

# DC Circuits

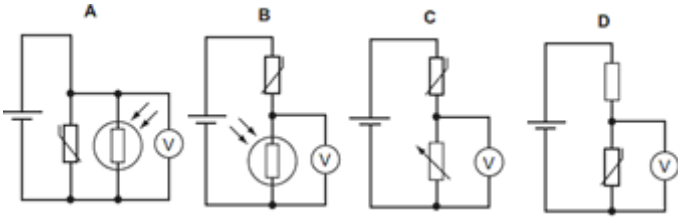
## TOPIC QUESTIONS (2)

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

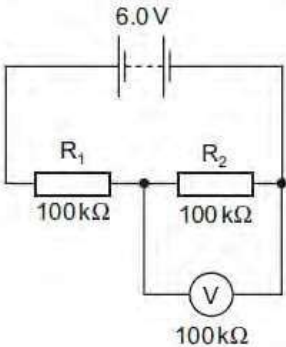
Time Allowed : 1hour 10min

EXAM PAPERS PRACTICE

1. A thermistor and another component are connected to a constant voltage supply. A voltmeter is connected across one of the components. The temperature of the thermistor is then reduced but no other changes are made.  
In which circuit will the voltmeter reading increase?

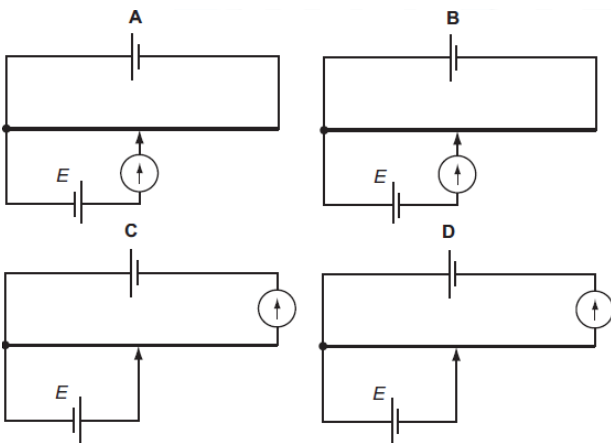


2. In the circuit shown, the 6.0 V battery has negligible internal resistance. Resistors  $R_1$  and  $R_2$  and the voltmeter have resistance  $100\text{ k}\Omega$ .

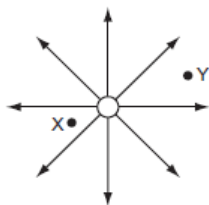


- What is the current in the resistor  $R_2$ ?  
A  $20\text{ }\mu\text{A}$  B  $30\text{ }\mu\text{A}$  C  $40\text{ }\mu\text{A}$  D  $60\text{ }\mu\text{A}$

3. The unknown e.m.f.  $E$  of a cell is to be determined using a potentiometer circuit. The balance length is to be measured when the galvanometer records a null reading.  
What is the correct circuit to use?



4. The diagram shows the electric field near a point charge and two electrons X and Y.



- Which row describes the forces acting on X and Y? direction of force magnitude of force on X

	direction of force	magnitude of force on X
A	radially inwards	less than force on Y
B	radially inwards	greater than force on Y
C	radially outwards	less than force on Y
D	radially outwards	greater than force on Y

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

What is the weight of the particle?

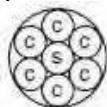
- A  $2.1 \times 10^{-14} \text{N}$    B  $2.1 \times 10^{-15} \text{N}$    C  $2.1 \times 10^{-17} \text{N}$    D  $1.1 \times 10^{-23} \text{N}$

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

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

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

7. An electric power cable consists of six copper wires surrounding a steel core.

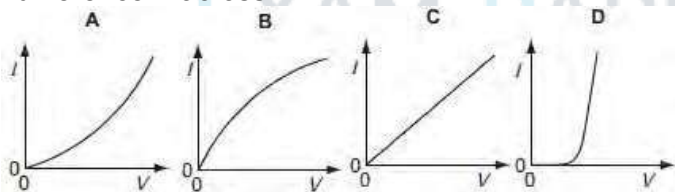


1.0 km of one of the copper wires has a resistance of  $10 \Omega$  and 1.0 km of the steel core has a resistance of  $100 \Omega$ .

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

- A  $0.61 \Omega$    B  $1.6 \Omega$    C  $160 \Omega$    D  $610 \Omega$

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

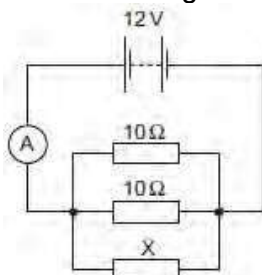


9. The charge that a fully-charged 12 V car battery can supply is 100 kC. The starter motor of the car requires a current of 200 A for an average period of 2.0 s. The battery does not recharge because of a fault.

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

- A 21   B 25   C 42   D 250

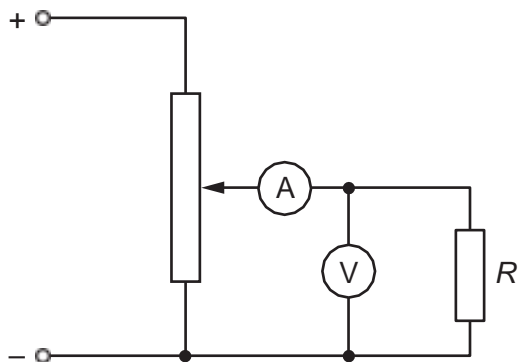
10. The diagram shows a circuit containing three resistors in parallel.



