WS-9 - current    7th foundation    (1)

Task

(1)

Given    internal resistance $r = ?$    E.m.f $= 2.1V$

$i = 0.2\ A$

$R = 10\ \Omega$.

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

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

$\Rightarrow 10+r = 10.5$

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

(2)

Given    E.m.f $= 1.08\ V$ ; $R = 30\ \Omega$

Potential difference $V = 0.6\ V$.

From $V = E - ir$ ;  $i = \dfrac{E}{R+r}$

$\Rightarrow ir = E - V$

$\Rightarrow \dfrac{Er}{R+r} = 1.08 - 0.06$

$\Rightarrow \dfrac{1.08 \times r}{30+r} = 0.48$.  $\Rightarrow \dfrac{r}{30+r} = \dfrac{0.48}{1.08} =$

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

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

$\Rightarrow 0.55r = 30 \times 0.44$

$r = 30 \times \dfrac{0.44}{0.55} = \overset{6}{\cancel{30}} \times \dfrac{4}{\cancel{5}}$

$r = 24\ \Omega \rightarrow B$

(3)

$\varepsilon = 1.5V$ ; $i = 3A$.

internal resistance $= \frac{\varepsilon}{i} = \frac{1.5}{3} = 0.5\,\Omega \rightarrow C$

(4)

Given $R = r$.

From $V = \varepsilon - ir$  $I = \frac{\varepsilon}{R+r} = \frac{\varepsilon}{r+r} = \frac{\varepsilon}{2r}$

$V = \varepsilon - \frac{\varepsilon}{2r} r$

$\Rightarrow V = \frac{2\varepsilon - \varepsilon}{2} = \frac{\varepsilon}{2} V \rightarrow A$

(5)

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

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

(6)

Given $R_1 = 18\,\Omega$; $R_2 = 4\,\Omega$.

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

$R_p = \frac{18 \times \cancel{4}2}{\cancel{22}11} = \frac{36}{11} = 3.27\,\Omega \rightarrow C$

Scanned with OKEN Scanner

(7)

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

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

(8)

For n unequal resistances : $n = 4$

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

(9)

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

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

(10)

If a Resistance R cut into n equal parts and are connected in Parallel.

Effective Resistance $= \frac{R}{n^2}$

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

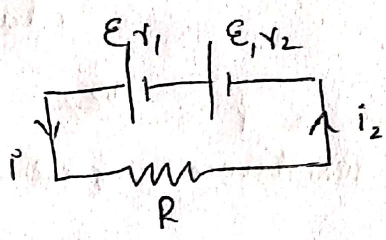
$\therefore$ $1 = \frac{36}{n^2} \Rightarrow n^2 = 36 \Rightarrow n = \sqrt{36}$

$\Rightarrow n = 6 \rightarrow C$.

(11)

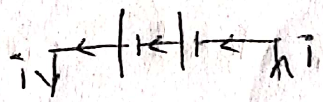
$\mathcal{E}_1 = \mathcal{E}_2 = \mathcal{E}$ : $r_2 > r_1$.

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




If $R = 0$

Direction of current




-ve terminal of second cell is at higher Potential.

we know Potential difference $V = \mathcal{E} - ir$

$$V_2 = \mathcal{E} - \frac{2E}{R + r_1 + r_2} r_2$$

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

And -ve terminal of $I^{th}$ 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)

e.m.f = 10 V ; internal resistance $r = 3\Omega$ ; $R = 17\Omega$

$i = 0.5$ A.

Total current in circuit $i = \dfrac{e.m.f}{\text{Total resistance}}$

$\Rightarrow i = \dfrac{10}{\;}$

Total resistance $= r + R = 3 + 17 = 20\,\Omega$

For closed circuit terminal voltage $V = E - ir$

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

$= 10 - 1.5 = 8.5$ V

(16)

No. of cells in each row $= n$

No. of rows $= m$

$R = 3\,\Omega$ ; Total no. of cells $= nm = 24$

$r = 0.5\,\Omega$

For mixed grouping $i = \dfrac{nE}{R + \frac{nr}{m}}$

For maximum current $R = \dfrac{nr}{m}$

$\Rightarrow 3 = \dfrac{n \times 0.5}{m} \Rightarrow 3 = \dfrac{\frac{\cancel{24}^{12}}{m} \times \frac{1}{\cancel{2}}}{m}$

