DPP – 10

SOLUTION

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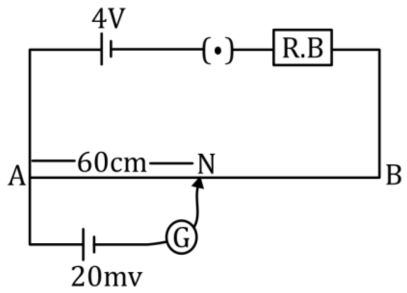
1. Current in circuit $i = \frac{4}{R+20}$



$$V_{AB} = i\,R_{AB} = \frac{4}{(R+20)} \times 20 = \frac{80}{(R+20)}$$

$$V_{AN} = \left(\frac{V_{AB}}{300}\right) \times 60$$

$\rightarrow$ Potential gradient

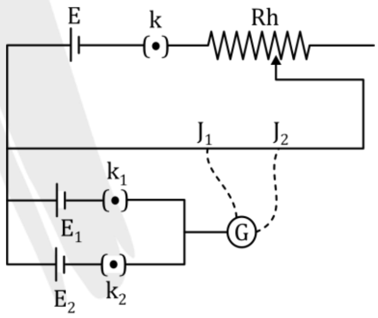
$$= \frac{(80)}{(R+20) \times 5} = \frac{16}{(R+20)}$$

$$V_{AN} = 20 \times 10^{-3}\ V = 2 \times 10^{-2}$$

$$\frac{16}{R+20} = 2 \times 10^{-2} \qquad \Rightarrow \qquad \frac{8}{10^{-2}} = R + 20$$

$$800 = R + 20 \Rightarrow \qquad R = 780\Omega$$

2. $E_1 \propto 380$



$E_2 \propto 760$

$$\frac{E_1}{E_2} = \frac{1}{2} = \frac{a}{b}$$

$a = 1$

3. When key is plugged b/w 2 & 1

$$V_1 = iR_1 = xl_1$$

when key is plugged b/w 3 & 1

$$V_2 = i(R_1 + R_2) = xl_2$$

$$\frac{R_1}{R_1 + R_2} = \frac{l_1}{l_2}$$

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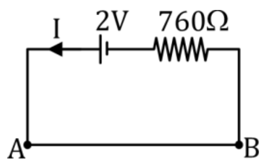
$$\frac{R_1}{R_2} = \frac{l_1}{l_2 - 1}$$

4. $R_{wire} = 40\Omega$



$l = 10$ m

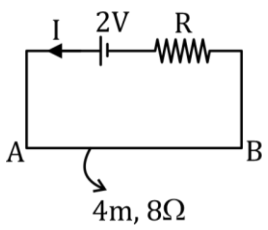
$$I = \frac{2}{760+40} = \frac{2}{800} = \frac{1}{400}$$

$$I = \frac{1}{400}\text{Amp.}$$

$$V_{AB} = I \cdot R_L = \frac{1}{400} \times 40 = \frac{1}{10}\text{volt}$$

$$x = \frac{V_{AB}}{l} = \frac{1}{10\times10} = 10^{-2}\ \text{V/m}$$

5. $l = 4$m



$R_l = 8\Omega$

$$I = \frac{2}{8+R}$$

$$V_{AB} = \left(\frac{2}{8+R}\right) \cdot 8 = \frac{16}{8+R}$$

$$V_{AB} = \frac{16}{8+R}$$

$$X = \frac{V_{Al}}{l} = \frac{16}{(8+R)4} = \frac{1\times10^{-3}}{10^{-2}}\ \text{V/m}$$

$$\frac{4}{8+R} = 0.1 \Rightarrow 4 = 0.8 + 0.1R$$

$$0.1R = 3.2 \quad \Rightarrow \quad R = 32\Omega$$

6. $E = \left(\frac{V_{AB}}{L}\right) l$

$$I = \frac{E_0}{r+r_1} \Rightarrow V_{AB} = \left(\frac{E_0}{r+r_1}\right) \times r$$

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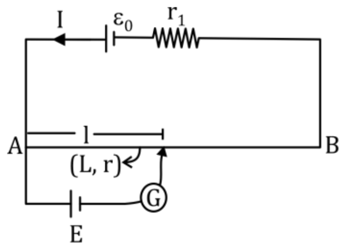
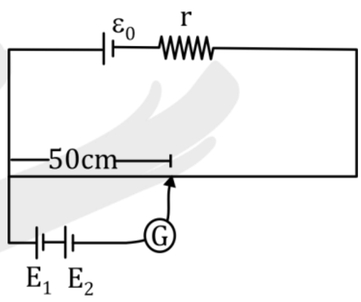
$$x = \frac{V_{AB}}{L} = \frac{E_0 r}{(r + r_1)L}$$