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

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

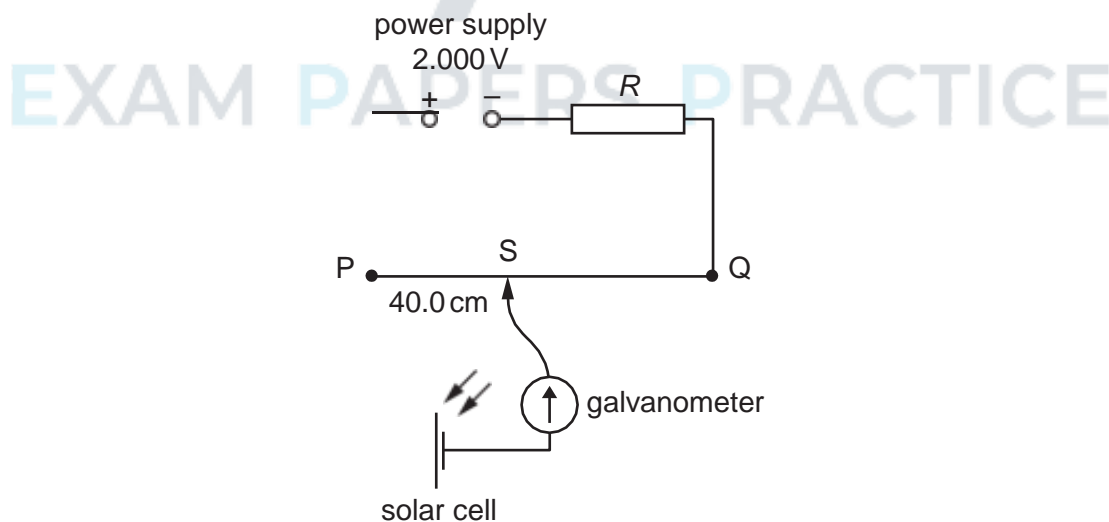
11. In the circuit below, a voltmeter of resistance  $R_V$  and an ammeter of resistance  $R_A$  are used to measure the resistance  $R$  of the fixed resistor.



Which condition is necessary for an accurate value to be obtained for  $R$ ?

- A  $R$  is much smaller than  $R_V$ .
- B  $R$  is much smaller than  $R_A$ .
- C  $R$  is much greater than  $R_V$ .
- D  $R$  is much greater than  $R_A$ .

12. A power supply and a solar cell are compared using the potentiometer circuit shown.



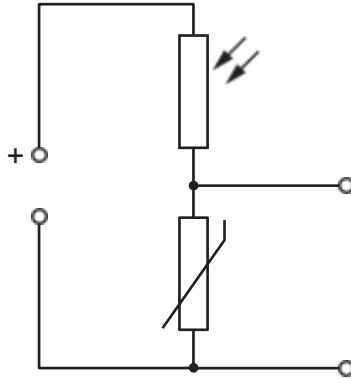
The e.m.f. produced by the solar cell is measured on the potentiometer.

The potentiometer wire PQ is  $100.0\ \text{cm}$  long and has a resistance of  $5.00\ \Omega$ . The power supply has an e.m.f. of  $2.000\ \text{V}$  and the solar cell has an e.m.f. of  $5.00\ \text{mV}$ .

Which resistance  $R$  must be used so that the galvanometer reads zero when  $PS = 40.0\ \text{cm}$ ?

- A  $395\ \Omega$
- B  $795\ \Omega$
- C  $995\ \Omega$
- D  $1055\ \Omega$

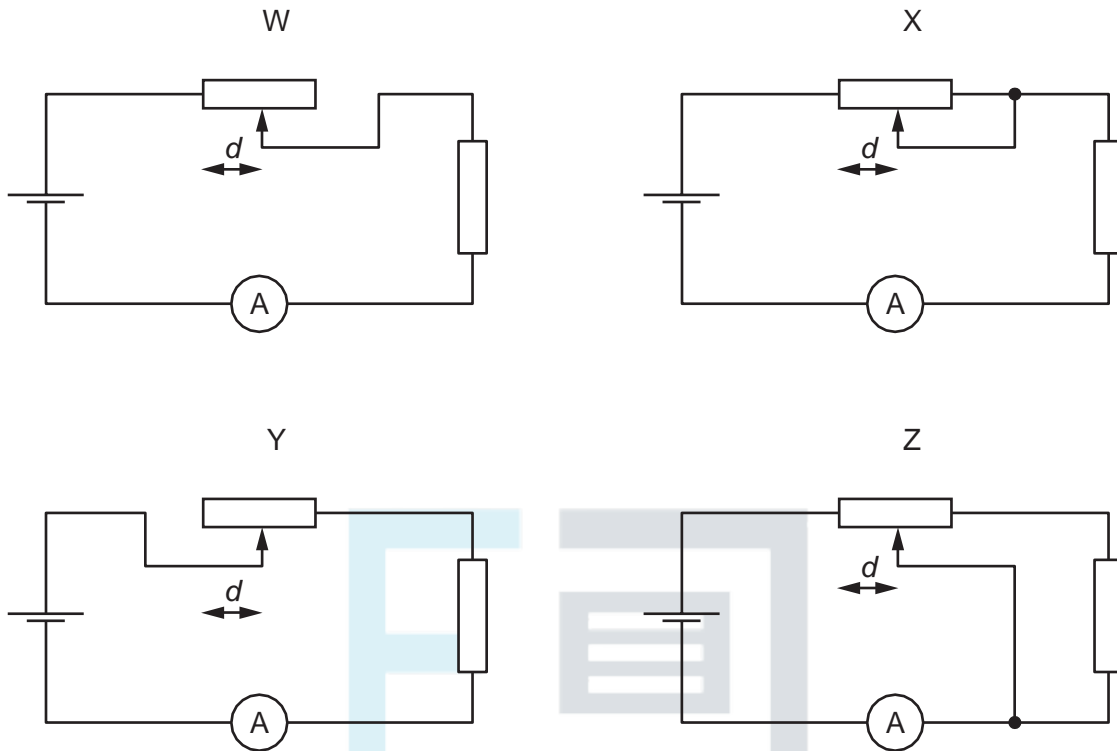
13. The diagram shows a light-dependent resistor (LDR) and a thermistor forming a potential divider.



