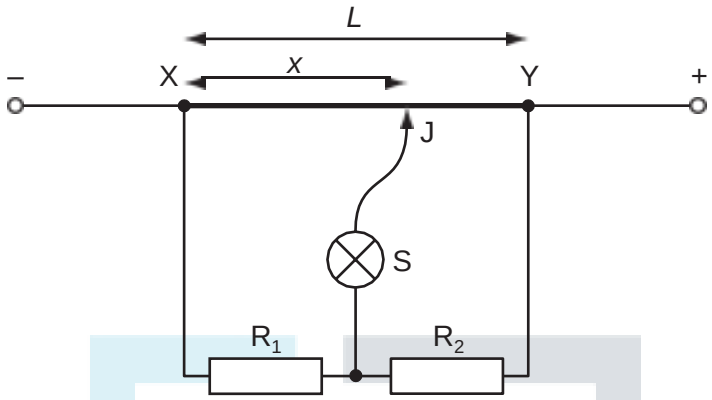


What is the reading on a voltmeter, also of resistance 200 kΩ, when connected across the 200 kΩ resistor as shown in the diagram?

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

13. 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.

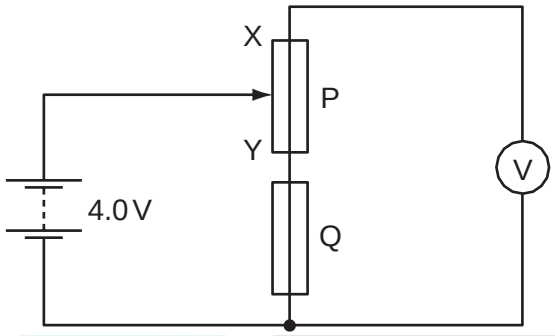


To determine the ratio $\frac{V_1}{V_2}$ of the potential differences across R_1 and R_2, a point is found on XY at which the lamp is off. This point is at a distance *x* from X.

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 $\frac{x}{L-x}$

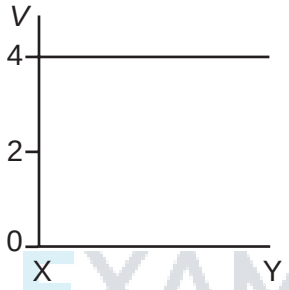
14. In the circuit below, P is a potentiometer of total resistance 10 Ω and Q is a fixed resistor of resistance 10 Ω. The battery has an e.m.f. of 4.0 V and negligible internal resistance. The voltmeter has a very high resistance.



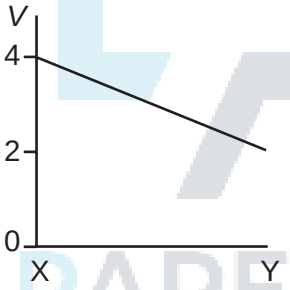
The slider on the potentiometer is moved from X to Y and a graph of voltmeter reading V is plotted against slider position.

Which graph would be obtained?

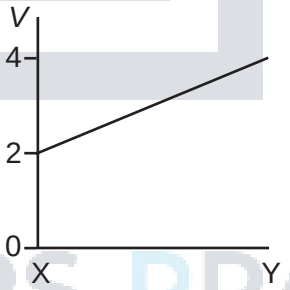
A



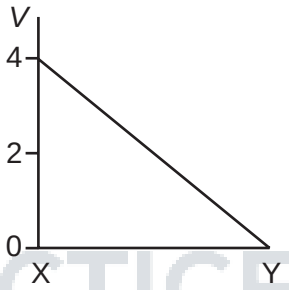
B



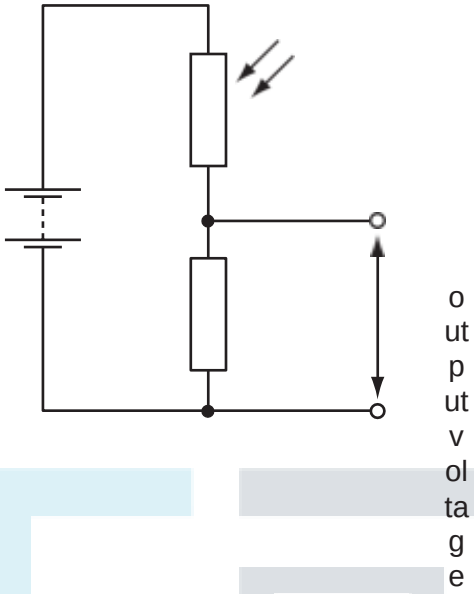
C



D



15. The diagram shows a potential divider circuit.

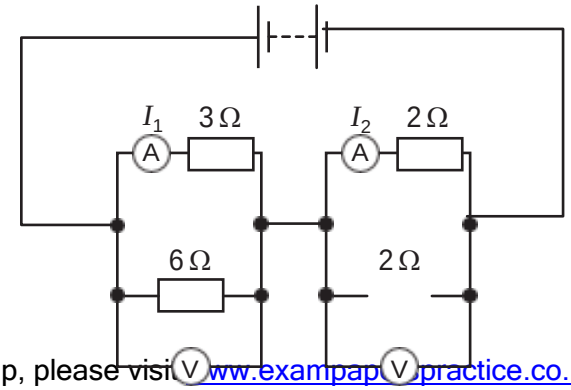


The light level increases.

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

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



V_1 V_2

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

What quantities are needed to calculate the fall in voltage?

