Automotive electricals - MEE1035

DA - 1

Sai gokul c
19BME0789

(1) Sol

$l = 0.8 \times 2000 = 1600 m$

$A = 0.8 \ mm^2$

$= 0.8 \times 10^{-6} \ m^2$

$R = \frac{\rho l}{A} = \frac{0.02 \times 10^{-6} \times 1600 \times 10^{-6}}{0.8}$

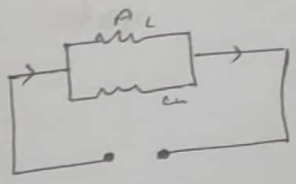
$= 40 \ \Omega$

Power observed $= \frac{V^2}{R} = (110)^2 / 40$

$= 302.5 \ W$

(2.) Sol.

$R_1 = \rho \frac{l_1}{a_1} \qquad R_2 = \rho \frac{l_2}{a_2}$



$a_2 = a_1 \frac{R_{21}}{R_2} \frac{P_2}{P_1} \cdot \frac{L_2}{L_1}$

$L_1 = 3A \ ; \ L_2 = 5 - 3 = 2A$

So, V (common voltage):

$\therefore \frac{R_1}{R_2} = \frac{l_2}{l_1} = \frac{2}{3}$

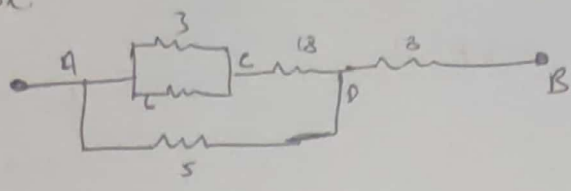
$V = I_1 R_1 = I_2 R_2$

$a_1 = \frac{\pi \times d_1^2}{4} = \frac{\pi d_1^2}{4} = \frac{\pi}{4} \ mm^2$

$a_2 = \frac{\pi}{4} \times \frac{2}{3} \times \frac{0.017}{0.028} \times \frac{6}{7.5} = 0.2544 \ m^2$

$\pi \times \frac{d_2^2}{4} = 0.2544 \rightarrow \boxed{d_2 = 0.564 \ mm}$

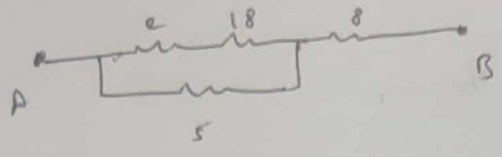
3. Sol.



for Parallel resistance

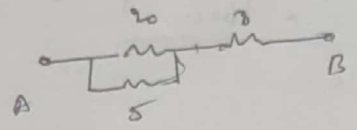
$$R = \frac{R_1 R_2}{R_1 R_2} = \frac{18}{9}$$

$$= 2\ \Omega$$



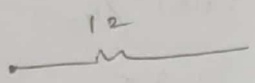
for series = 18 + 2

= 20 Ω



for parallel resistance

$$R = \frac{R_1 R_2}{R_1 + R_2} = 4\ \Omega$$



for series resistance.

R = 4 + 8 = 12 Ω

Total circuit current = 60/12 = 5A

current through 5 Ω = $5 \times \frac{20}{25}$ = 4A

current in ACD = $5 \times \frac{5}{25}$ = 1A

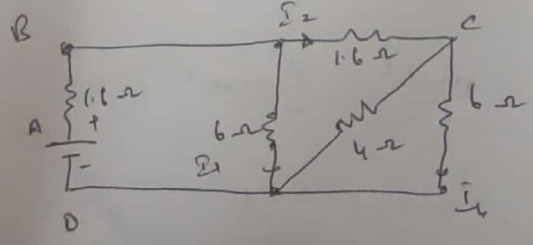
P-D 3 Ω + 6 Ω → 1 × 2 = 2 V

P-D 18 Ω → 1 × 18 = 18 V

P-D 5 Ω → 4 × 5 = 20 V

P-D 8 Ω → 5 × 8 = 40 V

4.



w.r.t D) $V_A = 40$

$V_B = 40 - 16 = 24$ V

$I_1 = 4$ amp

$I_2 = 6$ amp

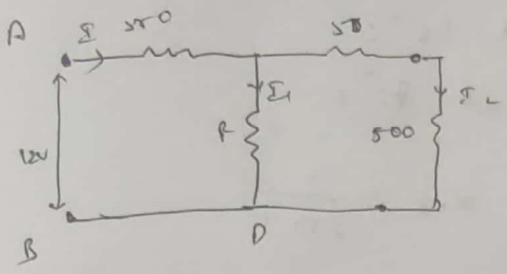
$V_c = V_0 - 12 \times 1.6 = 24 - 9.6 = 14.4\text{V}$

$I_3 = \frac{14.4}{4}$

$\boxed{I_3 = 3.6 \text{ amp}}$

$I_4 = 2.4$ amp

5. Sol.



Drop on 50 Ω = $(2.5 \times 30)/500 = 0.25\text{V}$

Drop CP = $2.5 + 0.25 = 2.75\text{V}$

Prop 550 Ω = $12 - 2.75 = 9.23\text{V}$

$I = 9.25/550 = 0.0168\text{ A}$

$I_2 = 2.3/500 = 0.005\text{ A}$

$I_1 = 0.0168 - 0.005 = 0.0118\text{ A}$

$0.0118 = \frac{2.75}{R}$

$\boxed{R = 233\ \Omega}$

(6) Sol.

