

Self-Assessment

Module 1 : Kirchhoff's Laws

Q.3.1.1 Kirchhoff's current law is a statement of

- (A) Conservation of current vector
- (B) Conservation of energy
- (C) Conservation of linear momentum
- (D) Conservation of charge.

Q.3.1.2 Fig.Q.3.1.1 shows a part of a network. What is the value of I ?

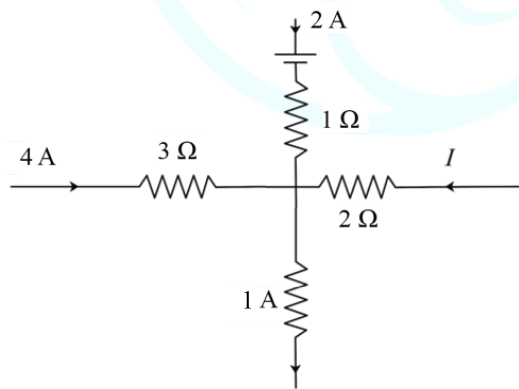


Fig.Q.3.1.1

- (A) 2 A
- (B) -5 A
- (C) +5 A
- (D) 3 A

Q.3.1.3 Fig.Q.3.1.2 shows a part of a network.

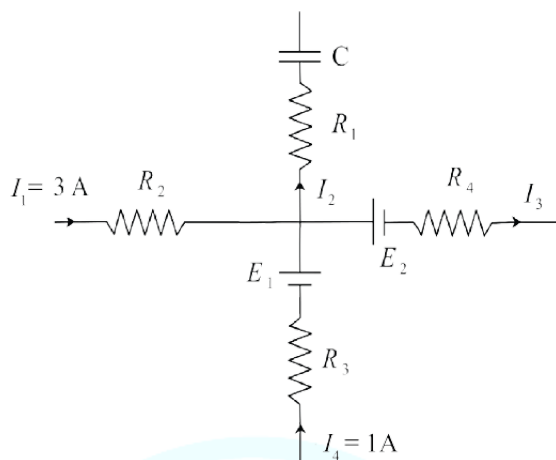


Fig.Q.3.1.2

What are the values of I_2 and I_3 ?

- (A) $I_2 = 0$; $I_3 = 4$ A
- (B) $I_2 = I_3 = 2$ A
- (C) $I_2 = 0$; $I_3 = -4$ A
- (D) $I_2 = 1$ A; $I_3 = 3$ A

Q.3.1.4 Fig.Q.3.1.3 shows a branch of a network. The p.d (V) across the cell is

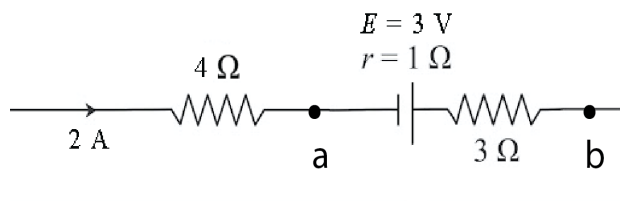


Fig.Q.3.1.3

- (A) 5 V
- (B) 1 V
- (C) 3 V
- (D) 4 V

Q.3.1.5 Fig.Q.3.1.4 shows a part of a network.

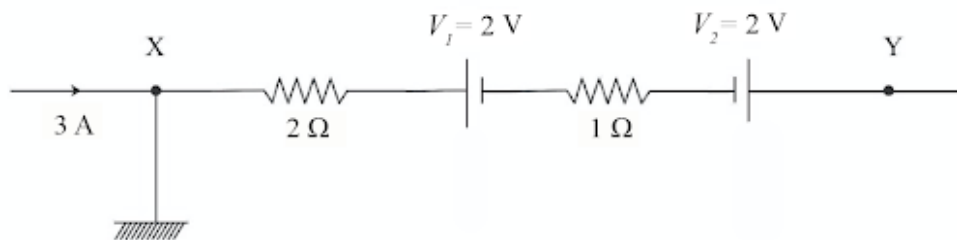


Fig.Q.3.1.4

The potential of point Y (in volt) (assuming Y end to be open) is

- (A) 0
- (B) -13
- (C) +9
- (D) -9

Q.3.1.6 Fig.Q.3.1.5 Shows two cells E_1 and E_2 connected across an external resistance R . The equivalent e.m.f (E_{eq}) and the equivalent internal resistance (r_{eq}) of the two cells are

