10. D.C. Circuits

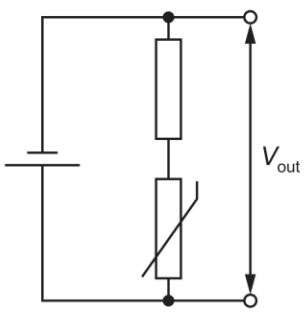
10.3 Potential dividers

Paper 1

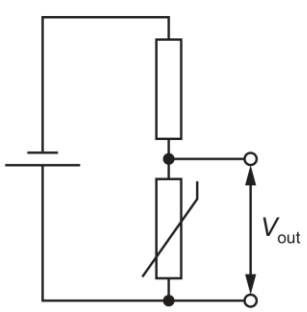
Question Paper

1 Which circuit results in output voltage V_{out} increasing with increasing temperature?

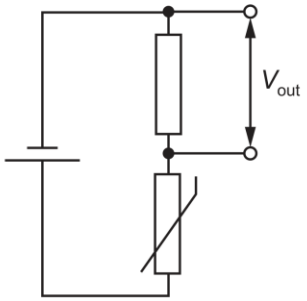
A



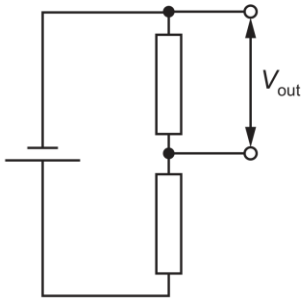
B



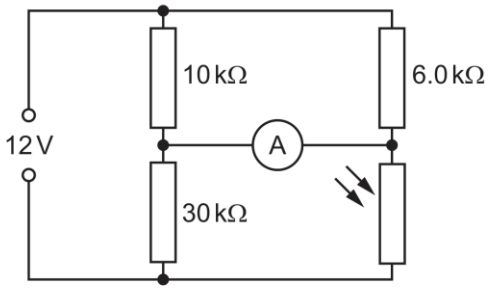
C



D



2 The diagram shows a circuit with a light-dependent resistor (LDR).

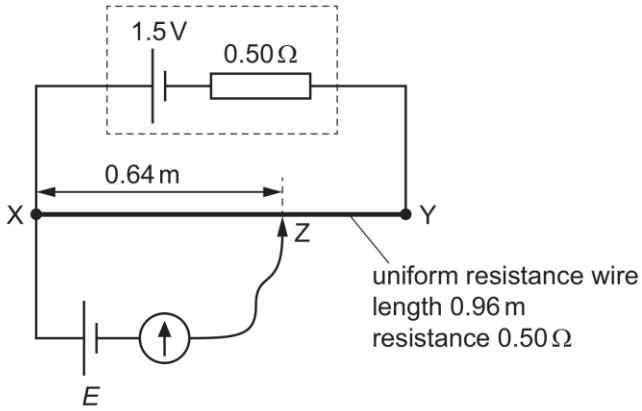


The ammeter reads zero current.

What is the resistance of the LDR?

A 6.0 kΩ **B** 18 kΩ **C** 26 kΩ **D** 30 kΩ

3 A potentiometer circuit is used to determine the electromotive force (e.m.f.) *E* of a cell. The circuit includes a second cell of e.m.f. 1.5 V and internal resistance 0.50 Ω that is connected to a uniform resistance wire XY, as shown.



The resistance wire XY has a length of 0.96 m and a resistance of 0.50 Ω.

The movable connection Z is moved along wire XY. The galvanometer reading is zero when length XZ is 0.64 m.

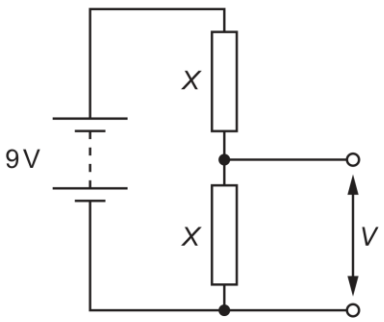
What is the value of e.m.f. *E*?

A 0.50 V **B** 0.75 V **C** 1.0 V **D** 1.1 V

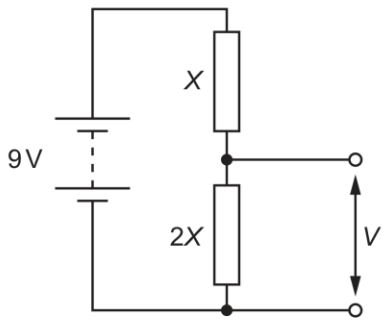
4 Four potential divider circuits each consist of a battery of electromotive force (e.m.f.) 9 V and negligible internal resistance connected to a combination of resistors. Each of the resistors in the circuits has a resistance of X or $2X$.