$\alpha = \frac{\alpha_0}{1 + \alpha_0 t}$ $\quad R = R_1(1 + \alpha(t_2 - t_1))$

$\alpha_{20} = \frac{\alpha_0}{(1 + \alpha_0(20)} = \frac{1}{245.5} = \alpha_0$

$\alpha_0 = \frac{1}{234.5}$ /°C

$$\rho_{60} = \rho_0 (1 + \alpha_0 (60))$$

$$= 1.6 \times 10^{-6} \left(1 + \frac{60}{234.5}\right)$$

$$\rho_{60} = 2.01 \times 10^{-6}$$

$$\alpha_{60} = \frac{\alpha_0}{1 + \alpha_0 (60)} = \frac{1/234.5}{1 + 60\left(\frac{1}{234.5}\right)} = \frac{1}{294.5} \text{ per } ^\circ C$$

7. Sol.

R_1 = Ω at 15°C

R_2 = Ω at t_2°C

$$\alpha_{15} = \frac{1}{254.5}$$

$$R_1 = 250/5 = 50\ \Omega$$

$$R_2 = 250/3.41 = 63.94\ \Omega$$

$$R_2 = R_1 (1 + \alpha_{15}(t_2 - t_1))$$

$$63.44 = 50 \left(1 + \frac{1}{254.5}(t_2 - 15)\right)$$

$$\boxed{t_2 = 86^\circ C}$$

8. Sol.

a) let 1 denote Cu wire and 2 denote Al wire

given $\frac{l_1}{l_2} = \frac{5}{2}$

if $i_2 = 1$ then $i_1 = 1.70$

if $i_1 = 1$ then $i_2 = 1.53$

The given wire is parallel so

$$i_1 R_1 = i_2 R_2$$

$$\frac{i_2}{i_1} = \frac{R_1}{R_2} = \frac{\frac{l_1 l_1}{A_1}}{\frac{l_2 l_2}{A_2}}$$

$$\frac{A_2}{A_1} = \frac{i_2}{i_1} \times \frac{l_2 l_2}{l_1 l_1}$$

$$= \frac{1}{1.7} \times \frac{2}{5} \times \frac{1.53}{1}$$

$$\frac{\frac{\pi}{4} d_2^2}{\frac{\pi}{4} d_1^2} = 0.36$$

$$\frac{d_2}{d_1} = 0.6$$

B) Max vol drop $= 0.5 = \Sigma IR$, $I = 8A$

$8R = 0.5 \Rightarrow R = \frac{1}{16}\ \Omega$ $\quad \left[\begin{array}{l} l = 120\ cm \\ \rho = 0.014 \times 10^{-6}\ \Omega cm \end{array}\right]$

$R = \frac{\rho l}{A} \Rightarrow \boxed{A = 32.64 \times 10^{-4}\ mm^2}$

9. Sol.

$$\frac{V^2}{R} = 80 \quad \text{or} \quad \frac{12.6^2}{R} = 80$$

$$R = 1.9\ \Omega$$

$$R_{24^\circ 20} = R_{20}\left[1 + (24^\circ 20 - 20) \times 0.005\right]$$

$$1.9 = R_{20}\left[1 + 12\right]$$

$$R_{20} = \frac{1.9}{13}\ \Omega$$

$$\rho_{20} = 2.89 \times 10^{-8}\ \Omega cm$$

$$A = \frac{\pi (0.002)^2}{4}\ cm^2$$

$$l = \frac{A \times R_{20}}{\rho_{20}} = \frac{\pi (0.002)^2 \times 1.9}{4 \times 13 \times 2.89 \times 10^{-8}} \Rightarrow \boxed{l = 0.0158 \times 10^{-2}}$$

10.

$0.12\,A \rightarrow 15^\circ C \rightarrow 12.6\,V$

$I_a = 0.12\,A$

0.0043 per $^\circ C$ at $6^\circ C$

$$R_{15} = \frac{12.6}{0.12} = 105\,\Omega$$

$$R_t = \frac{12.6}{6.15} = 84\,\Omega$$

$$R_{15} = R_0(1+15\alpha_0)$$
$$= R_0(1+15(0.0043)) \quad -(1)$$

$$R_t = R_0(1+0.0043t) \quad -(2)$$

$$\frac{(2)}{(1)} \Rightarrow \frac{R_t}{R_{15}} = \frac{1+0.0043t}{1.0654} \rightarrow \frac{84}{105}$$

$$t \rightarrow 105 + 0.4515t = 89.486$$

$$0.4515t = -15.5064$$

$$\boxed{t = -34.3441\,^\circ C}$$