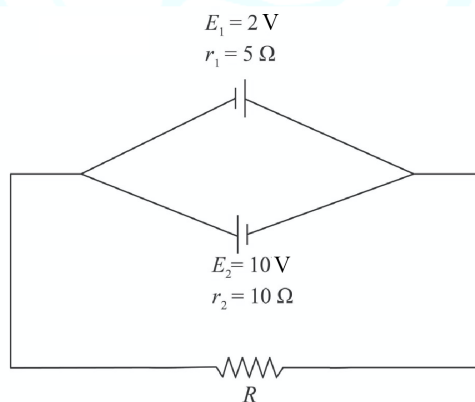


Fig.Q.3.1.5

- (A) $E_{eq} = 4.67 \text{ V}; r_{eq} = 15 \Omega$
- (B) $E_{eq} = 2 \text{ V}; r_{eq} = 3.33 \Omega$
- (C) $E_{eq} = 8 \text{ V}; r_{eq} = 3.33 \Omega$
- (D) $E_{eq} = 12 \text{ V}; r_{eq} = 15 \Omega$

Q.3.1.7 Kirchhoff's loop rule is a restatement of

- (A) Law of conservation of charge
- (B) Law of conservation of linear momentum
- (C) Law of conservation of energy
- (D) Law of conservation of linear momentum and law of conservation of charge applied simultaneously.

Q.3.1.8 Fig.Q.3.1.6 shows two cells of e.m.f E_1 and E_2 ($E_2 > E_1$) and internal resistances r_1 and r_2 respectively; connected across an external resistance R . The p.d of cell E_1 is zero. What is the value of R ?

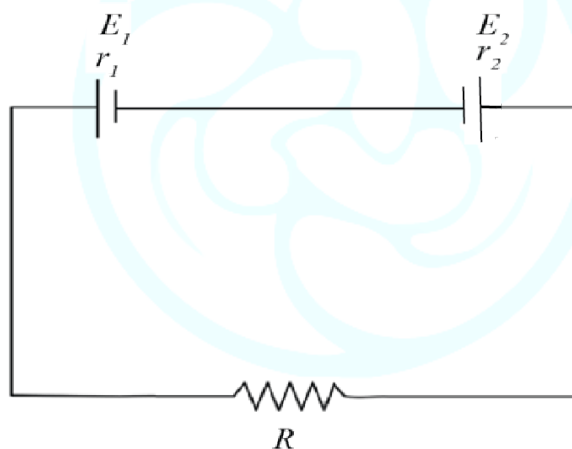


Fig.Q.3.1.6

- (A) $r_1 \simeq r_2$
- (B) $\left(\frac{E_1}{E_2}\right)r_1 - r_2$
- (C) $\left(\frac{E_2}{E_1}\right)r_1 - r_2$
- (D) $\left(\frac{E_2}{E_1}\right)r_2 - r_1$

Q.3.1.9 Fig.Q.3.1.7 shows a circuit arrangement. A is an ideal ammeter. Reading of ammeter (A) is

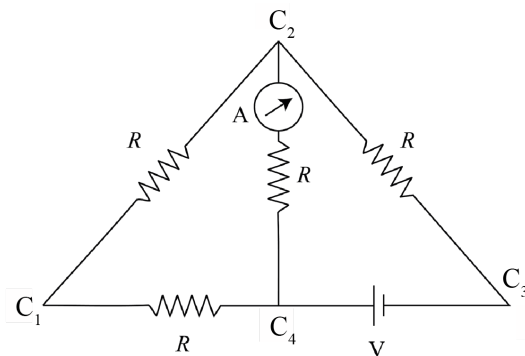


Fig.Q.3.1.7

- (A) $\frac{3V}{5R}$
- (B) $\frac{2V}{5R}$
- (C) $\frac{3V}{R}$
- (D) $\frac{5V}{3R}$