Which circuit has the largest output voltage V?

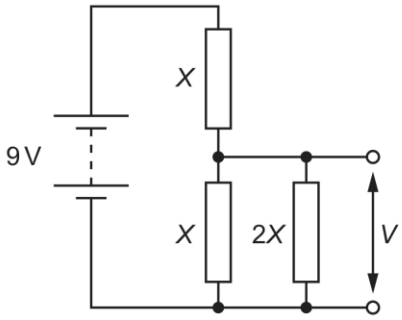
A



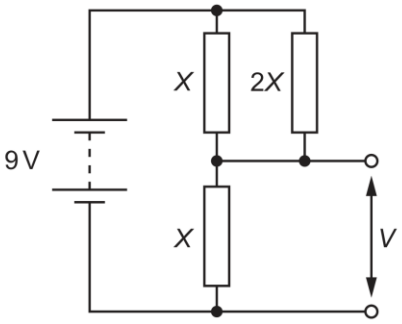
B



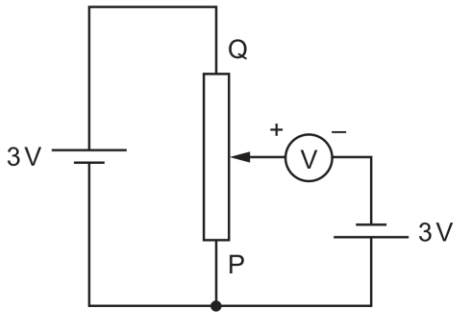
C



D



5 A voltmeter is connected into a circuit with the polarity shown.

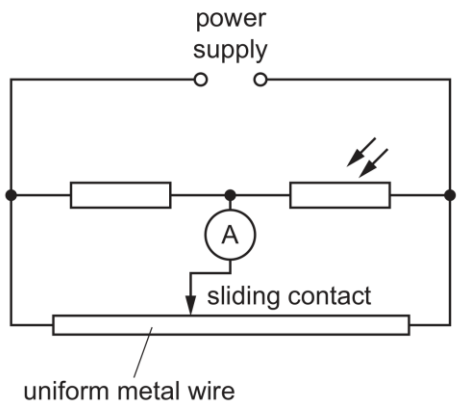


The sliding contact is moved to end P of the potentiometer and then to end Q.

What are the two readings of the voltmeter?

	sliding contact at end P	sliding contact at end Q
A	0 V	3 V
B	0 V	6 V
C	3 V	3 V
D	3 V	6 V

6 In the potentiometer circuit shown, the reading on the ammeter is zero.



The light-dependent resistor (LDR) is then covered and the ammeter gives a non-zero reading.

Which change could return the ammeter reading to zero?

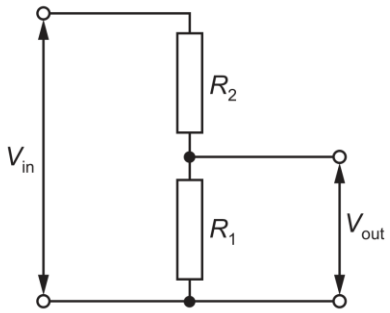
A decreasing the supply voltage

B increasing the supply voltage

C moving the sliding contact to the left

D moving the sliding contact to the right

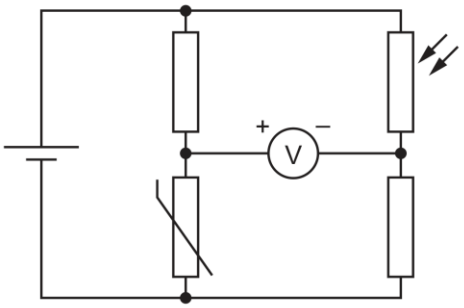
7 A potential divider consists of two resistors of resistances R_1 and R_2 connected in series across a source of potential difference (p.d.) V_{in}. The p.d. across R_1 is V_{out}.