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

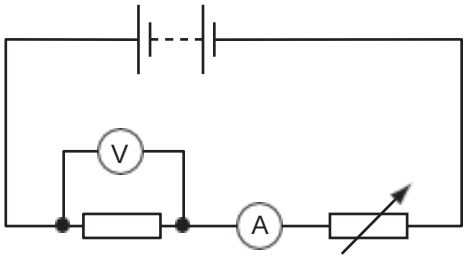
B the battery's e.m.f. and the current

C the current and the battery's internal resistance

D the current and the external resistance

18. 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?

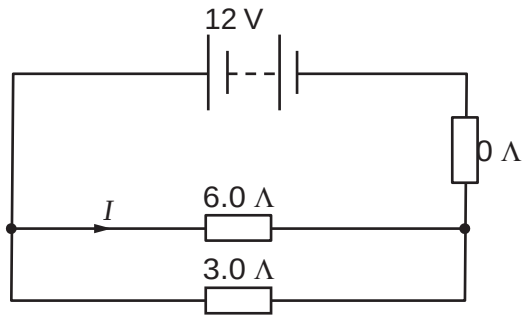
	ammeter	vo
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

19. 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

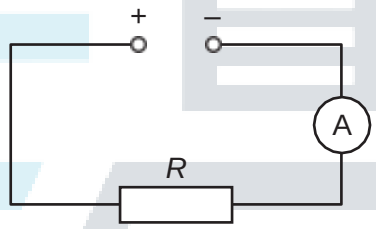
20. The diagram shows a circuit in which the battery has negligible internal resistance.



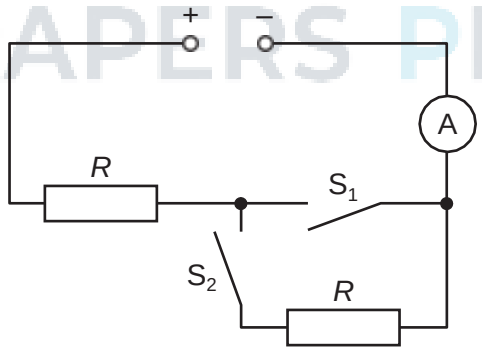
What is the value of the current I?

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

21. 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

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

1 It involves changing electrical energy into other forms.

2 It involves changing other energy forms into electrical energy.

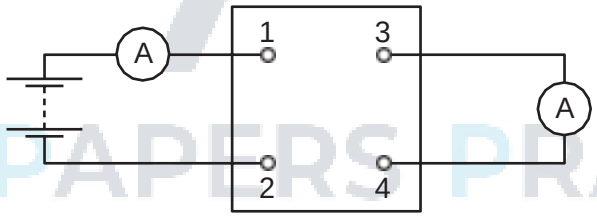
3 It is the energy per unit charge to move charge right round a circuit.

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

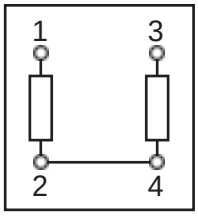
23. The diagram shows a four-terminal box connected to a battery and two ammeters.



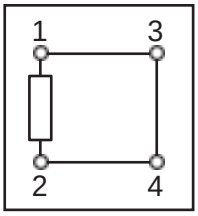
The currents in the two meters are identical.

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

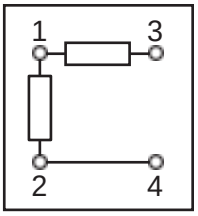
A



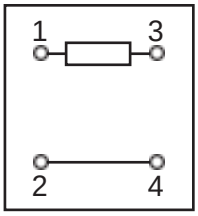
B



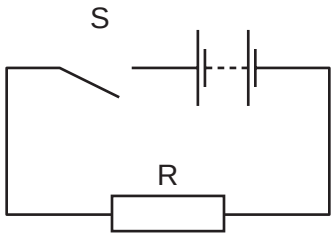
C



D



24. The diagram shows a simple circuit.



Which statement is correct?

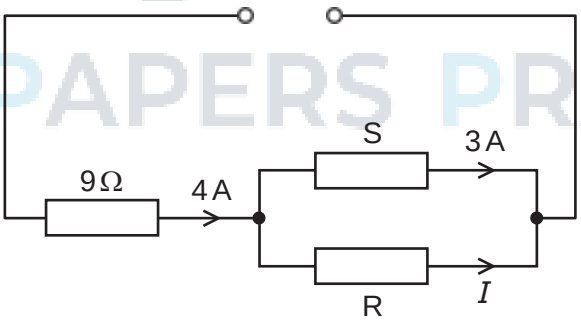
A When switch S is closed, the electromotive force (e.m.f.) of the battery falls because work is done against the internal resistance of the battery.

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.

25. 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

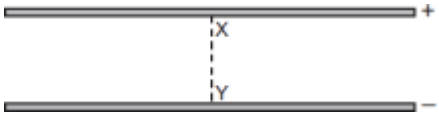
D Kirchhoff's second law

26. An electric railway locomotive has a maximum mechanical output power of 4.0 MW. Electrical power is delivered at 25 kV from overhead wires. The overall efficiency of the locomotive in converting electrical power to mechanical power is 80 %.

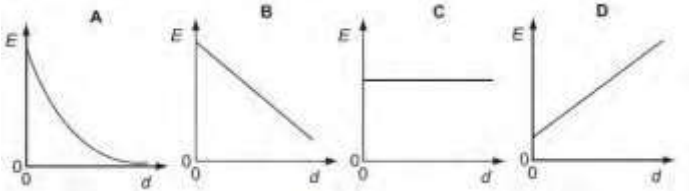
What is the current from the overhead wires when the locomotive is operating at its maximum power?