Q.3.1.10 In the circuit shown in Fig.Q.3.1.8

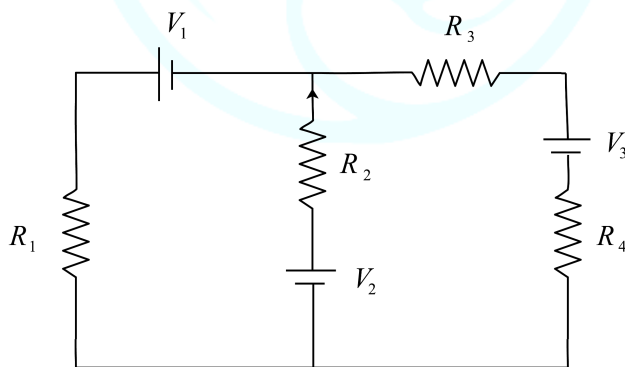


Fig.Q.3.1.8

$$V_1 = 4 \text{ V}, V_2 = 3 \text{ V}, V_3 = 5 \text{ V}; R_1 = 1 \Omega, R_2 = 2 \Omega; R_3 = 3 \Omega; R_4 = 5 \Omega$$

The current in the branch of cell V_1 (in A)is

- (A) $\frac{27}{13}$
- (B) $-\frac{27}{13}$
- (C) $\frac{37}{13}$
- (D) $-\frac{37}{13}$

Module 2 : Wheatstone Bridge

Q.3.2.1 $R_1 = 4\ \Omega$, $R_2 = 6\ \Omega$, $R_3 = 2\ \Omega$, $R_4 = 4\ \Omega$,
 $R_5 = 10\ \Omega$. V_B and V_D , respectively, denote potentials of points B and D (Fig.Q.3.2.1).

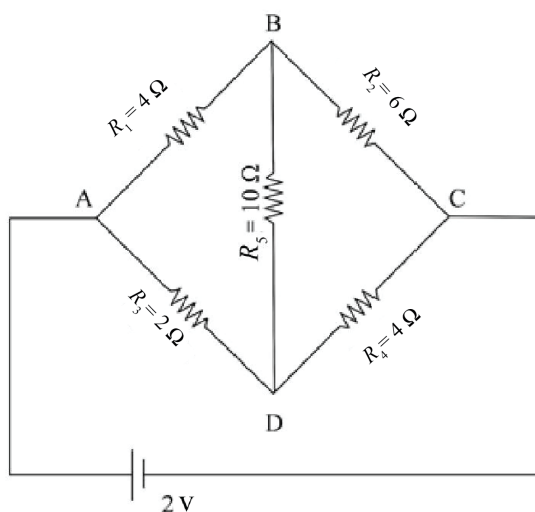


Fig.Q.3.2.1

then which one among the following is acceptable?

- (A) $V_B = V_D$
- (B) $V_B < V_D$
- (C) $V_B > V_D$, but the relation between V_B and V_D can not be ascertained
- (D) $V_B = 2V_D$, where the equality holds in a particular situation

Q.3.2.2 In Fig.Q.3.2.2 R_{AC} and R_{BD} respectively denote the equivalent resistance of the arrangement between the pair of points (i) A and C, (ii) B and D

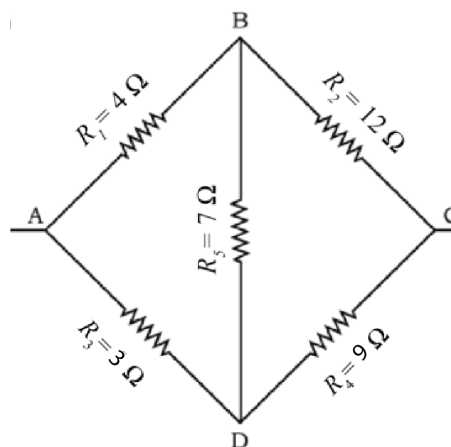


Fig.Q.3.2.2

The ratio $\frac{R_{AC}}{R_{BD}}$ is

- (A) 16/7
- (B) 64/49
- (C) 96/49
- (D) 7/16

Q.3.2.3 For the arrangement of resistors shown in Fig.Q.3.2.3,

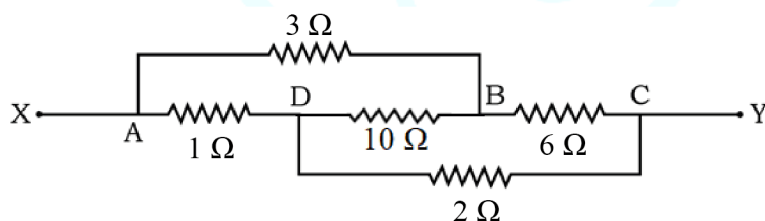


Fig.Q.3.2.3

the equivalent resistance between points X and Y is

- (A) 1.25
- (B) 2.0
- (C) 2.25
- (D) 2.67

Q.3.2.4 Fig.Q.3.2.4 shows an arrangement of resistors.