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

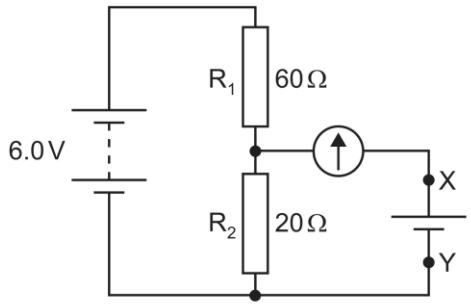
8 A student sets up a circuit. The circuit diagram shows how the positive and negative terminals of a voltmeter are connected to the circuit. The voltmeter has an initial reading that is positive.



Which changes, if any, in temperature and light intensity would cause the voltmeter reading to **decrease**?

	temperature	light intensity
A	increase	increase
B	no change	decrease
C	decrease	no change
D	decrease	decrease

9 In the circuit shown, a battery of negligible internal resistance is connected in series with a pair of fixed resistors R_1 and R_2.



The circuit is to be used to test whether the electromotive force (e.m.f.) of a particular cell is 1.5 V. The cell is connected between terminals X and Y in parallel with R_2 and in series with a galvanometer.

Which statement about the test is correct?

A Any non-zero reading on the galvanometer means the cell has an e.m.f. of 1.5 V.

B The battery does not need to have an e.m.f. of 6.0 V.

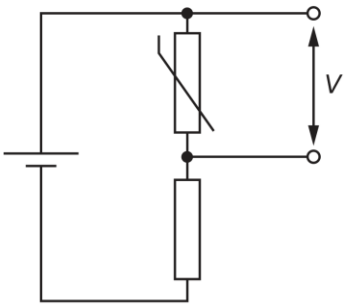
C The cell may be connected either way round between X and Y.

D The galvanometer does not need a scale calibrated in amperes.

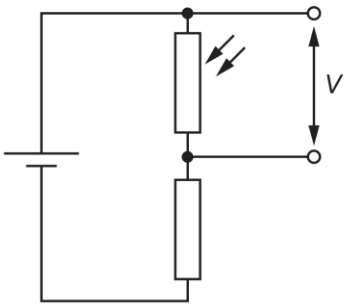
10 In the circuits shown, the temperature remains constant.

In which circuit does the potential difference (p.d.) *V* increase with increasing light intensity?

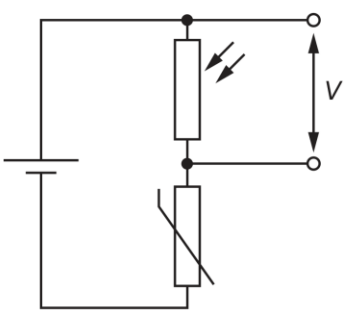
A



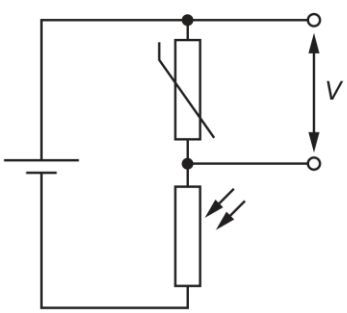
B



C



D



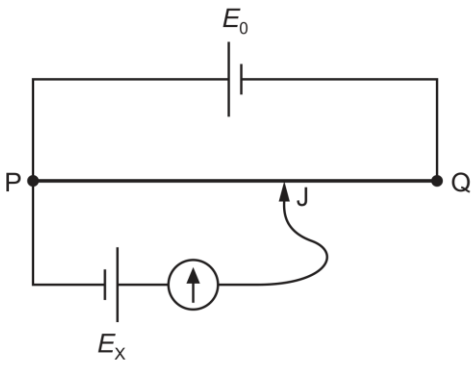
11 A potentiometer circuit is used to determine the electromotive force (e.m.f.) E_X of a cell. The circuit includes a second cell of known e.m.f. E_0 and negligible internal resistance, and a uniform resistance wire PQ of known length.

E_X is less than E_0.

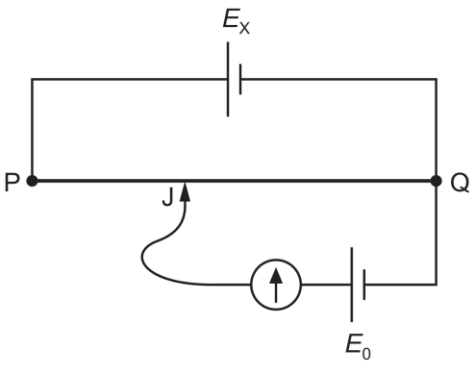
The movable connection J can be positioned anywhere along the length of the resistance wire.