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

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

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

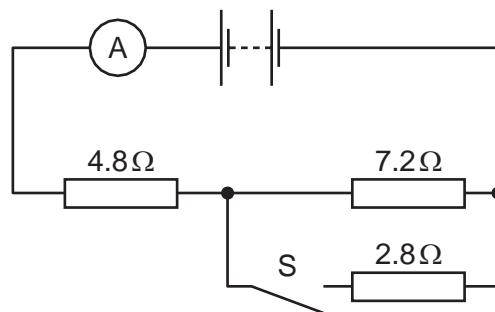


The distance  $d$  between the sliding contact and a particular end of the potentiometer is varied. The current measured is then plotted against the distance  $d$ .

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

15. A battery of negligible internal resistance is connected to a resistor network, an ammeter and a switch S, as shown.

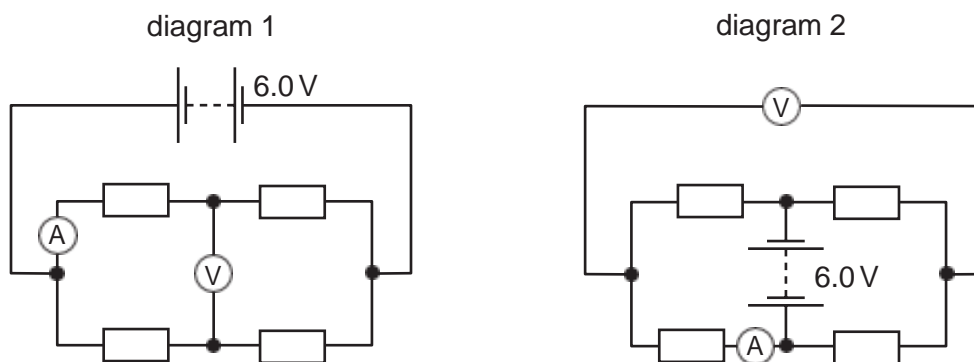


When S is open, the reading on the ammeter is 250 mA.

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

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

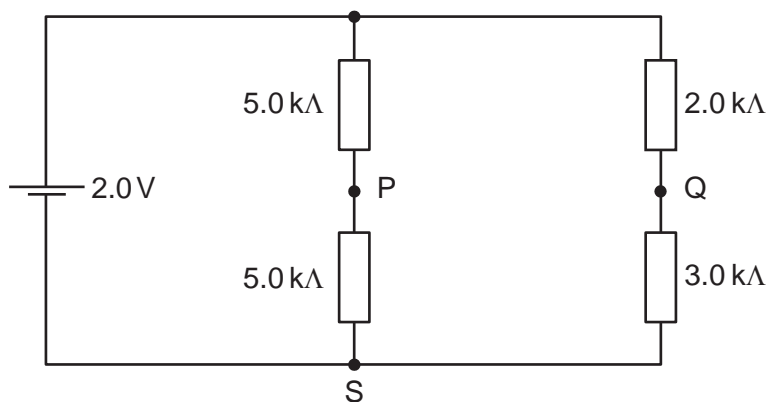


The resistors and meters are reconnected to the supply as shown in diagram 2.

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

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

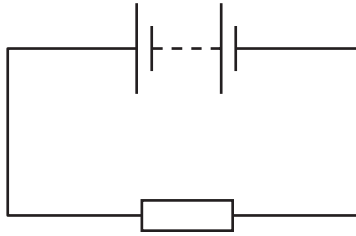


$V_1$  is the potential difference between S and P.  $V_2$  is the potential difference between S and Q.

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

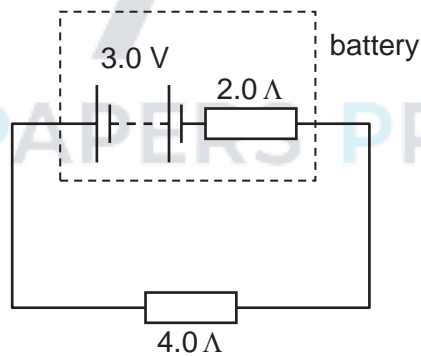
18. In the circuit below, the battery converts an amount  $E$  of chemical energy to electrical energy when charge  $Q$  passes through the resistor in time  $t$ .



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

	e.m.f.	c
A	$EQ$	$Q/t$
B	$EQ$	$QT$
C	$E/Q$	$Q/t$
D	$E/Q$	$QT$

19. A battery has an e.m.f. of  $3.0\text{ V}$  and an internal resistance of  $2.0\ \Omega$ .



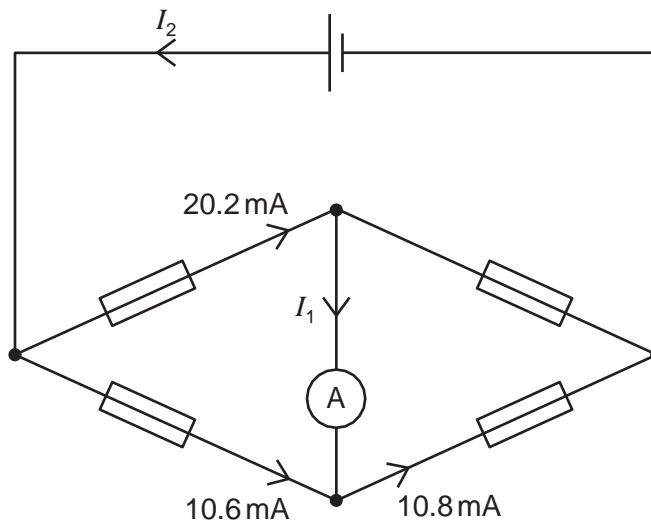
The battery is connected to a load of  $4.0\ \Omega$ .

