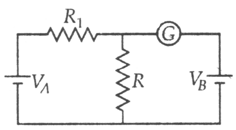
Current Electricity

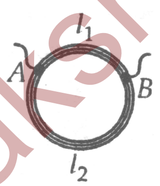
2012

1. **In the circuit shown the cells A and B have negligible resistance. For V_A = 12 V, R_1 = 500 Ω and r = 100 Ω the galvanometer (G) shows no deflection. The value of V_B is**



a) 4V b) 2 V c) 12 V d) 6 V

2. **A ring is made of a wire having a resistance R_0 = 12 Ω. Find the points A and B, as shown in the figure, at which a current carrying conductor should be connected so that the resistance R of the sub circuit between these points is equal to $\frac{8}{3}\Omega$**



a) $\frac{l_1}{l_2}=\frac{5}{8}$ b) $\frac{l_1}{l_2}=\frac{1}{3}$

c) $\frac{l_1}{l_2}=\frac{3}{8}$ d) $\frac{l_1}{l_2}=\frac{1}{2}$

3. **A cell having an emf ε and internal resistance r is connected across a variable external resistance R. As the resistance R is increase, the plot of potential difference V across R is given by**

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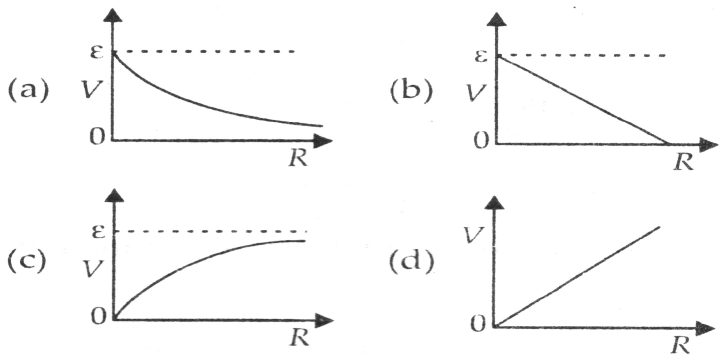


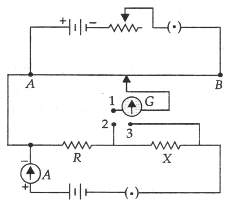
2011

4. A current of 2A flows through a 2 Ω resistor when connected across a battery. The same battery supplied a current of 0.5 A when connected across a 9 Ω resistor. The internal resistance of the battery is

a) 0.5 Ω b) 1/3 Ω c) 1/4 Ω d) 1 Ω

2010

5. A potentiometer circuit is set up as shown. The potential gradient, across the potentiometer wire, is k volt cm and the ammeter, present in the circuit, reads 1.0A when two way key is switched off. The balance points, when the key between the terminals (i) 1 and 2 (ii) 1 and 3, is plugged in, are found to be at lengths l_1 cm and l_2 cm respectively. The magnitudes, of the resistors R and X, in ohms, are then, equal, respectively, to



a) $k(l_2-l_1)$ and kl_2 b) kl_1 and $k(l_2-l_1)$ c) $k(l_2-l_1)$ and kl_1 d) kl_1 and kl_2

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6. **Consider the following two statements.**

(A) Kirchhoff's junction law follows from the conservation of charge

(B) Kirchhoff's loop law follows from the conservation of energy

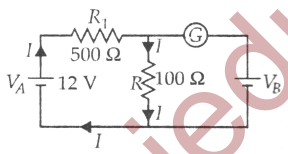
Which of the following is correct?

a) Both (A) and (B) are wrong
b) (A) is correct and (B) is wrong
c) (A) is wrong and (B) is correct
d) Both (A) and (B) are correct

Solutions

1. (b)

Since the galvanometer shows no deflection so current will flow as shown in the figure



Current, $I = \frac{V_A}{R_1 + R} = \frac{12V}{(500+100)\Omega} = \frac{12}{600}A$