Which circuit is suitable for determining E_X?

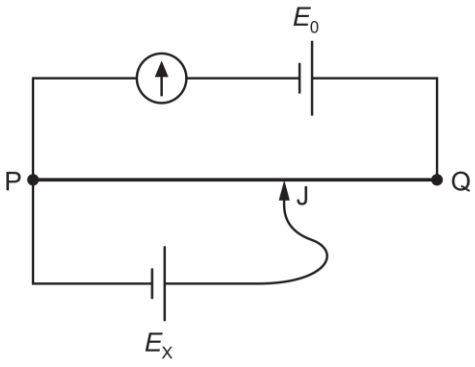
A



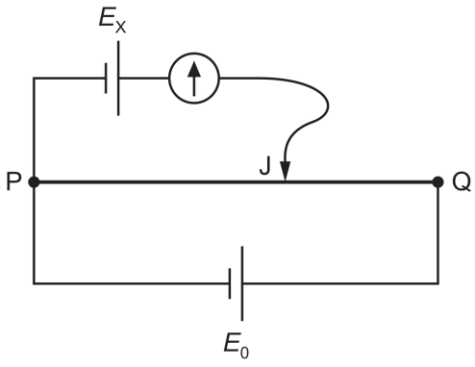
B



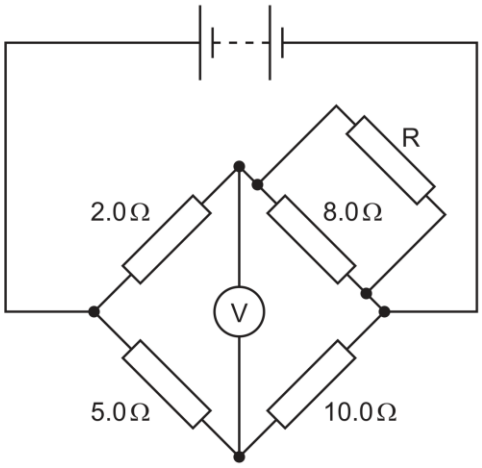
C



D



12 A circuit consists of a battery, a voltmeter and five fixed resistors, as shown.



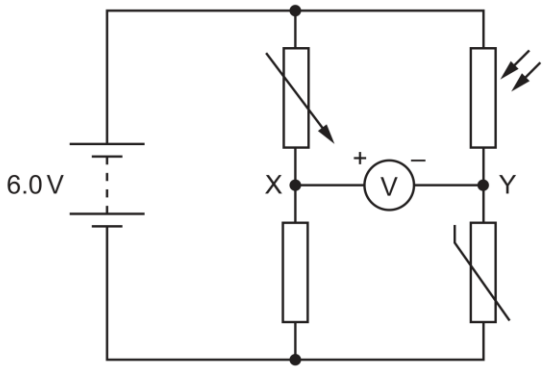
The voltmeter reading is zero.

What is the resistance of resistor R?

A 1.1 Ω **B** 2.1 Ω **C** 4.0 Ω **D** 8.0 Ω

13 A battery of electromotive force (e.m.f.) 6.0 V and negligible internal resistance is connected to a voltmeter and four other components, as shown.

The voltmeter is connected between points X and Y. The positive terminal of the voltmeter is connected to X and the negative terminal of the voltmeter is connected to Y.



Initially, the resistance of each of the four components is 1.0 kΩ.

Which change, on its own, will cause the voltmeter to show a positive reading?

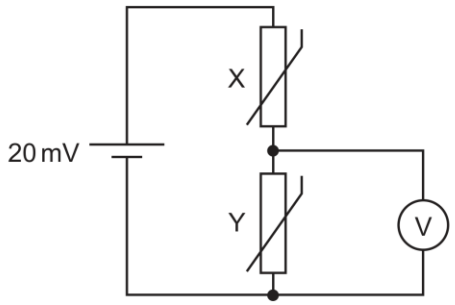
A Decrease the temperature of the thermistor.

B Increase the resistance of the variable resistor.

C Reduce the intensity of light incident on the light-dependent resistor (LDR).

D Replace the fixed resistor with a 500 Ω resistor.