$E = xl = \frac{E_0 r \cdot l}{(r+r_1)L}$ $\Rightarrow$ $\left[E = \frac{E_0 r\, l}{(r+r_1)L}\right]$

7. $l = 100$ cm



$E_1 + E_2 = x \cdot 50$ _____ (i)

$x \rightarrow$ Potential gradient

when connect opposite to each other

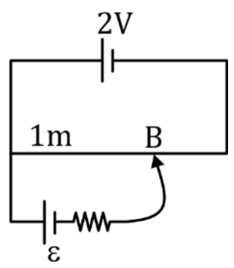
$E_1 - E_2 = x \cdot 10$ _____ (ii)

$$\frac{E_1 + E_2}{E_1 - E_2} = 5$$

$E_1 + E_2 = 5E_1 - 5E_2$

$4E_1 = 6E_2$ $\Rightarrow$ $\frac{E_1}{E_2} = \frac{3}{2}$

8. Initial Condition



$\varepsilon = x.55$ _____(i)

$x \rightarrow$ Potential gradient.

Final case.

$$i = \frac{\varepsilon}{10 + r}$$

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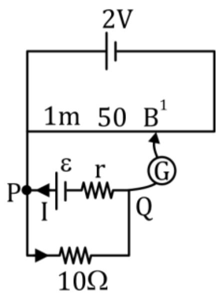
$V_{PQ} = \varepsilon - ir$



$= \varepsilon - \frac{\varepsilon}{(10+r)} \cdot r$

$= \varepsilon\left(1 - \frac{r}{10+r}\right) = \frac{10\varepsilon}{10+r}$

$V_{PQ} = x.50$

$\frac{10\varepsilon}{10+r} = 50x$ ____ (ii)

$\frac{(i)}{(ii)} \Rightarrow \frac{\varepsilon}{\frac{10\varepsilon}{10+r}} = \frac{11}{10}$ $\Rightarrow \frac{10+r}{10} = \frac{11}{10}$

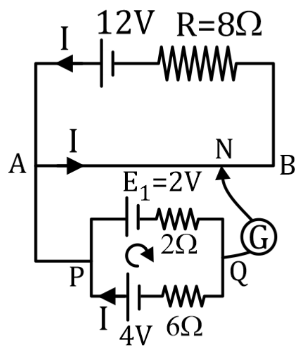
$100 + 10r = 110$

$10r = 100$

$r = 10\Omega$

9. $I = \frac{12}{8+R_{wire}}$ $R_{wire} = 4 \times 4 = 16\Omega$

$I = \frac{12}{8+16} = \frac{12}{24} = \frac{1}{2}$ Amp.



Using kVl

$4 - 2 - 2i - 6i = 0$

$8i = 2 \Rightarrow$ $i = \frac{1}{4}$

$V_p - 4 + 6 \times \frac{1}{4} = V_Q$

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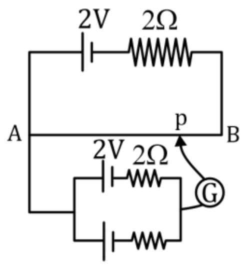
$$V_P - V_Q = 4 - \frac{3}{2} = \frac{5}{2}$$

$\frac{5}{2} = 2 \times L_{AN}$

$L_{AN} = \frac{5}{4} = 1.25 \quad \Rightarrow \quad 125cm.$

10. 

A&P have same potential.

Ans. 0

11. ε must be greater than ε '

→ Either the +ive terminal of C & D or -ive terminal of both C & D must be Joined to A

→ b cz this device based on null deflection.

12. $\pi > R_0$

13. $E_2 = xl$

$x = \frac{V_l}{l_{wire}}$

→ If I_2 shifted towards right current in primary circuit decreases Potential across wire decrease So Potential gradient also decreases

↓ due to this J_1 shifter right & l increase.

→ If E_1 increase

Potential gradient also increase l decrease. (C)

(A, B, C)

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14. If E_1 is increased

Potential gradient across wire also increase, l decrease.

$\longrightarrow$ R shift towards Left

(a) $\longrightarrow$ p.

(b) If resistance of rheostatic is increased, Potential gradient across wire also decrease R shift towards right.

(b) $\rightarrow$ q

& similar $c \rightarrow q \Rightarrow d \rightarrow r$