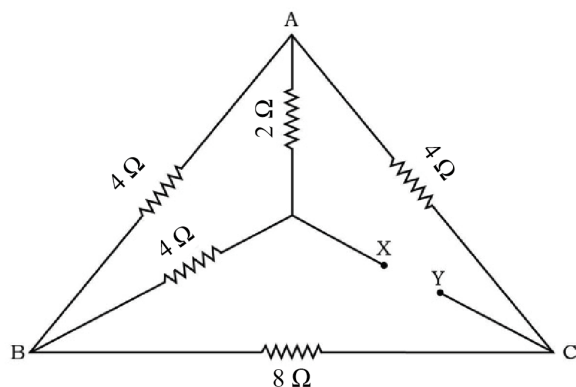


Fig.Q.3.2.4

The equivalent resistance of the arrangement between points X and Y is

- (A) $4\ \Omega$
- (B) $6\ \Omega$
- (C) $8\ \Omega$
- (D) $16\ \Omega$

Q.3.2.5 For the arrangement of resistors shown in Fig.Q.3.2.5;

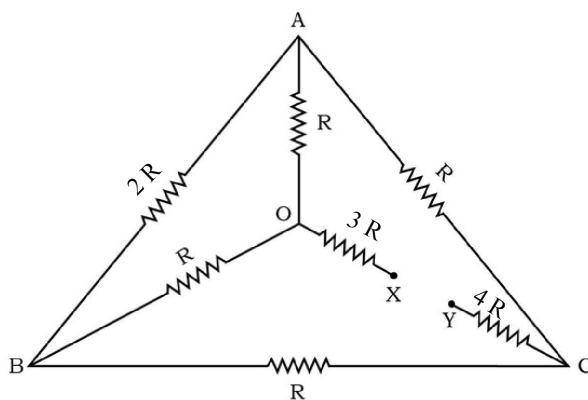


Fig.Q.3.2.5

the equivalent resistance between points X and Y is

- (A) R
- (B) $2R$
- (C) $4R$
- (D) $8R$

Q.3.2.6 Refer to Fig.Q.3.2.6, of the Wheatstone bridge.

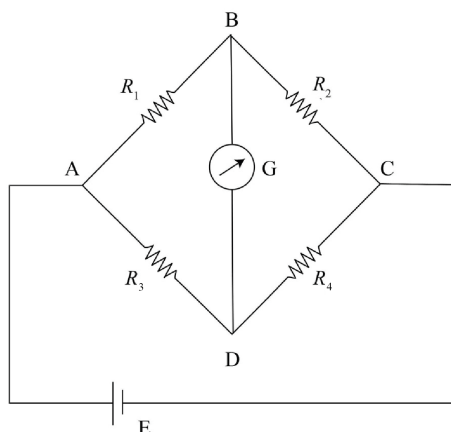


Fig.Q.3.2.6

An observer P; performs the experiment using $R_1 = 5 \Omega$; $R_2 = 10 \Omega$ and $R_3 = 6 \Omega$ and found null deflection for $R_4 = 12 \Omega$. Another observer Q, repeats the experiment taking $R_1 = 500 \Omega$, $R_2 = 1000 \Omega$, $R_3 = 6 \Omega$. He also finds $R_4 = 12 \Omega$ for null deflection. Which of the following statements is correct?

- (A) Error in measurement of P and Q is the same.
- (B) Detecting null points will be easier for Q than for P.
- (C) Measurement of P is more accurate than that of Q.
- (D) Measurement of P is less accurate than that of Q.