14 A potential divider circuit is designed to detect the difference in temperature between two different places.



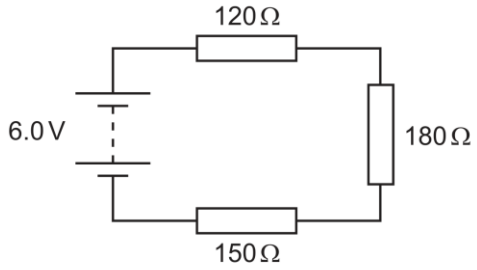
The cell has electromotive force (e.m.f.) 20 mV and negligible internal resistance.

Initially, thermistors X and Y are at the same temperature and have the same resistance. The voltmeter reads 10 mV. X is then placed in a cold environment and its resistance doubles. Y is placed in a warm environment and its resistance halves.

What is the new reading on the voltmeter?

A 4 mV **B** 5 mV **C** 15 mV **D** 16 mV

15 Three resistors are connected in series with a battery, as shown. The battery has negligible internal resistance.

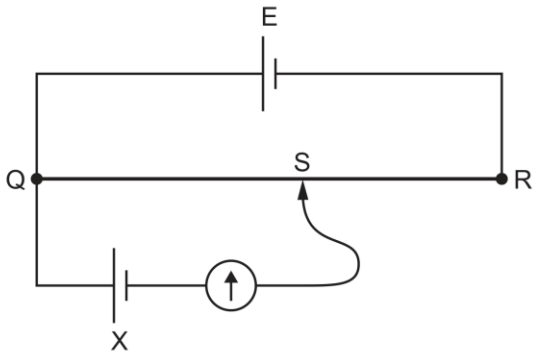


What is the potential difference across the 180 Ω resistor?

A 1.6 V **B** 2.4 V **C** 3.6 V **D** 4.0 V

16 A potentiometer circuit is used to determine the unknown electromotive force (e.m.f.) of a cell X.

In the circuit shown, E is a cell with an e.m.f. that is known accurately. QR is the potentiometer wire, which has a movable contact S. Contact S is connected to a galvanometer and to cell X.



What is **not** a necessary requirement to determine the e.m.f. of X from the circuit?

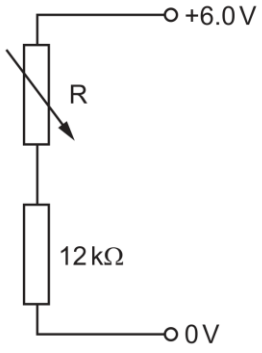
A The e.m.f. of cell X must be lower than the e.m.f. of cell E.

B The internal resistance of cell X must be known.

C The lengths QS and QR must be determined accurately.

D The resistance of the wire QR must be proportional to its length.

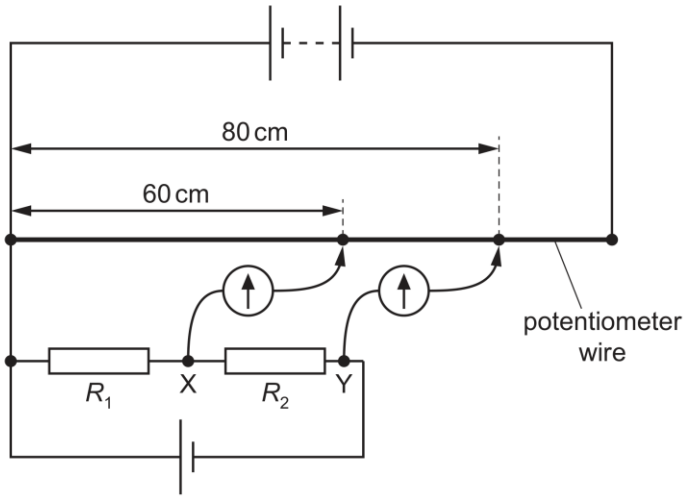
17 Two resistors are connected in series with a 6.0 V power supply, as shown.



What is the resistance of the variable resistor R to give a potential difference of 1.0 V across the 12 kΩ resistor?

A 2.0 kΩ **B** 10 kΩ **C** 60 kΩ **D** 72 kΩ

18 Potential differences across two resistors of resistances R_1 and R_2 are compared using a potentiometer wire (uniform resistance wire) in the electrical circuit shown.



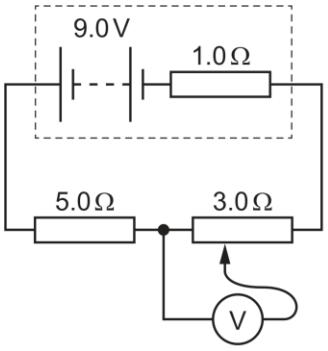
One terminal of a galvanometer is connected to point X. The galvanometer reads zero when its other terminal is connected to a point that is a distance of 60 cm from one end of the potentiometer wire.

