

WS-9-current 7th foundation
Task

①

①

Given

internal resistance $r = 2 \Omega$? $\mathcal{E} = 2.1 \text{ V}$

$$i = 0.2 \text{ A}$$

$$R = 10 \Omega$$

we know $i = \frac{\mathcal{E}}{R+r}$

$$\Rightarrow R+r = \frac{\mathcal{E}}{i} = \frac{2.1}{0.2} = \frac{21}{2}$$

$$\Rightarrow 10+r = 10.5$$

$$\Rightarrow r = 0.5 \Omega \rightarrow B$$

②

Given

$$\mathcal{E} = 1.08 \text{ V} \quad R = 30 \Omega$$

$$\text{Potential difference } V = 0.6 \text{ V}$$

$$\text{From } V = \mathcal{E} - i r \quad \Rightarrow i = \frac{\mathcal{E}}{R+r}$$

$$\Rightarrow i r = \mathcal{E} - V$$

$$\Rightarrow \frac{\mathcal{E} r}{R+r} = 1.08 - 0.6$$

$$\Rightarrow \frac{1.08 \times r}{30+r} = 0.48 \quad \Rightarrow \frac{r}{30+r} = \frac{0.48}{1.08}$$

$$\Rightarrow r = (30+r) \times 0.44$$

$$\Rightarrow r - 0.44r = 30 \times 0.44$$

$$\Rightarrow 0.55r = 30 \times 0.44$$

$$r = 30 \times \frac{0.44}{0.55} = \frac{30 \times 4}{5}$$

$$r = 24 \Omega \rightarrow B$$



3

$$\mathcal{E} = 1.05 \text{ V} \quad ; \quad i = 3 \text{ A}$$

$$\text{internal resistance } r = \frac{\mathcal{E}}{i} = \frac{1.05}{3} = 0.05 \Omega \rightarrow c$$

4

$$\text{Given } R = r$$

$$\text{From } V = \mathcal{E} - ir$$

$$i = \frac{\mathcal{E}}{R+r} = \frac{\mathcal{E}}{2r} = \frac{\mathcal{E}}{2r}$$

$$V = \mathcal{E} - \frac{\mathcal{E}}{2r} r$$

$$\Rightarrow V = \frac{2\mathcal{E} - \mathcal{E}}{2} = \frac{\mathcal{E}}{2} \quad V \rightarrow A$$

5

All cells are identical $\therefore$ effective emf = 2V

$$i = \frac{n\mathcal{E}}{nR+r} \Rightarrow \frac{4 \times 2}{4 \times 6 + 1} = \frac{8}{25} = 0.32 \text{ A} \rightarrow A$$

6

$$\text{Given } R_1 = 18 \Omega; \quad R_2 = 4 \Omega$$

$$\text{The effective resistance } R_p = \frac{R_1 R_2}{R_1 + R_2} = \frac{18 \times 4}{18 + 4}$$

$$R_p = \frac{18 \times 4}{22} = \frac{36}{11} = 3.27 \Omega \rightarrow c$$

(2)

If n equal resistances are given : $n = 3$

$$\text{Possible no. of combinations} = 2^{n-1} = 2^{3-1} = 2^2 = 4 \rightarrow A$$

(8)

For n unequal resistances : $n = 4$

$$\text{possible no. of combinations} = 2^n = 2^4 = 16 \rightarrow D$$

(9)

$$\text{Given } R_1 = 3\Omega; R_2 = 6\Omega; R_3 = 9\Omega.$$

$$R_s = R_1 + R_2 + R_3 = 3 + 6 + 9 = 18\Omega \rightarrow B$$

(10)

If a resistance R cut into n equal parts and are connected in parallel.

$$\text{Effective resistance} = \frac{R}{n^2}$$

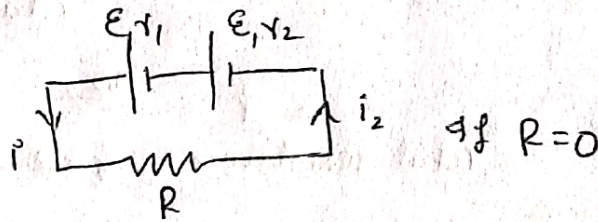
$$\text{Given } R = 36\Omega; R_{\text{eff}} = 1$$

$$\therefore 1 = \frac{36}{n^2} \Rightarrow n^2 = 36 \Rightarrow n = \sqrt{36} \\ \Rightarrow n = 6 \rightarrow C$$