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

	$V/\text{V}$	$P/\text{W}$
A	1.0	0.50
B	1.0	1.5
C	2.0	1.0
D	2.0	1.5



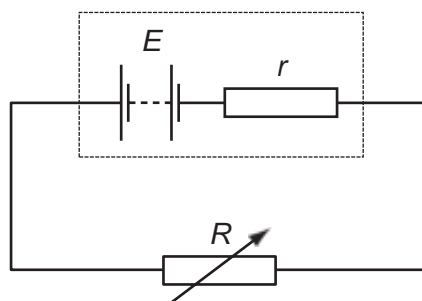
20. The diagram represents a circuit.



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 mA
B	0.2 mA	30 mA
C	-0.2 mA	20 mA
D	-0.2 mA	30 mA

21. A battery with e.m.f.  $E$  and internal resistance  $r$  is connected in series with a variable external resistor.



The value of the external resistance  $R$  is slowly increased from zero.

Which statement is correct? (Ignore any temperature effects.)

- A. The potential difference across the external resistance decreases.
- B. The potential difference across the internal resistance increases.
- C. The power dissipated in  $r$  increases and then decreases.

D. The power dissipated in  $R$  increases and then decreases.

22. A cell of e.m.f.  $E$  delivers a charge  $Q$  to an external circuit.

Which statement is correct?

- A The energy dissipation in the external circuit is  $EQ$ .
- B The energy dissipation within the cell is  $EQ$ .
- C The external resistance is  $EQ$ .
- D The total energy dissipation in the cell and the external circuit is  $EQ$ .



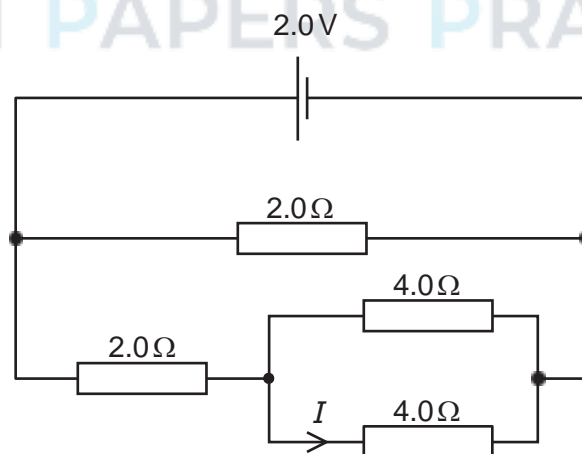
EXAM PAPERS PRACTICE

23. 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

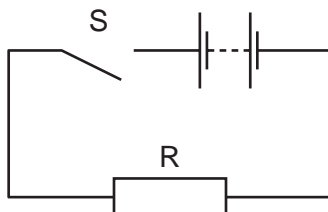
24. A cell of e.m.f. 2.0 V and negligible internal resistance is connected to a network of resistors as shown.



What is the current  $I$ ?

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

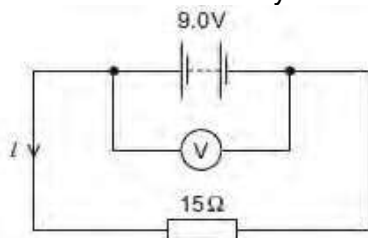
25. The diagram shows a simple circuit.



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 of 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 of R.

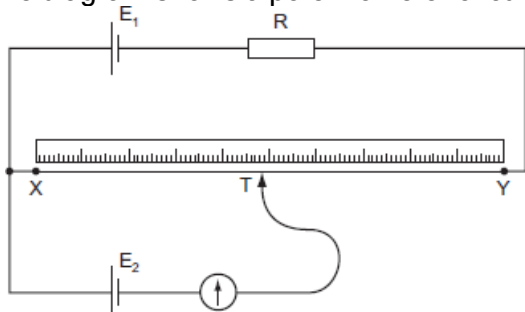
26. The e.m.f. of the battery is 9.0 V. The reading on the high-resistance voltmeter is 7.5 V.



What is the current  $I$ ?

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

27. The diagram shows a potentiometer circuit.

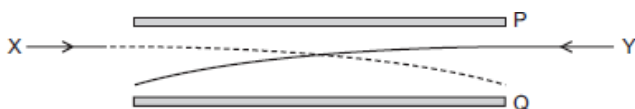


The contact T is placed on the wire and moved along the wire until the galvanometer reading is zero. The length XT is then noted.

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

- A the e.m.f. of the cell E1
- B the e.m.f. of the cell E2
- C the resistance of resistor R
- D the resistance of the wire XY

28. The diagram shows the paths of two charged particles, X and Y, during their passage between a pair of oppositely charged metal plates, P and Q.



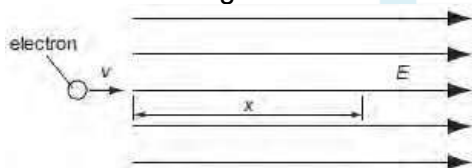
The plates are charged such that the electric field between them is directed from Q to P. Which charges on X and Y will produce the observed paths?

	X	Y
A	-	-
B	-	+
C	+	-
D	+	+

29. There is a potential difference between a pair of parallel plates. Which values of potential difference and separation of the plates will produce an electric field strength of the greatest value?

	potential difference	separation
A	2V	2d
B	2V	$\frac{d}{2}$
C	$\frac{V}{2}$	2d
D	$\frac{V}{2}$	$\frac{d}{2}$

30. The diagram shows an electron, with charge  $e$ , mass  $m$ , and velocity  $v$ , entering a uniform electric field of strength  $E$ .



The direction of the field and the electron's motion are both horizontal and to the right. Which expression gives the distance  $x$  through which the electron travels before it stops momentarily?