One terminal of a second galvanometer is connected to point Y. This galvanometer reads zero when its other terminal is connected to a point that is a distance of 80 cm from the same end of the potentiometer wire.

What is the ratio $\frac{R_2}{R_1}$?

A $\frac{1}{3}$ **B** $\frac{3}{4}$ **C** $\frac{3}{1}$ **D** $\frac{4}{3}$

19 A battery of electromotive force (e.m.f.) 9.0 V and internal resistance 1.0 Ω is connected to a fixed resistor of resistance 5.0 Ω and a potentiometer of maximum resistance 3.0 Ω, as shown.



The sliding contact of the potentiometer is moved over its full range of movement.

What is the maximum value of the potential difference that is measured by the voltmeter?

A 3.0 V **B** 3.4 V **C** 4.5 V **D** 5.4 V

20 A galvanometer of resistance 5 Ω is to be used in a null method.

In order to protect the galvanometer from damage due to an excessive initial current, resistors of resistance 0.5 Ω and 1 kΩ are available.

Which arrangement would provide this protection?

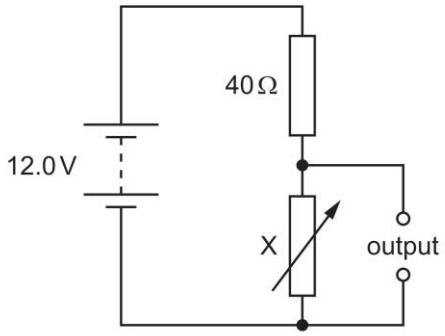
A the 0.5 Ω resistor in series with the galvanometer

B the 0.5 Ω resistor in parallel with the galvanometer and this combination placed in series with the 1 kΩ resistor

C the 1 kΩ resistor in parallel with the galvanometer

D the 1 kΩ resistor in parallel with the galvanometer and this combination placed in series with the 0.5 Ω resistor

21 In the circuit shown, X is a variable resistor whose resistance can be changed from 5.0 Ω to 500 Ω. The electromotive force (e.m.f.) of the battery is 12.0 V. It has negligible internal resistance.



What is the maximum range of values of potential difference across the output?

A 1.3 V to 11.1 V

B 1.3 V to 12.0 V

C 1.5 V to 11.1 V

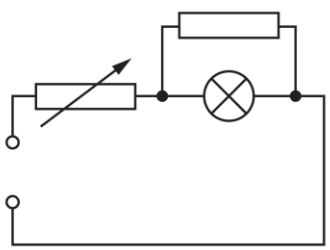
D 1.5 V to 12.0 V

22 In the circuits shown, the power supply has an electromotive force (e.m.f.) greater than the normal operating voltage of the lamp. The internal resistance of the power supply is negligible.

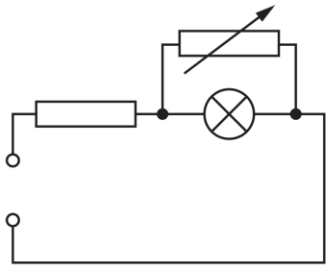
The resistance of the variable resistor is adjusted from zero to its maximum value.

In which circuit could the voltage across the lamp change from zero to its normal operating voltage and **not** exceed its normal operating voltage?