Q.3.2.7 Refer to the meter bridge circuit shown in Fig.Q.3.2.7. For $S = 2.2 \Omega$ at balance jockey (J) divides wire AC into two parts having lengths in the ratio of 9:11. The balancing length l and R are

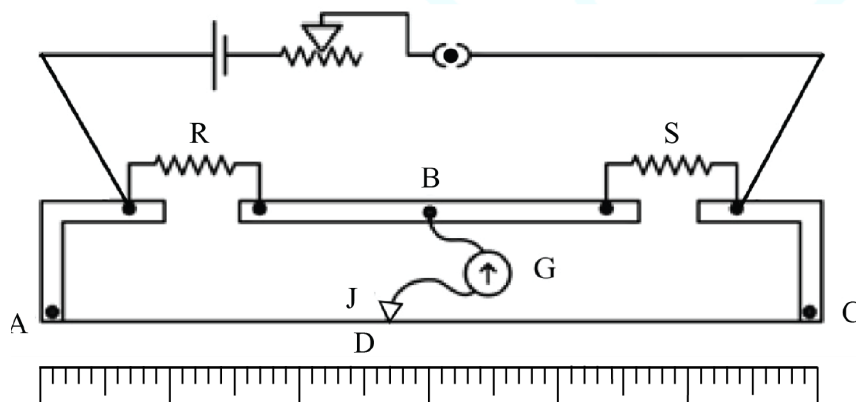


Fig.Q.3.2.7

- (A) $l = 45 \text{ cm}$; $R = 1.8 \Omega$
- (B) $l = 45 \text{ cm}$; $R \approx 2.67 \Omega$

(C) $l = 55 \text{ cm}$; $R \approx 2.67 \Omega$

(D) $l = 55 \text{ cm}$; $R \approx 1.8 \Omega$

Q.3.2.8 Refer to Fig.Q.3.2.8, $R = 2 \Omega$; $S = 4 \Omega$. A resistor of 4Ω is connected in parallel with S. The balancing Length is l_1 . 4Ω resistance connected across S is disconnected and connected in series with R. The balancing length is l_2 . Then $(\frac{l_1}{l_2})$ is

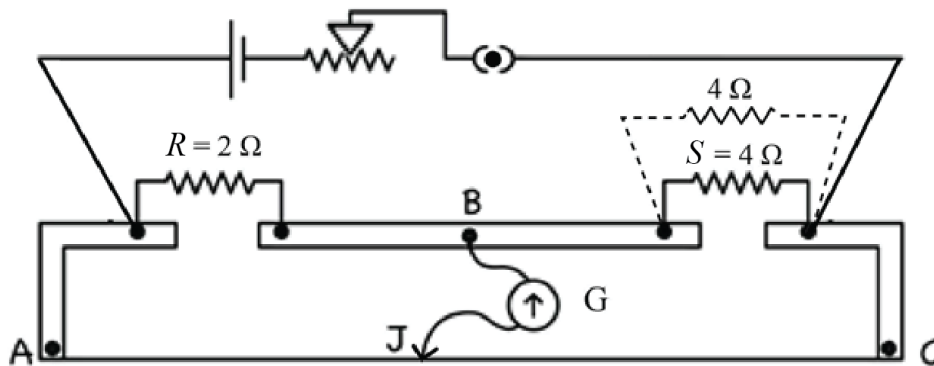


Fig.Q.3.2.8

(A) $5/6$

(B) $6/5$

(C) $1/2$

(D) $2/3$

Q.3.2.9 Refer to Fig.Q.3.2.9, at balance jockey (J) divides bridge wire into two parts having lengths in a ratio of 1:2. Resistors each of value X are connected in series with R and S simultaneously. At balance the jockey divides bridge wire into two parts having lengths in ratio of 2:3. $\frac{X}{R}$ is

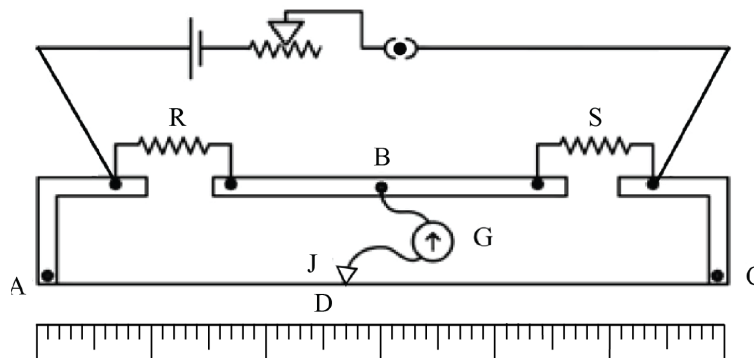


Fig.Q.3.2.9

- (A) 1
- (B) $2/3$
- (C) $1/2$
- (D) $5/4$

Q.3.2.10 Refer to Fig.Q.3.2.10, Which of the following statements is incorrect?