A  $x = \frac{mv}{E}$    
 B  $x = \frac{mv}{Ee}$    
 C  $x = \frac{mv^2}{2E}$    
 D  $x = \frac{mv^2}{2Ee}$

31. Which amount of charge, flowing in the given time, will produce the largest current?

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

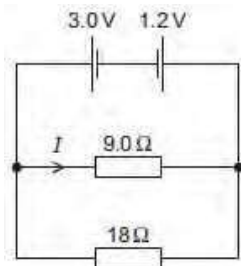
32. A 12 V battery is charged for 20 minutes by connecting it to a source of electromotive force (e.m.f.). The battery is supplied with  $7.2 \times 10^4$  J of energy in this time. How much charge flows into the battery? A 5.0 C B 60 C C 100 C D 6000 C

33. What is meant by the electromotive force (e.m.f.) of a cell?

- A. The e.m.f. of a cell is the energy converted into electrical energy when unit charge passes through the cell.
- B. The e.m.f. of a cell is the energy transferred by the cell in driving unit charge through the external resistance.
- C. The e.m.f. of a cell is the energy transferred by the cell in driving unit charge through the internal resistance of the cell.
- D. The e.m.f. of a cell is the amount of energy needed to bring a unit positive charge from infinity to its

positive pole.

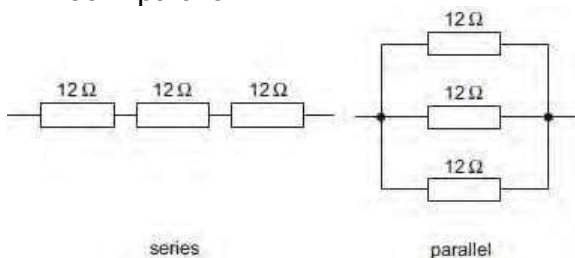
34. Two cells of e.m.f. 3.0 V and 1.2 V and negligible internal resistance are connected to resistors of resistance 9.0  $\Omega$  and 18  $\Omega$  as shown.



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

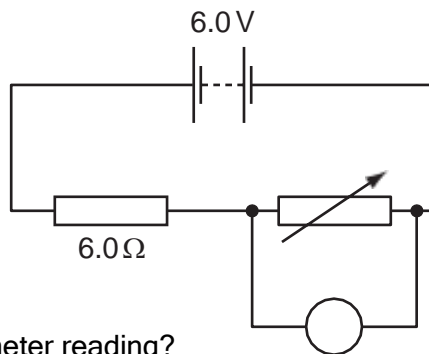
35. Six identical 12  $\Omega$  resistors are arranged in two groups, one with three in series and the other with three in parallel.



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

	series	parallel
A	4.0 $\Omega$	0.25 $\Omega$
B	4.0 $\Omega$	36 $\Omega$
C	36 $\Omega$	0.25 $\Omega$
D	36 $\Omega$	4.0 $\Omega$

36. 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.



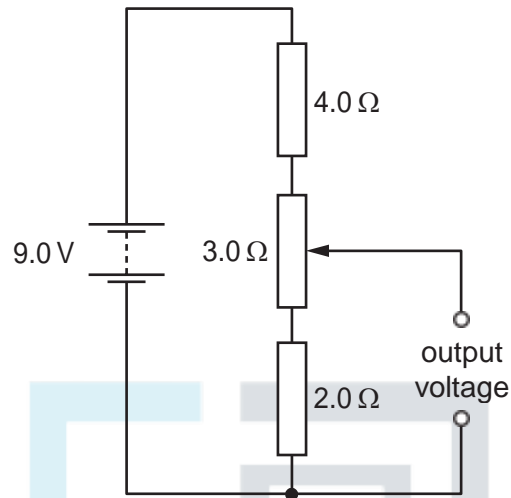
What is the range of the voltmeter reading?

- 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

0–4.0 Ω

V

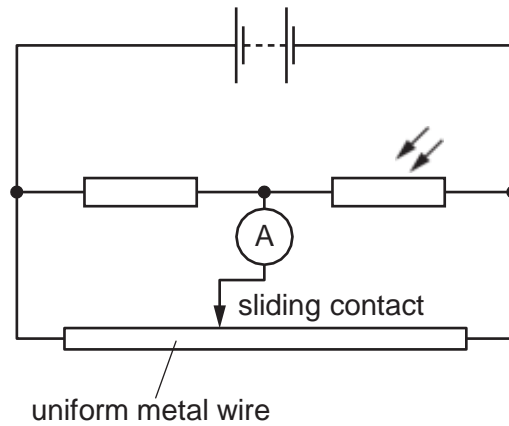
37. A potential divider circuit consists of fixed resistors of resistance  $2.0\ \Omega$  and  $4.0\ \Omega$  connected in series with a  $3.0\ \Omega$  resistor fitted with a sliding contact. These are connected across a battery of e.m.f.  $9.0\ \text{V}$  and zero internal resistance, as shown.



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

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



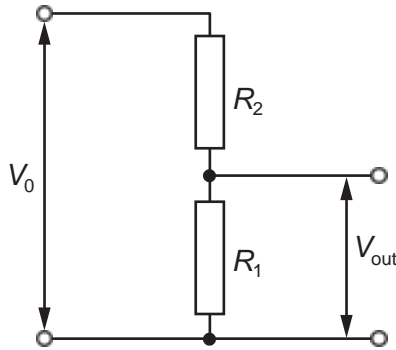
The light-dependent resistor (LDR) is then covered up and the ammeter gives a non-zero reading.

Which change could return the ammeter reading to zero?

- A. Decrease the supply voltage.
- B. Increase the supply voltage.
- C. Move the sliding contact to the left.
- D. Move the sliding contact to the right.