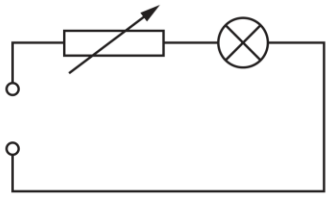
A



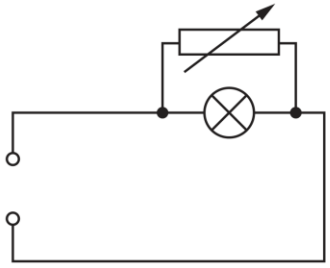
B



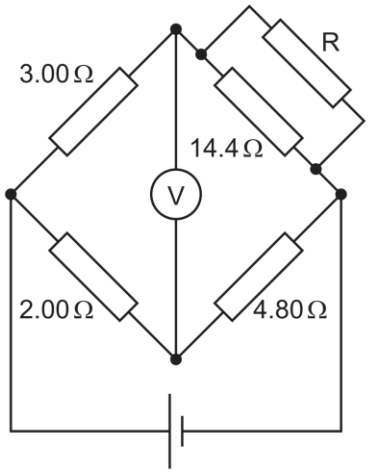
C



D



23 A cell of negligible internal resistance is connected to a network of resistors and a voltmeter, as shown.

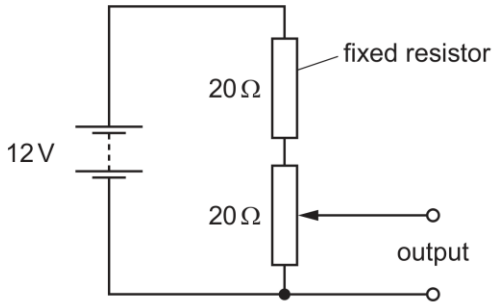


The reading on the voltmeter is zero.

What is the resistance of resistor R?

A 1.20 Ω **B** 1.80 Ω **C** 7.20 Ω **D** 14.4 Ω

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

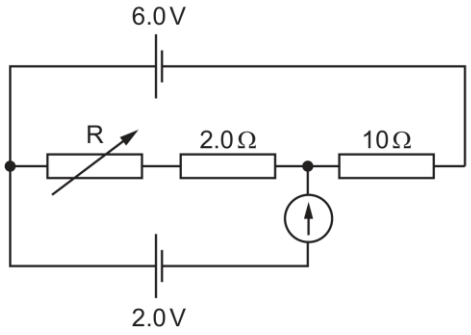


The fixed resistor and the potentiometer each have resistance 20 Ω. The circuit is designed to provide a variable output voltage.

What is the range of output voltages?

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

25 The diagram shows a variable resistor R and two fixed resistors connected in series in a circuit to act as a potential divider.

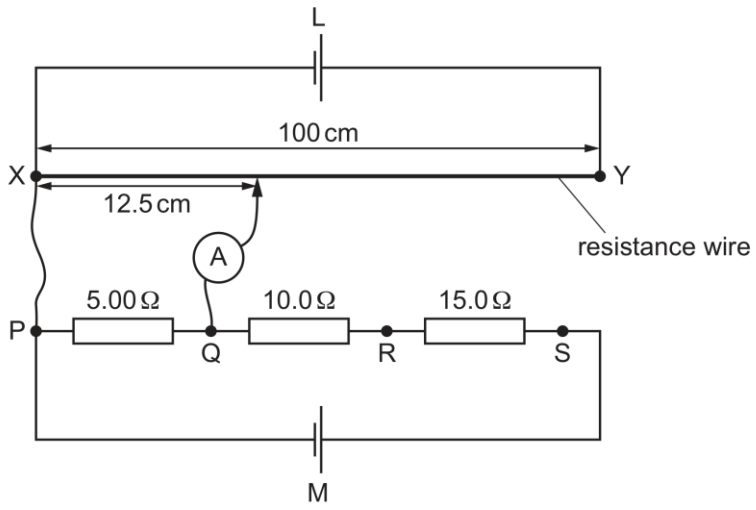


The cell of electromotive force (e.m.f.) 6.0 V has negligible internal resistance. A cell of e.m.f. 2.0 V and a galvanometer are connected into the potential divider. The resistance of R is varied until the galvanometer reads zero.

What is the resistance of resistor R?

A 3.0 Ω **B** 5.0 Ω **C** 8.0 Ω **D** 18 Ω

26 A uniform resistance wire XY of length 100 cm is connected in series with a cell L. Another cell M is connected in series with resistors of resistances 5.00 Ω, 10.0 Ω and 15.0 Ω.



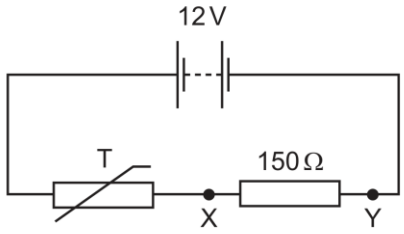
The potential difference (p.d.) between P and Q is balanced against 12.5 cm of the resistance wire, so that the ammeter reads zero.

The p.d. across the other resistors is then balanced against other lengths of the resistance wire.

Which balanced lengths of resistance wire correspond to the connection points given in the table?

connection points	balanced length / cm			
	A	**B**	**C**	**D**
Q and R	12.5	25.0	25.0	25.0
Q and S	62.5	62.5	75.0	62.5
P and R	37.5	37.5	37.5	12.5

27 A thermistor is an electrical component with a resistance that varies with temperature. A thermistor T is used in a fire alarm system. The alarm is triggered when the potential difference between X and Y is 4.5 V.