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

$\Rightarrow m^2 = 4$

$\Rightarrow m = 2$

(17)

E.m.f $= 50V$. $R = 10\Omega$, $i = 4.5A$

$$i = \frac{e}{R+r} \Rightarrow R + r = \frac{e}{i}$$

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

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

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

$$= 1.1\Omega$$

(18)

For charging cell potential difference

$$V = E + iR \Rightarrow V > E$$

For discharging of cell potential difference

$$V = E - iR \Rightarrow V < E$$

For short circuited $V = 0$.

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

$$\Rightarrow V = E$$

L Task

SAQ's

(2)

Number of cells are $n = 12$ ; E.m.f $= 2V$.

Number of wrongly connected cells are $m = 3$

∴ The effective e.m.f of the combination

$$= (n - 2m) E$$

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

$$= 6 \times 2 = 12V$$

(1)

Number of cells $N = 4$ ; $e.m.f = 1V$ ; $r = 0.5\Omega$

$R = 1\Omega$.

No. of wrong connected cells $m = 1$

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

$\Rightarrow i = \frac{(4-2(1))\cdot 1}{1+4\times0.5} = \frac{4-2}{1+2} = \frac{2}{3}A.$

(3)

let $\varepsilon_1 = 1.25\,V$ ; $V_2 = 0.75\,V$. ; $r_1 = r_2 = 1\Omega$

Effective emf $= \frac{\frac{\varepsilon_1}{r_1}+\frac{\varepsilon_2}{r_2}}{\frac{1}{r_1}+\frac{1}{r_2}} = \frac{\frac{1.25}{1}+\frac{0.75}{1}}{\frac{1}{1}+\frac{1}{1}}$

$= \frac{1.25+0.75}{1+1} = \frac{2}{2} = 1\,V.$

(4)

$E.m.f = 20V$. If all cells are identical in parallel combination Total emf = emf of any cell

$= 20V$.

(5)

let e.mf of battery = $\mathcal{E}$

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

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

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

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

$$\Rightarrow \frac{12}{11} = \frac{\frac{\mathcal{E}(16+r) - \mathcal{E}r}{16 + r}}{\frac{\mathcal{E}(10+r) - \mathcal{E}r}{10 + r}} = \frac{\cancel{16}^{8}\cancel{\mathcal{E}}}{\cancel{10}_{5}\cancel{\mathcal{E}}} \times \frac{10 + r}{16 + r}$$

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

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

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

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

L Task

Jee mains level

(6)

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

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

(7)

If $n$ wires of equal resistances are given

Number of combinations $= 2^{n-1} = 2^{4-1} = 2^3 = 8 \to C$

(8)

For $n$ identical resistors are connected in series Effective resistance $= nR = 5 \times 6 = 30\Omega$.

(9)

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

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

(10)

If $n$ identical Resistors are connected in Parallel

The effective resistance $= \frac{R}{n}$. $[R = 60\,\Omega$, $n = 6]$

$= \frac{60}{6}$

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

(16)

Given $n = 5$ ; $R = 1$. All are connected in Parallel $R_{eff} = \frac{R}{n} = \frac{1}{5} = 0.2\,\Omega$

WS-10

Friction

7th foundation

(1)

we know

coefficient of friction $= \frac{f}{N}$

$[\mu] = \frac{[f]}{[N]} = \frac{MLT^{-2}}{MLT^{-2}} = M^0L^0T^0 \rightarrow$ No dimensions

(2)

when Normal reaction is halved $N' = \frac{N}{2}$

frictional force also halved $f' = \frac{f}{2}$

Since $\mu = \frac{f}{N} \Rightarrow \mu' = \frac{f'}{N'} = \frac{\frac{f}{\cancel{2}}}{\frac{N}{\cancel{2}}} = \frac{f}{N} = \mu$

$\therefore$ coefficient of friction remain same unchanged