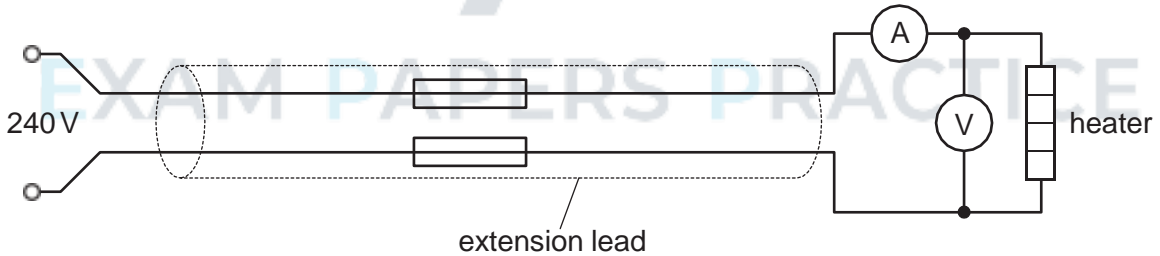
39. A potential divider consists of resistors of resistance  $R_1$  and  $R_2$  connected in series across a source of potential difference  $V_0$ . The potential difference across  $R_1$  is  $V_{out}$ .



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

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

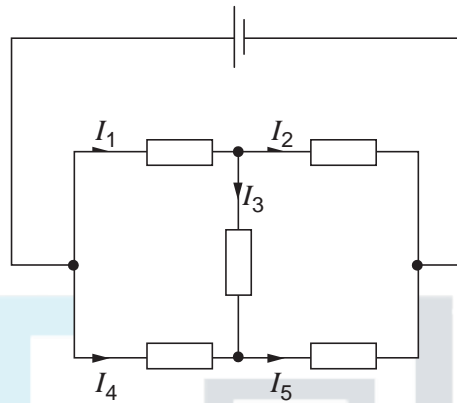


A voltmeter measures the potential difference (p.d.) across the heater as 216V and an ammeter measures the current through the heater as 7.7A.

What is the total resistance of the extension lead?

- A  $3.1\ \Omega$       B  $6.2\ \Omega$       C  $28\ \Omega$       D  $31\ \Omega$

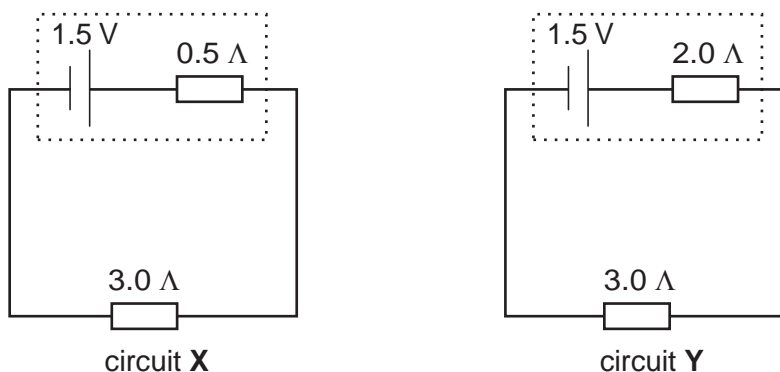
41. The diagram shows currents  $I_1$ ,  $I_2$ ,  $I_3$ ,  $I_4$  and  $I_5$  in different branches of a circuit.



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**  $I_4 = I_5 + I_3$

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



Which line in the table is correct?

	potential difference across 3.0 $\Omega$ resistor	power dissipated in 3.0 $\Omega$ resistor
<b>A</b>	greater in X than in Y	less in X than in Y
<b>B</b>	greater in X than in Y	greater in X than in Y
<b>C</b>	less in X than in Y	less in X than in Y
<b>D</b>	less in X than in Y	greater in X than in Y

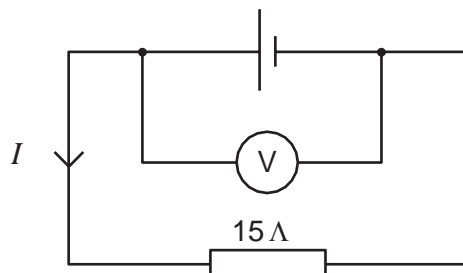
## EXAM PAPERS PRACTICE

43. 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.

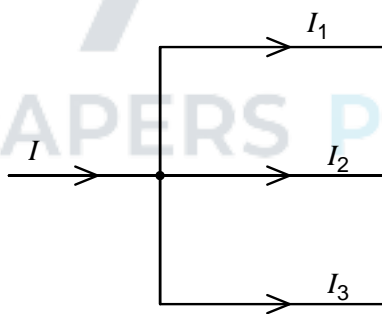
44. The e.m.f. of the cell in the following circuit is 9.0 V. The reading on the high-resistance voltmeter is 7.5 V.



What is the current  $I$ ?

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

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



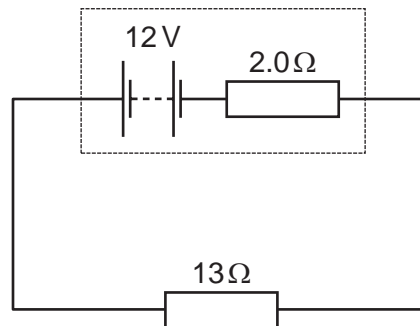
These currents are related by the equation

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

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

46. A power supply of electromotive force (e.m.f.) 12 V and internal resistance  $2.0\ \Omega$  is connected in series with a  $13\ \Omega$  resistor.



What is the power dissipated in the  $13\ \Omega$  resistor?

- A 8.3W      B 9.6W      C 10W      D 11W



EXAM PAPERS PRACTICE

47. When a battery is connected to a resistor, the battery gradually becomes warm. This causes the internal resistance of the battery to increase whilst its e.m.f. stays unchanged.