(11)

$$\mathcal{E}_1 = \mathcal{E}_2 = \mathcal{E} \quad r_2 > r_1$$

For series combination $i = \frac{2\mathcal{E}}{R + r_1 + r_2}$



Direction of current $i_1 \leftarrow i_2 \leftarrow i_3$

-ve terminal of second cell is at higher potential.

we know potential difference $V = \mathcal{E} - i r$

$$V = \frac{\mathcal{E} - 2\mathcal{E}}{R + r_1 + r_2} r_2$$

For $R = r_2 - r_1$ we will get $V_2 = P.D$ across second cell zero

And -ve terminal of 1st cell never be at higher potential [by seeing direction of current] we can conclude

(13)

House hold appliances are connected in parallel because if one appliance is short circuited, it will not effect other appliances due to parallel combination, different currents are passes through them and potential difference is same across them

(15)

$$\mathcal{E} \cdot m \cdot f = 10 \text{ V} ; \text{ internal resistance } r = 3 \Omega ; R = 17 \Omega$$

$$I = 0.5 \text{ A}$$

$$\text{Total current in circuit } I = \frac{\mathcal{E} \cdot m \cdot f}{\text{Total resistance}}$$

$$\Rightarrow I = \frac{10}{20}$$

$$\text{Total resistance} = r + R = 3 + 17 = 20 \Omega$$

$$\text{For closed circuit terminal voltage } V = \mathcal{E} - Ir$$

$$\Rightarrow V = 10 - (0.5) \times 3$$

$$= 10 - 1.5 = 8.5 \text{ V}$$

(16)

$$\text{No. of cells in each row} = n$$

$$\text{No. of rows} = m$$

$$R = 3 \Omega ; \text{ Total no. of cells} = nm = 24$$

$$r = 0.5 \Omega$$

$$\text{For mixed grouping } I = \frac{n \mathcal{E}}{R + \frac{nr}{m}}$$

$$\text{For maximum current } R = \frac{nr}{m}$$

$$\Rightarrow 3 = \frac{n \times 0.5}{m} \Rightarrow 3 = \frac{24}{m} \times \frac{1}{m}$$

$$\Rightarrow 3 = \frac{12}{m^2} \Rightarrow m^2 = \frac{12}{3}$$

$$\Rightarrow m^2 = 4$$

$$\Rightarrow m = 2$$

(17)

$$\mathcal{E} = m \cdot f = 50 \text{ V} \quad R = 10 \Omega \quad i = 4.5 \text{ A}$$

$$i = \frac{\mathcal{E}}{R + r} \Rightarrow R + r = \frac{\mathcal{E}}{i}$$

$$\Rightarrow 10 + r = \frac{50}{4.5}$$

$$\Rightarrow 10 + r = \frac{500}{45} = \frac{100}{9}$$

$$\Rightarrow r = \frac{100}{9} - 10 = 11.1 - 10 = 1.1 \Omega$$

(18)

For charging cell Potential difference

$$V = \mathcal{E} + iR \Rightarrow V > \mathcal{E}$$

For discharging of cell Potential difference

$$V = \mathcal{E} - iR \Rightarrow V < \mathcal{E}$$

For short circuited $V = 0$

For open circuit $i = 0 \Rightarrow V = \mathcal{E} - iR$
 $\Rightarrow V = \mathcal{E}$

Task

SAG's

(2)

Number of cells are $n = 12$; $\mathcal{E} \cdot m \cdot f = 2 \text{ V}$

Number of wrongly connected cells are $m = 3$

$\therefore$ The effective em.f of the combination

$$= (n - 2m) \mathcal{E}$$

$$= (12 - 2 \times 3) \times 2 = (12 - 6) \times 2$$

$$= 6 \times 2 = 12 \text{ V}$$



①

Number of cells $N = 4$; $\text{E.m.f} = 1\text{V}$; $r = 0.5\Omega$
 $R = 1.2$.