A 130 A B 160 A C 200 A D 250 A

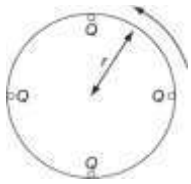
27. An electric field exists in the space between two chargedmetal plates.



Which graph shows the variation of electric field strength E withdistance d from X along the line XY?



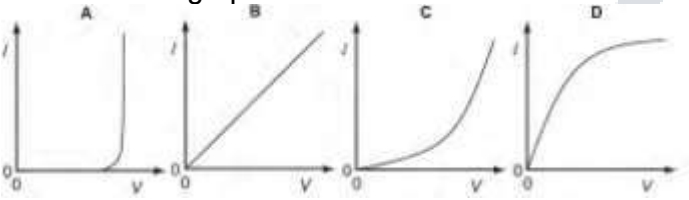
28. Four point charges, each of charge Q, are placed on theedge of an insulating disc of radius r. The frequency of rotation of the disc is f.



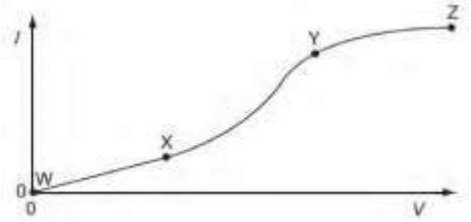
What is the equivalent electric current at the edge of the disc?

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

29. Which graph shows the *I* – V characteristic of a filament lamp?



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

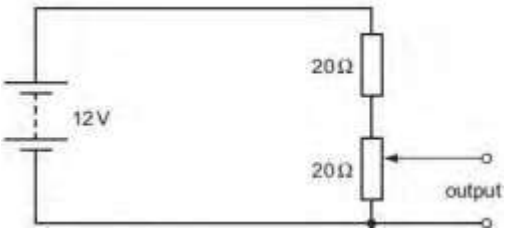


In which ways does the resistance of the component vary withineach of the three sections?

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

31. diagram shows a potentiometer and a fixed resistor connected across a 12 V battery of negligible

internal resistance.



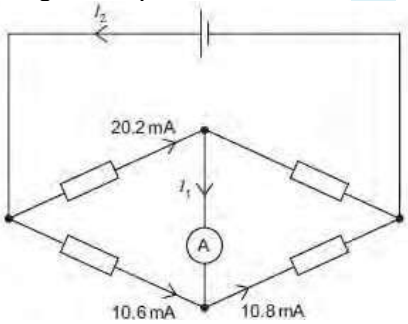
The fixed resistor and the potentiometer each have resistance 20 Ω. The circuit is designed to provide a variable output voltage.
What is the range of output voltages?

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

32. The resistance of a device is designed to change with temperature.
What is the device?

A a light-dependent resistor B a potential divider
C a semiconductor diode D a thermistor

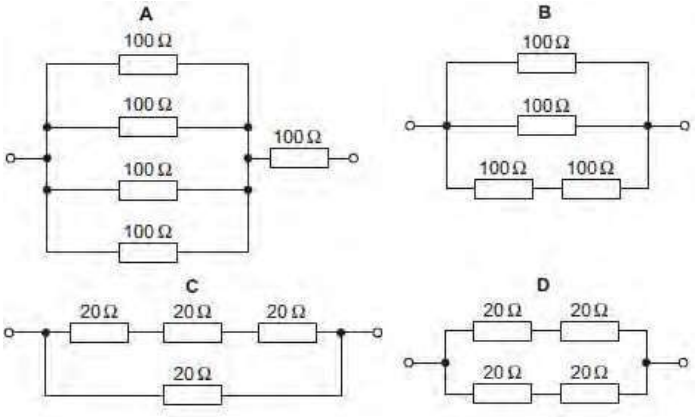
33. The diagram represents a circuit.



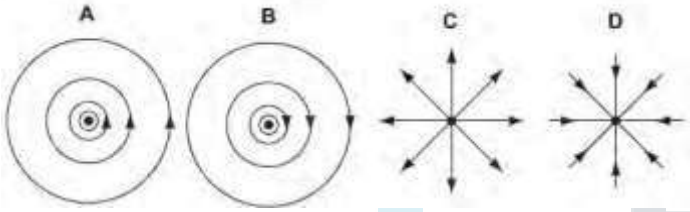
Some currents have been shown on the diagram. What are the currents I1 and I2?

	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

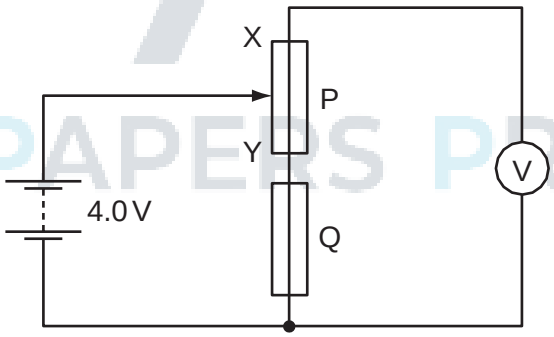
34. Which circuit has a resistance of 40 Ω between the terminals?



35. Which diagram represents the electric field of a negative point charge, shown by • ?



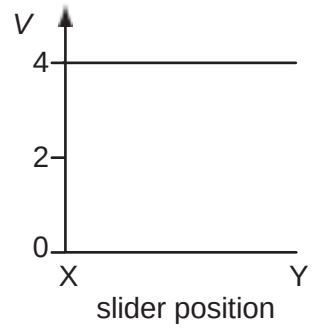
36. 36 In the circuit below, P is a potentiometer of total resistance 10 Ω and Q is a fixed resistor of resistance 10 Ω. The battery has an electromotive force (e.m.f.) of 4.0 V and negligible internal resistance. The voltmeter has a very high resistance.