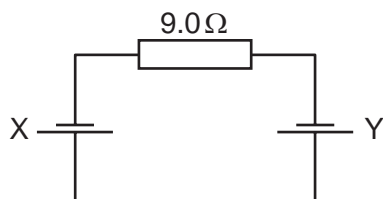
As the internal resistance of the battery increases, how do the terminal potential difference and the output power change, if at all?

	terminal potential difference	output power
A	decrease	decrease
B	decrease	unchanged
C	unchanged	decrease
D	unchanged	unchanged

48. 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

49. Two cells X and Y are connected in series with a resistor of resistance  $9.0\ \Omega$ , as shown.

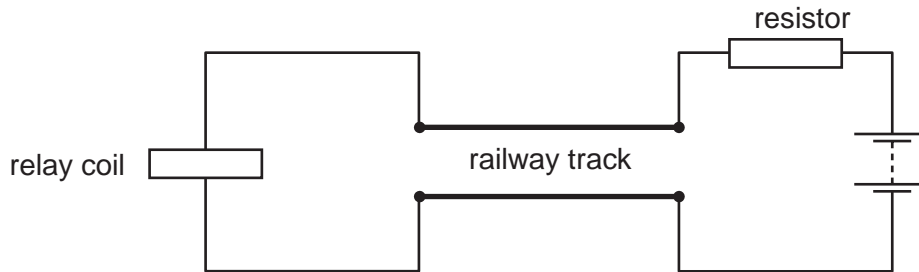


Cell X has an electromotive force (e.m.f.) of  $1.0\text{V}$  and an internal resistance of  $1.0\ \Omega$ . Cell Y has an e.m.f. of  $2.0\text{V}$  and an internal resistance of  $2.0\ \Omega$ .

What is the current in the circuit?

- A  $0.25\text{A}$       B  $0.17\text{A}$       C  $0.10\text{A}$       D  $0.083\text{A}$

50. The diagram shows a length of track from a model railway connected to a battery, a resistor and a relay coil.



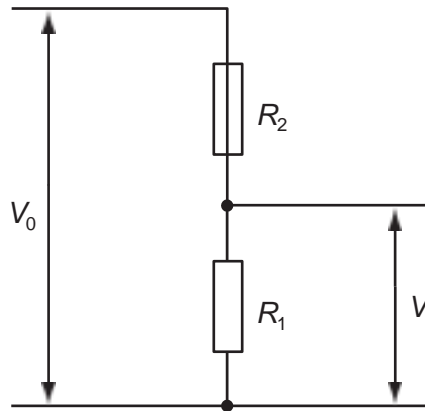
With no train present, there is a current in the relay coil which operates a switch to turn on a light.

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

51. 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  $\frac{V_0 R_1}{R_2}$

B  $\frac{V_0 R_1}{R_1 + R_2}$

C  $\frac{V_0 R_2}{R_1 + R_2}$

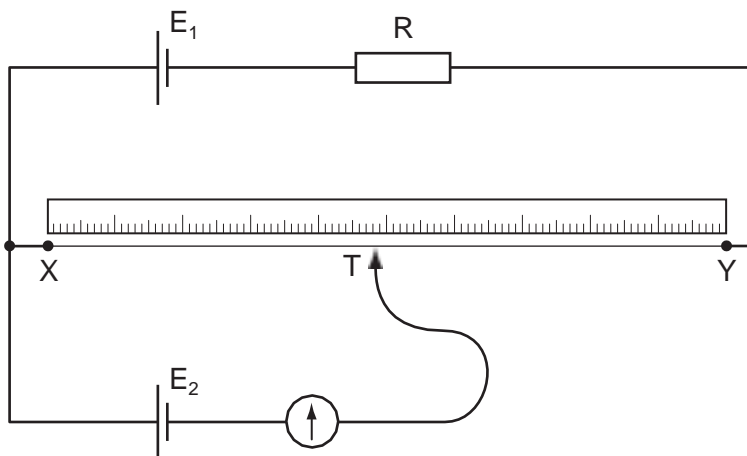
D  $\frac{V_0 (R_1 + R_2)}{R_1}$





# EXAM PAPERS PRACTICE

52. The diagram shows a potentiometer circuit.



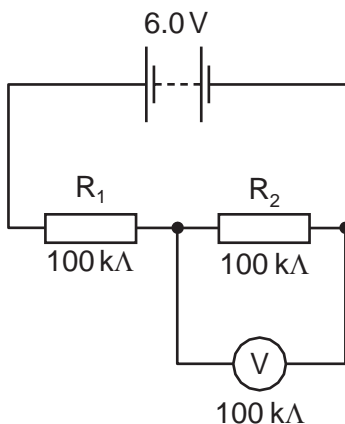
The contact T is placed on the wire and moved along the wire until the galvanometer reading is zero. The length XT is then noted.

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

- A the e.m.f. of the cell  $E_1$
- B the e.m.f. of the cell  $E_2$
- C the resistance of resistor R
- D the resistance of the wire XY