No. of wrong connected cells $m = 1$

$\therefore$ The current in the circuit $i = \frac{(N-2m)\text{E}}{R + nr}$

$$\Rightarrow i = \frac{(4-2(1)) \cdot 1}{1 + 4 \times 0.5} = \frac{4-2}{1+2} = \frac{2}{3} \text{ A.}$$

③

let $\text{E}_1 = 1.25\text{V}$; $\text{V}_2 = 0.75\text{V}$; $r_1 = r_2 = 1\Omega$

$$\begin{aligned} \text{Effective emf} &= \frac{\frac{\text{E}_1}{r_1} + \frac{\text{E}_2}{r_2}}{\frac{1}{r_1} + \frac{1}{r_2}} = \frac{\frac{1.25}{1} + \frac{0.75}{1}}{\frac{1}{1} + \frac{1}{1}} \\ &= \frac{1.25 + 0.75}{1+1} = \frac{2}{2} = 1\text{V.} \end{aligned}$$

④

$\text{E.m.f} = 20\text{V}$. if all cells are identical

in parallel combination total emf = emf of any cell
 $= 20\text{V}$.

⑤

Let e.m.f of battery = $\mathcal{E}$

For $R_1 = 16 \Omega \rightarrow$ voltage across it $V_1 = \mathcal{E} - i_1 r = 12V$

For $R_2 = 10 \Omega \rightarrow$ voltage across it $V_2 = \mathcal{E} - i_2 r = 11V$

$$i_1 = \frac{\mathcal{E}}{R_1 + r} = \frac{\mathcal{E}}{16 + r}; \quad i_2 = \frac{\mathcal{E}}{R_2 + r} = \frac{\mathcal{E}}{10 + r}$$

$$\therefore \frac{V_1}{V_2} = \frac{\mathcal{E} - i_1 r}{\mathcal{E} - i_2 r} \Rightarrow \frac{12}{11} = \frac{\mathcal{E} - \frac{\mathcal{E}r}{16+r}}{\mathcal{E} - \frac{\mathcal{E}r}{10+r}}$$

$$\Rightarrow \frac{12}{11} = \frac{\frac{\mathcal{E}(16+r) - \mathcal{E}r}{16+r}}{\frac{\mathcal{E}(10+r) - \mathcal{E}r}{10+r}} = \frac{\cancel{16}\cancel{\mathcal{E}}}{\cancel{10}\cancel{\mathcal{E}} \times \frac{10+r}{16+r}}$$

$$\Rightarrow \frac{12}{11} = \frac{8}{5} \left[\frac{10+r}{16+r} \right] \Rightarrow 60(16+r) = 88(10+r)$$

$$\Rightarrow 60 \times 16 - 60r = 880 + 88r$$

$$\Rightarrow 960 - 880 = 148r$$

$$\Rightarrow r = \frac{80}{148} = \frac{40}{74} = \frac{20}{37} \Omega$$

L Task

Jee main level

(6)

Given $R_1 = 2\Omega$, $R_2 = 4\Omega$; $R_3 = 6\Omega$.

$$R_{\text{eff}} = R_1 + R_2 + R_3 = 2 + 4 + 6 = 12\Omega \rightarrow A$$

(7)

if n wires of equal resistances are given

$$\text{Number of combinations} = 2^{n-1} = 2^{4-1} = 2^3 = 8 \rightarrow c$$

(8)

For n identical resistors are connected in

Series effective resistance = $nR = 5 \times 6 = 30\Omega$.

(9)

Given $R_1 = 3\Omega$; $R_2 = 6\Omega$.

$$R_{\text{eff}} = \frac{R_1 R_2}{R_1 + R_2} = \frac{3 \times 6}{3 + 6} = \frac{3 \times 6^2}{9 \times 3} = 2\Omega.$$

⑩

If n identical Resistors are connected in parallel

The effective resistance = $\frac{R}{n}$. [$R=60\Omega$

$$= \frac{60}{6}$$

$n=6$]

$$R_{\text{eff}} = 10\Omega$$

⑪

Given $n=5$; $R=1$. All are connected in

parallel

$$R_{\text{eff}} = \frac{R}{n} = \frac{1}{5} = 0.2\Omega$$