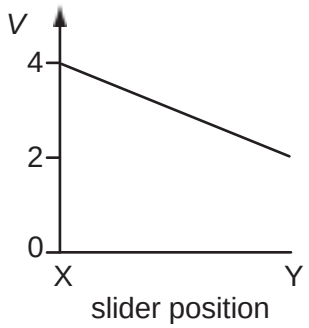
The slider on the potentiometer is moved from X to Y and a graph of voltmeter reading V is plotted against slider position.

Which graph would be obtained?

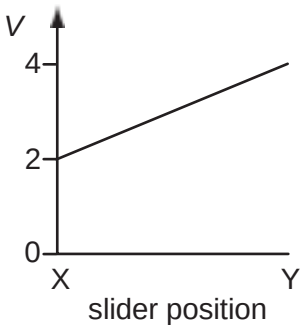
A



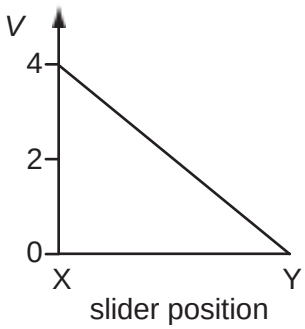
B



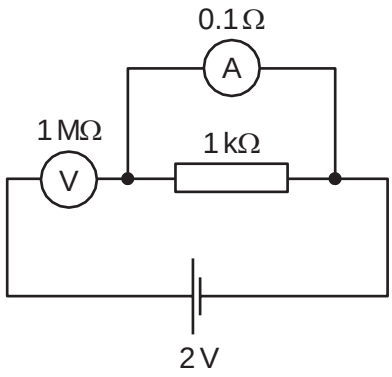
C



D



37. 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?

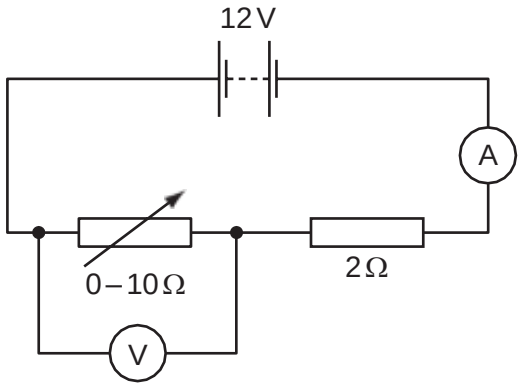
A The ammeter reads 2 mA.

B The ammeter reads 20 A.

C The voltmeter reads zero.

D The voltmeter reads 2 V.

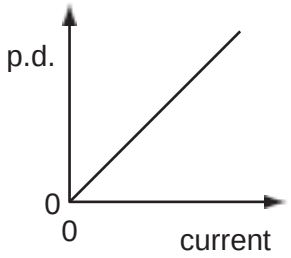
38. A 12 V battery is in series with an ammeter, a 2 Ω fixed resistor and a 0–10 Ω variable resistor. A high-resistance voltmeter is connected across the variable resistor.



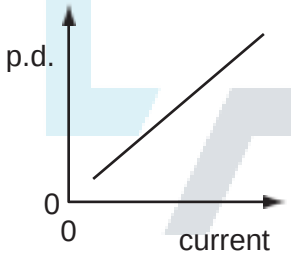
The resistance of the variable resistor is changed from zero to its maximum value.

Which graph shows how the potential difference (p.d.) measured by the voltmeter varies with the current measured by the ammeter?

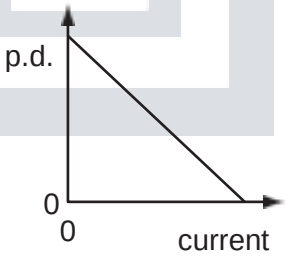
A



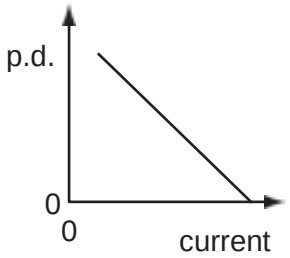
B



C

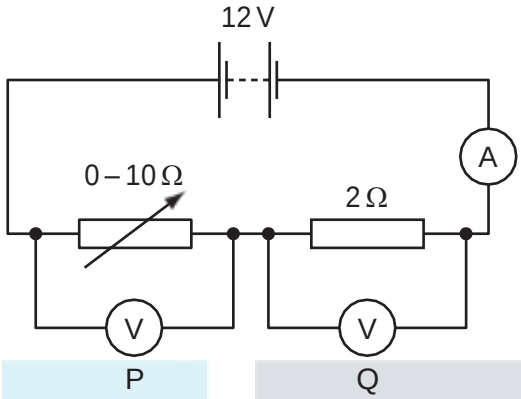


D



39. A 12 V battery is in series with an ammeter, a 2 Ω fixed resistor and a 0 – 10 Ω variable resistor.

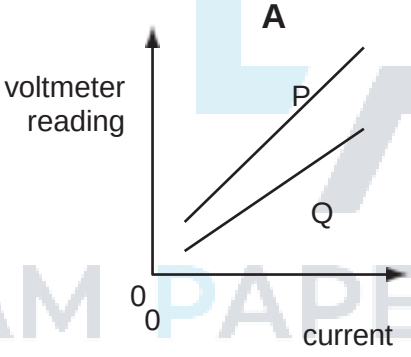
High-resistance voltmeters P and Q are connected across the variable resistor and the fixed resistor respectively, as shown.