$V_B = IR = \left(\frac{12}{600}A\right)(100\Omega) = 2V$

2. (d)

Let x be resistance per unit length of the wire. Then,

The resistance of the upper portion is $R_1 = xl_1$

The resistance of the lower portion is

$$R_2 = xl_2$$

Equivalent resistance between A and B is

$$R = \frac{R_1R_2}{R_1 + R_2} = \frac{(xl_1)(xl_2)}{xl_1 + xl_2}$$

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$\frac{8}{3} = \frac{xl_1l_2}{l_1 + l_2}$ or $\frac{8}{3} = \frac{xl_1l_2}{l_2\left(\frac{l_1}{l_2} + 1\right)}$

Or $\frac{8}{3} = \frac{xl_1l_2}{\left(\frac{l_1}{l_2} + 1\right)}$ …..(i)

Also $R_0 = xl_1 + xl_2$

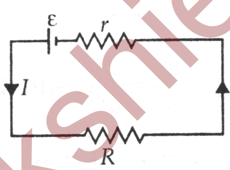
$12 = x(l_1 + l_2)$

$12 = xl_2\left(\frac{l_1}{l_2} + 1\right)$ ….. (ii)

Divide (i) be (ii), we get

$\therefore \frac{l_1}{l_2} = \frac{1}{2}$

3. (c) consider the circuit



Current in the circuit,

$$I = \frac{\varepsilon}{R + r}$$

Potential difference across R,

$$V = IR = \left(\frac{\varepsilon}{R + r}\right)R$$

$$V = \frac{\varepsilon}{1 + \frac{r}{R}}$$

When R = 0, V = 0

$R = \infty$, $V = \varepsilon$

Hence, option (c) represents the correct graph.

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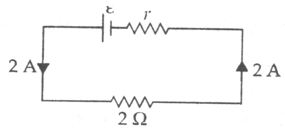
4. (b) Let ε be the emf and r be internal resistance of the battery.

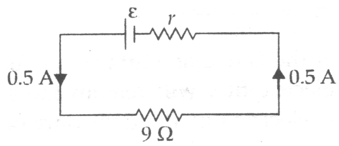
In the first case,



As they are in series

$$e = \frac{\varepsilon}{2+r} \qquad \text{….. (i)}$$

In the second case,



As they are in parallel

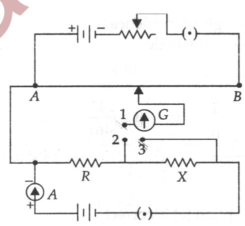
$$0.5 = \frac{\varepsilon}{9+r} \qquad \text{….. (ii)}$$

Divide, (i) by (ii), we get

$$\frac{2}{0.5} = \frac{9+r}{2+r} \quad \Rightarrow \quad 4 + 2r = 4.5 + 0.5\,r$$

$$1.5\,r = 0.5 \quad \Rightarrow r = \frac{0.5}{1.5} = \frac{1}{3}\Omega$$

5 (b)



When the two way key is switched off, then

The current flowing in the resistors R and X is I = 1A

…………………. (i)

When the key between the terminals 1 and 2 is a plugged in then,

the potential difference across R = iR = kl_1

……….(ii)

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Where k is the potential gradient across the potentiometer wire

When the key between the terminals 1 and 3 is plugged in, then

Potential difference across (R+X) = I(R+X) = kl_2

………………. (iii)

From equation (ii), we get $R = \frac{kl_1}{I} = \frac{kl_1}{1} = kl_1 \Omega$

………………. (iv)

From equation (iii), we get $R + X = \frac{kl_2}{I} = \frac{kl_2}{1} = kl_2$ (Using (i))

$X = kl_2 - R$

$= kl_2 - kl_1$

$= k (l_2 - l_1)\ \Omega$

6. (d) Kirchhoff's junction law or Kirchhoff's first law is based on the conservation of charge.

Kirchhoff's loop law or Kirchhoff's second law is based on the conservation of energy.

Hence both statements (A) and (B) are correct.

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