EXAM PAPERS PRACTICE

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

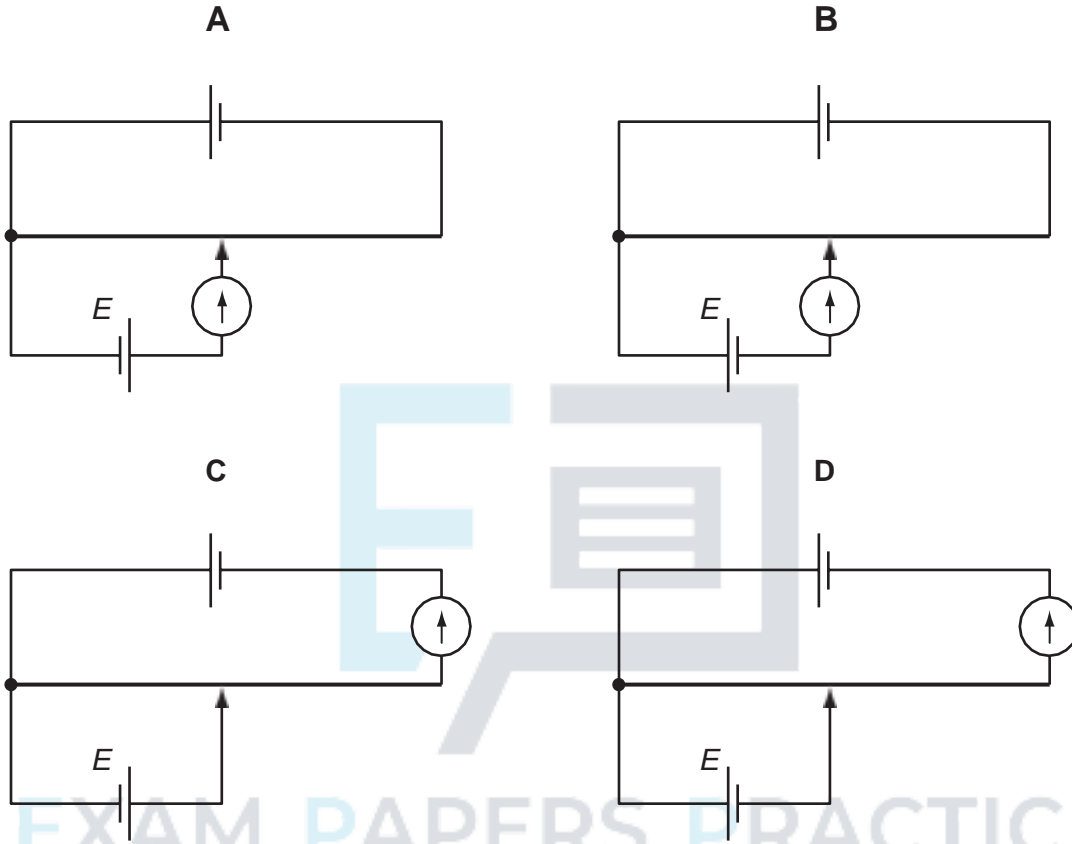


What is the current in the resistor  $R_2$ ?

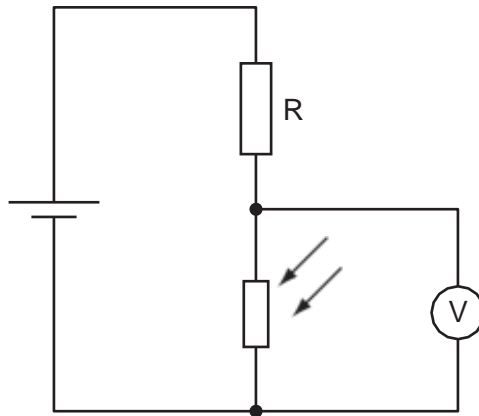
- A  $20\text{ }\mu\text{A}$
- B  $30\text{ }\mu\text{A}$
- C  $40\text{ }\mu\text{A}$
- D  $60\text{ }\mu\text{A}$

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

What is the correct circuit to use?



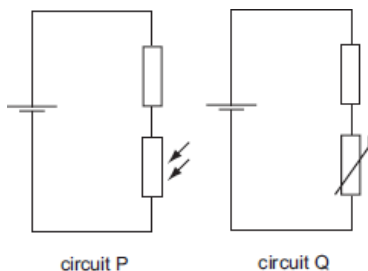
55. A potential divider consists of a fixed resistor  $R$  and a light-dependent resistor (LDR).



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.

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



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

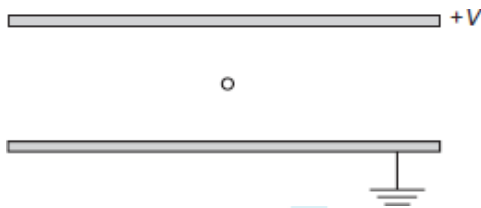
	circuit P	circuit Q
A	decrease	decrease
B	decrease	increase
C	increase	decrease
D	increase	increase

57. A small charge  $q$  is placed in the electric field of a large charge  $Q$ . Both charges experience a force  $F$ .

What is the electric field strength of the charge  $Q$  at the position of the charge  $q$ ?

- A  $\frac{F}{Qq}$     B  $\frac{F}{Q}$     C  $FqQ$     D  $\frac{F}{q}$

58. The diagram shows two parallel horizontal metal plates held at a potential difference  $V$ .



A small charged liquid drop, midway between the plates, is held in equilibrium by the combination of its weight and the electric force acting on it. The acceleration of free fall is  $g$  and the electric field strength is  $E$ .

What is the ratio of the charge to mass of the drop, and the polarity of the charge on the drop?

	charge mass	polarity
A	$\frac{g}{E}$	positive
B	$\frac{g}{E}$	negative
C	$\frac{E}{g}$	positive
D	$\frac{E}{g}$	negative

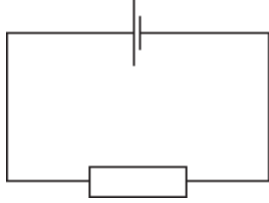
59. The electric field at a certain distance from an isolated alpha particle is  $3.0 \times 10^7 \text{ N C}^{-1}$ .

What is the force on an electron when at that distance from the alpha particle?

- A  $4.8 \times 10^{-12} \text{ N}$     B  $9.6 \times 10^{-12} \text{ N}$   
 C  $3.0 \times 10^7 \text{ N}$     D  $6.0 \times 10^7 \text{ N}$

60. A cell is connected to a resistor.

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



Which statement explains this?

- A The cell is continually discharging.
- B The connecting wire has some resistance.
- C Energy is needed to drive charge through the cell.
- D Power is used when there is a current in the resistor



EXAM PAPERS PRACTICE