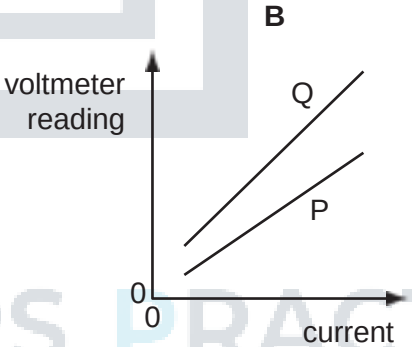
The resistance of the variable resistor is changed from its maximum value to zero.

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

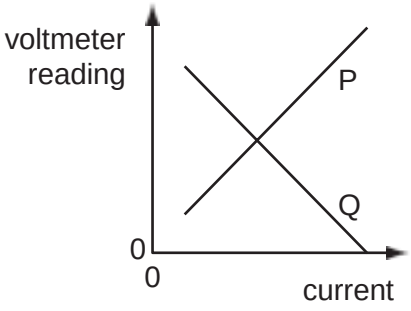
A



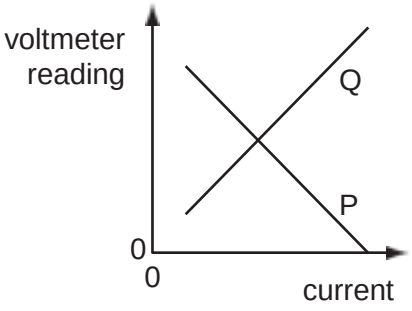
B



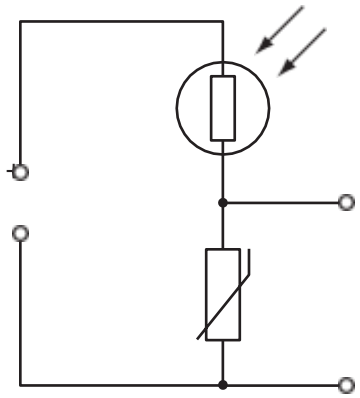
C



D



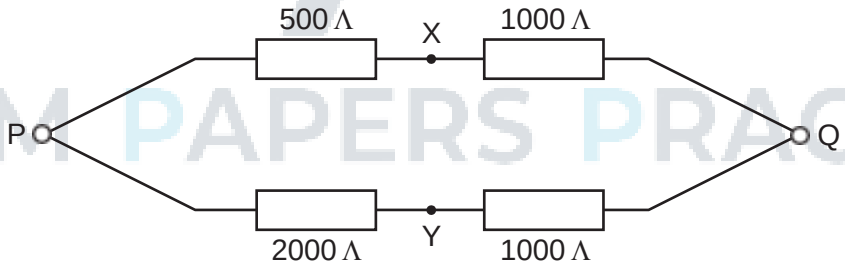
40. The diagram shows a light-dependent resistor (LDR) and a thermistor forming a potential divider.



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

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

41. 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

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

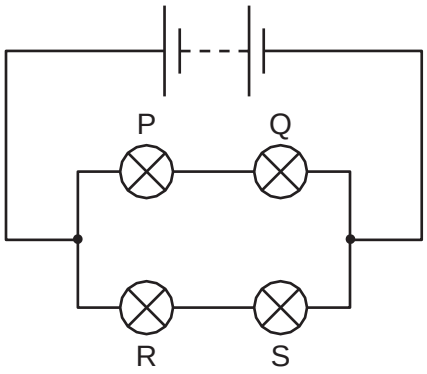


diagram 1

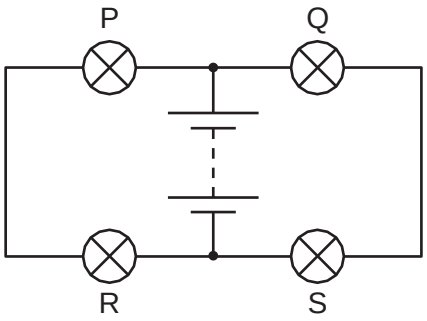


diagram 2

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

Which statement is correct?

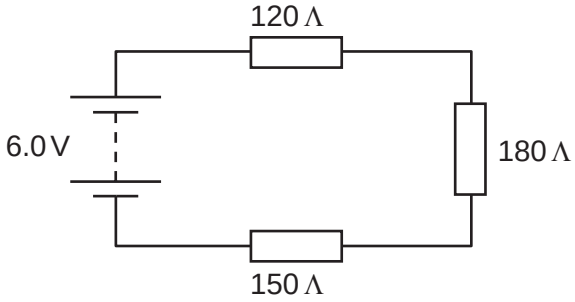
a. The lamps do not light.

b. The lamps are less bright than normal.

c. The lamps have normal brightness.

d. The lamps are brighter than normal.

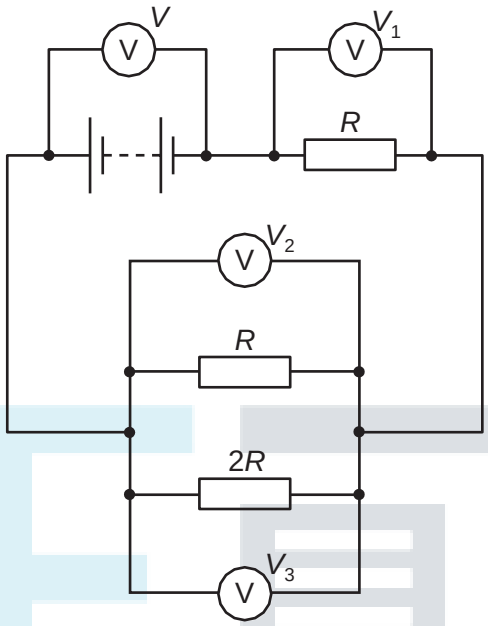
43. Three resistors are connected in series with a battery as shown in the diagram. The battery has negligible internal resistance.