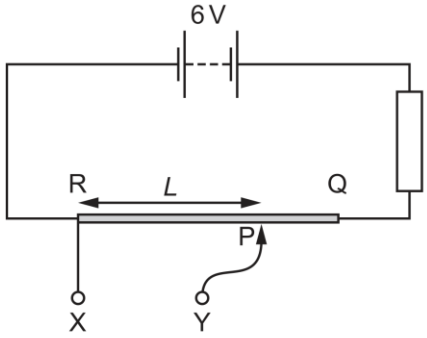


What is the resistance of T when the alarm is triggered?

A 90 Ω **B** 150 Ω **C** 250 Ω **D** 400 Ω

28 The diagram shows a battery of electromotive force (e.m.f.) 6 V, connected in series with a resistor and a uniform resistance wire RQ of length 60 cm.

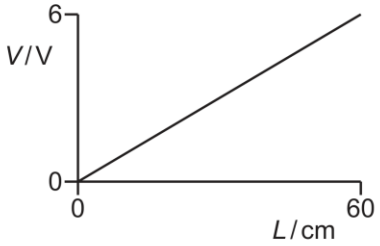
The resistance of RQ is equal to the resistance of the resistor.



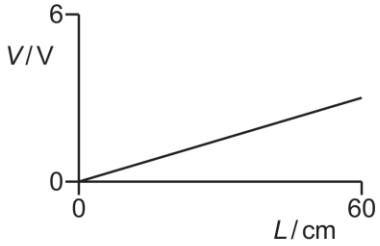
Terminal X is connected to fixed point R. Terminal Y is connected to point P, a connection that may be made at any position along the wire. *L* is the distance between R and P.

Which graph shows the variation with *L* of the potential difference (p.d.) *V* across XY?

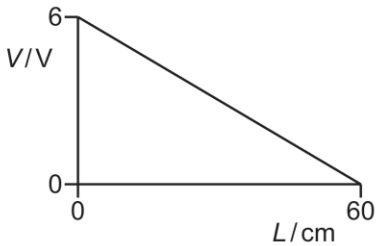
A



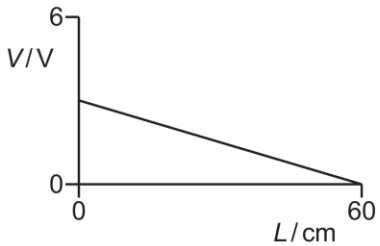
B



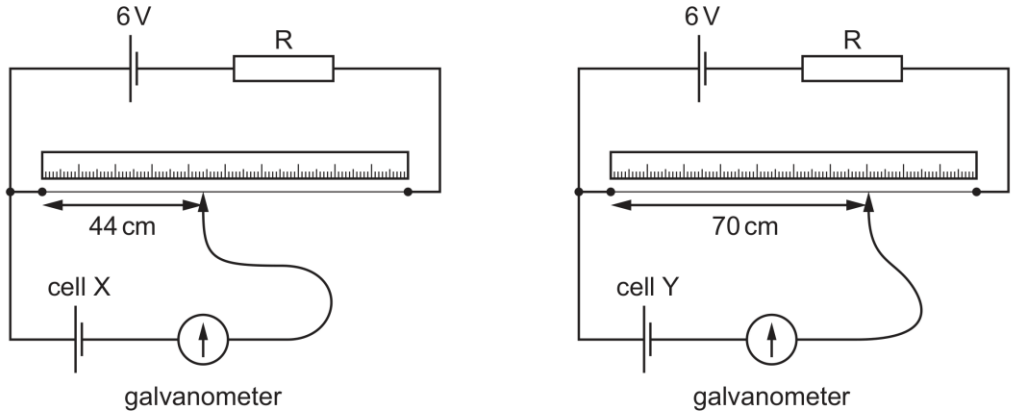
C



D



29 Two cells are investigated using a potentiometer. At the balance point, cell X gives a reading of 44 cm and cell Y gives a reading of 70 cm.



Which statement is **not** correct?

A A potentiometer balance point results in zero current through the galvanometer.

B At the balance point, the current through resistor R in both circuits is the same.

C The electromotive force (e.m.f.) of cell X is larger than that of cell Y.

D The value of the e.m.f. of each of the cells X and Y is less than 6 V.