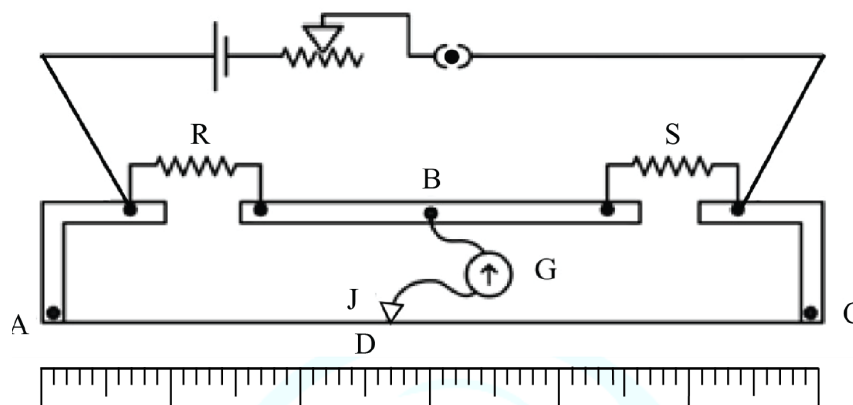


Fig.Q.3.2.10

- (A) For a given value of R and S ; there is only one balancing point.
- (B) Increasing R ; Shifts the balancing point away from end A of the bridge wire
- (C) Increasing S ; shifts the balance point towards end C of the bridge wire.
- (D) Interchanging the position of battery and galvanometer; balance point remains same

Module 3 : Potentiometer

Q.3.3.1 An emf ε is balanced across a length l of a potentiometer wire. The percentage change in potential gradient across potentiometer wire to increase balancing length by 50% is

- (A) +50%
- (B) -50%
- (C) +33.3%
- (D) -33.3%

Q.3.3.2 A potentiometer has a wire of length 1 m having a uniform resistance $0.1 \Omega(\text{cm})^{-1}$. A battery of p.d 5 V is connected across potentiometer wire with a series resistance of 490Ω . The potential gradient across the potentiometer wire is

- (A) $10^{-3} \text{ V}(\text{cm})^{-1}$
- (B) $10^{-2} \text{ V}(\text{cm})^{-1}$
- (C) 10^{-3} Vm^{-1}
- (D) $5 \times 10^{-2} \text{ Vm}^{-1}$

Q.3.3.3 A potentiometer has a wire of length 10 m having a resistance of $2 \Omega\text{m}^{-1}$. A battery of p.d. 4 V is connected across the potentiometer wire and a series resistance R . A p.d. of 20 mV is balanced across 4 m length of potentiometer wire. R equals

- (A) 1600Ω
- (B) 1620Ω
- (C) 1580Ω
- (D) 1598Ω

Q.3.3.4 Two cells of e.m.f E_1 and E_2 ($<E_1$) have internal resistances of 1Ω and 2Ω respectively. Series combination of E_1 and E_2 is balanced across a length l of a potentiometer. E_1 and E_2 are joined in opposition with one another. The balancing length on the same potentiometer is 40% less than l . What is E_1/E_2 ?

- (A) ≈ 1.67
- (B) 0.5
- (C) 0.25
- (D) 4

Q.3.3.5 A potentiometer has a wire of length 4 m. The potential gradient across the potentiometer is 0.2 Vm^{-1} . A source of p.d. 1 V is connected appropriately across the setup. Which of the following statements is **INCORRECT**?

- (A) On moving the jockey from the positive end of the wire to the other, the deflection in the galvanometer in the same direction increases.
- (B) On moving the jockey from the positive end of the wire to the other end deflection in the galvanometer, in the same direction, decreases to a finite non-zero value.
- (C) A balance cannot be obtained for the given p.d.

- (D) The potential gradient across the potentiometer must be more than or equal to 0.25 Vm^{-1} to balance the given p.d.