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

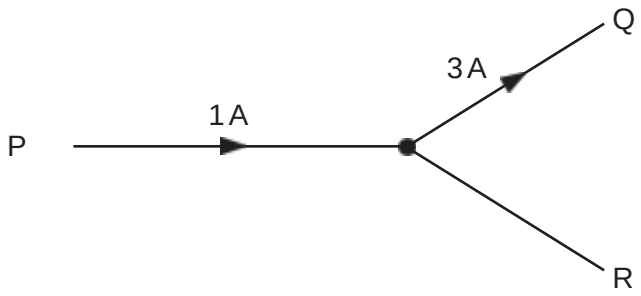
44. The diagram shows a circuit with four voltmeter readings V, V_1, V_2 and V_3.



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. $V - V_1 = V_3$

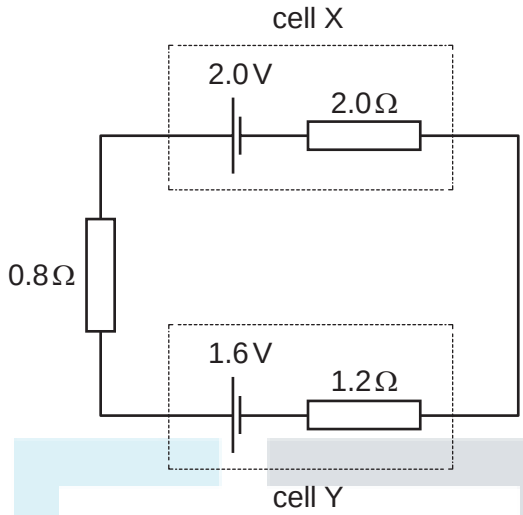
45. The diagram shows a junction in a circuit where three wires P, Q and R meet. The currents in P and Q are 1 A and 3 A respectively, in the directions shown.



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

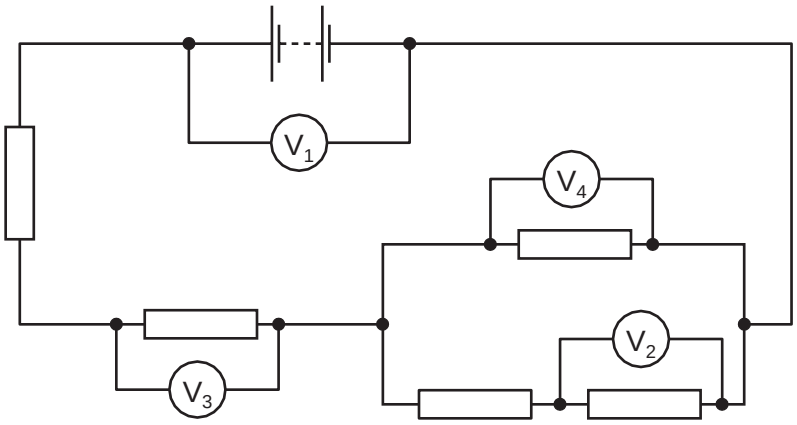
46. Cell X has an e.m.f. of 2.0 V and an internal resistance of 2.0 Ω. Cell Y has an e.m.f. of 1.6 V and an internal resistance of 1.2 Ω. These two cells are connected to a resistor of resistance 0.8 Ω, asshown.



What is the current in cell X?

A 0.10 A B 0.50 A C 0.90 A D 1.0 A

47. In the circuit shown, all the resistors are identical.

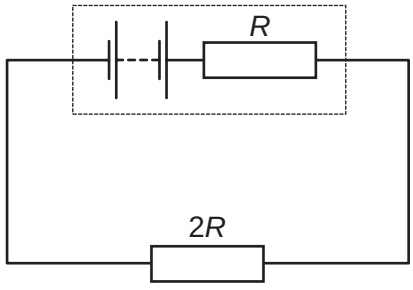


The reading on voltmeter V_1 is 8.0 V and the reading on voltmeter V_2 is 1.0 V.

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

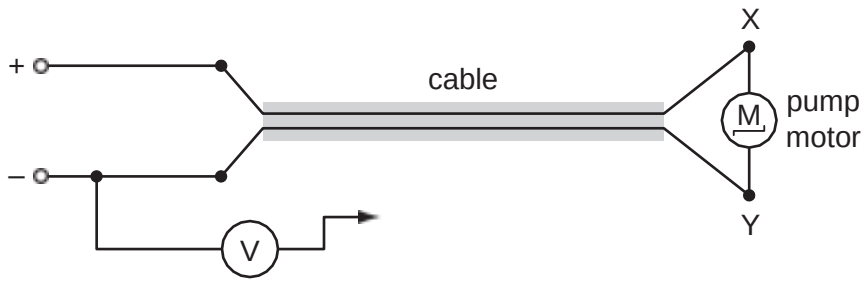
48. The diagram shows an electric circuit in which the resistance of the external resistor is $2R$ and the internal resistance of the source is R.



What is the ratio $\frac{\text{power in external resistor}}{\text{power in internal resistance}}$?

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

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

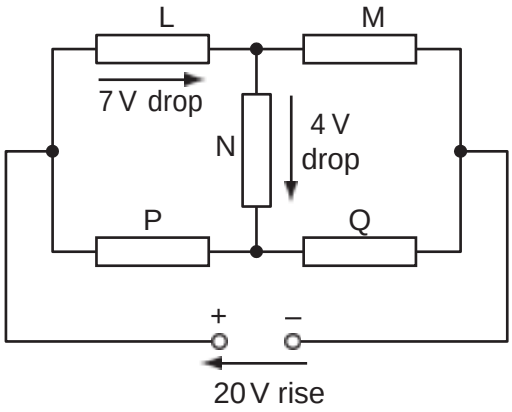


The motor does not work so, to find the fault, the negative terminal of a voltmeter is connected to the negative terminal of the power supply and its other end is connected in turn to terminals X and Y at the motor.

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

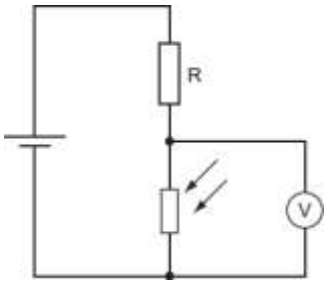
50. A 20 V d.c. supply is connected to a circuit consisting of five resistors L, M, N, P and Q.



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

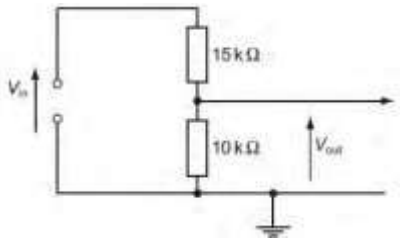
51. A potential divider consists of a fixed resistor R and a light-dependent resistor (LDR).



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

A. The voltmeter reading decreases because the LDR resistance decreases.
B The voltmeter reading decreases because the LDR resistance increases.
C The voltmeter reading increases because the LDR resistance decreases.
D The voltmeter reading increases because the LDR resistance increases.

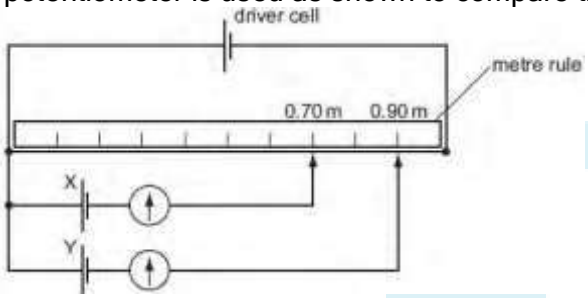
52. The circuit is designed to trigger an alarm system when the input voltage exceeds some preset value. It does this by comparing V_{out} with a fixed reference voltage, which is set at 4.8 V.



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

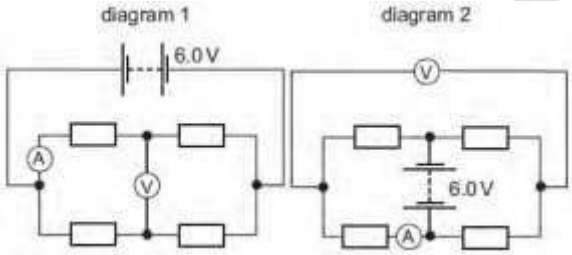
53. A potentiometer is used as shown to compare the e.m.f.s oftwo cells.



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

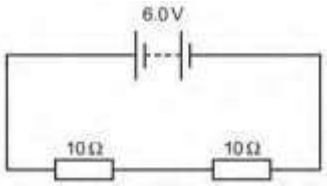
54. When four identical resistors are connected as shown in diagram 1, the ammeter reads 1.0 A and the voltmeter reads zero.



The resistors and meters are reconnected to the supply as shown indiagram 2. What are the meter readings in diagram

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

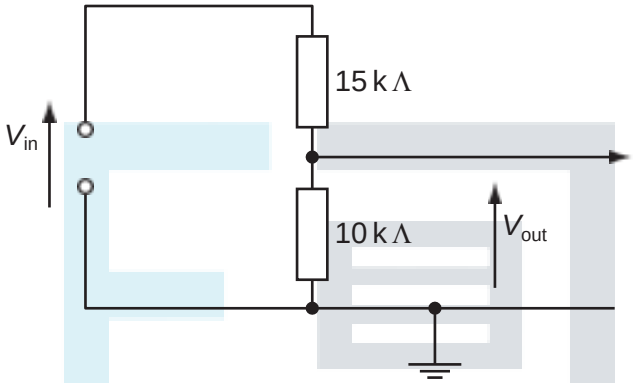
55. A battery of negligible internal resistance is connected totwo 10 Ω resistors in series.



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

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

56. 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.

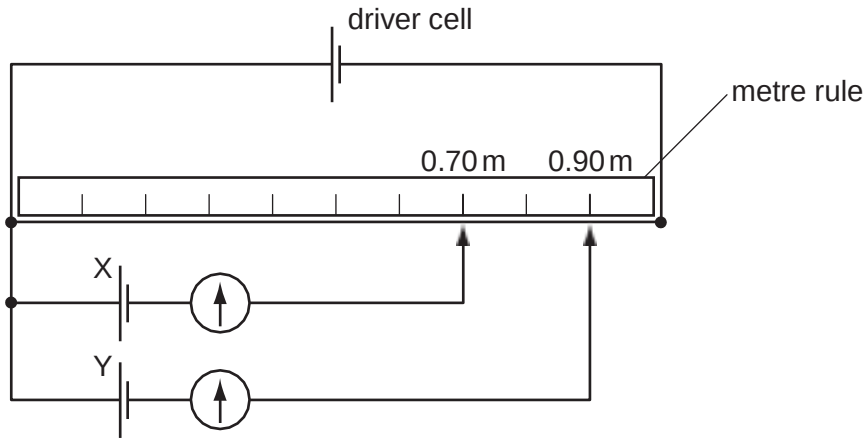


V_{out} is equal to 4.8 V.