Q.3.3.6 V_{AB} is the total potential difference across potentiometer wire AB. $E(<V_{AB})$ is an unknown e.m.f between points X and Y in the potentiometer circuit shown in Fig.Q.3.3.1

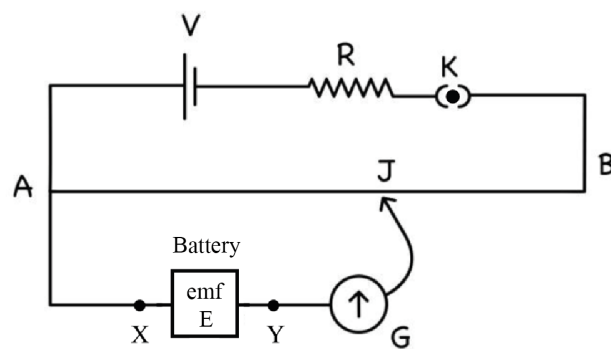


Fig.Q.3.3.1

Moving jockey (J) from end A to end B, the deflection in galvanometer (G) increases in the same direction. To obtain a balance point on the potentiometer wire

- (A) V_{AB} should be increased
- (B) V_{AB} should be decreased
- (C) Galvanometer terminal connections should be interchanged
- (D) The polarity of E should be reversed

Q.3.3.7 Fig.Q.3.3.2 shows a potentiometer arrangement to compare resistors R_1 and R_2 Joining 1 and 3 on a two-way key the balancing length is 5 m.

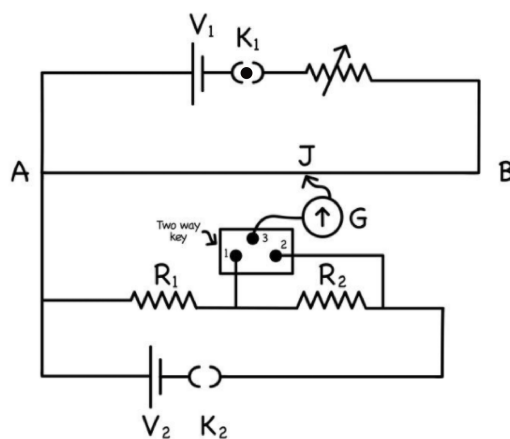


Fig.Q.3.3.2

When two way key is inserted between 2 and 3; the balancing length is 7.5 m R_1/R_2 is

- (A) $2/3$
- (B) $3/2$
- (C) $1/2$
- (D) 2

Q.3.3.8 Fig.Q.3.3.3 shows an ideal ammeter having resistance $R = 5 \Omega$. The reading of the ammeter is 1 A. The p.d. across R is measured using a potentiometer having a potential gradient of $10^{-2} \text{ V}(\text{cm})^{-1}$. The balancing length for p.d across R is 4.5 m.

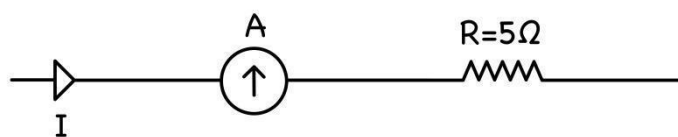


Fig.Q.3.3.3

The percentage error in reading of the ammeter is

- (A) + 10%
- (B) - 10%
- (C) + 11.1% (nearly)
- (D) -11.1% (nearly)

Q.3.3.9 A cell of e.m.f ($=E$); internal resistance ($=r$) has a balancing length l_0 when it (cell) is in an open circuit. On a shunting cell by an external resistance R , the balancing length is l_1 . The shunt resistance is increased and the balancing length observed is l_2 . Which of the following is correct?

- (A) $l_2 = l_0$
- (B) $l_2 > l_1$
- (C) $l_2 < l_1$ but the relation between l_1 and l_2 cannot be ascertained
- (D) $l_1 = \frac{l_2 - l_0}{2}$, where the equality holds is a very restricted sense

Q.3.3.10 An ideal voltmeter connected across a resistance $R = 10 \Omega$ carrying a current measures p.d. across R as 1.9 V. The same p.d is measured by a potentiometer having a potential gradient of 5 mV per centimetre. The balancing length for p.d across R is 4 m. The percentage error in reading of voltmeter is

- (A) +5%

(B) -5%

(C) $+5.5$ (nearly)

(D) $- 5.5 \%$ (nearly)



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