What is the input voltage V_{in}?

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

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

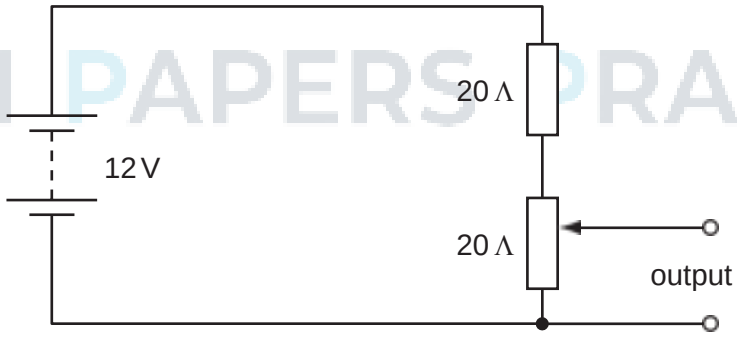


The balance points for cells X and Y are 0.70 m and 0.90 m respectively.

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

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

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

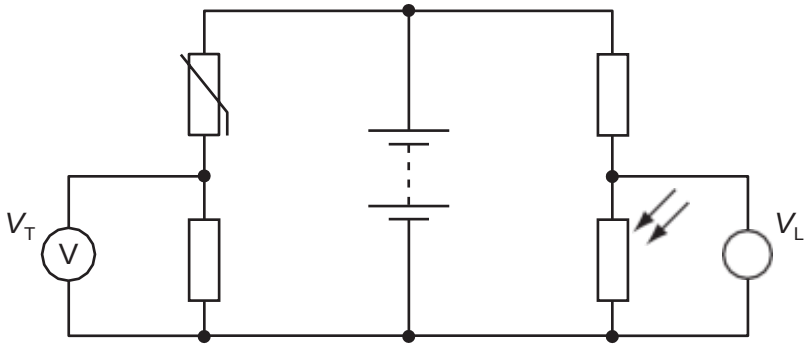


The fixed resistor and the potentiometer each have resistance 20 Ω. The circuit is designed to provide a variable output voltage.

What is the range of output voltages?

A 0–6 V B 0–12 V C 6–12 V D 12–20 V

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

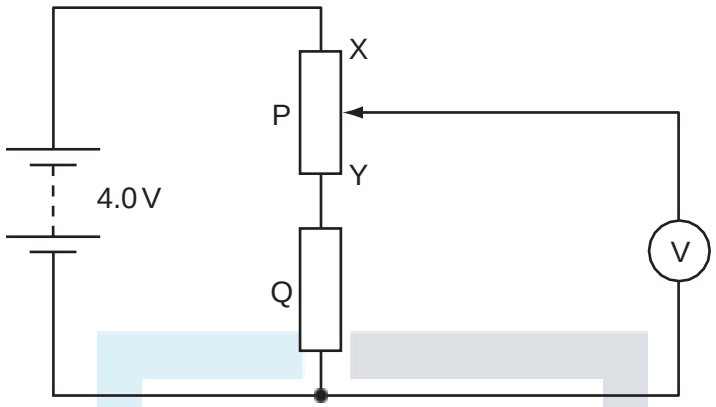


The readings on V_T and V_L are both high.

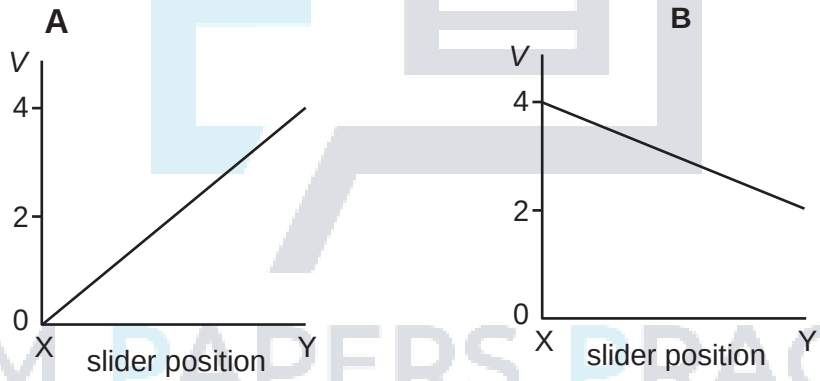
What are the conditions of temperature and light level?

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

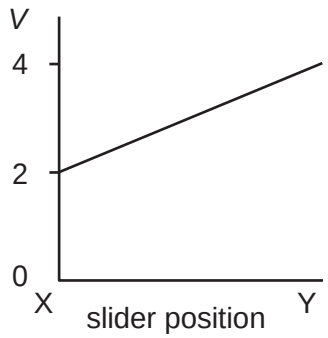
60. In the circuit below, P is a potentiometer of total resistance 10 Ω and Q is a fixed resistor of resistance 10 Ω. The battery has an e.m.f. of 4.0 V and negligible internal resistance. The voltmeter has a very high resistance. The slider on the potentiometer is moved from X to Y and a graph of voltmeter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



Which graph is obtained?



C



D