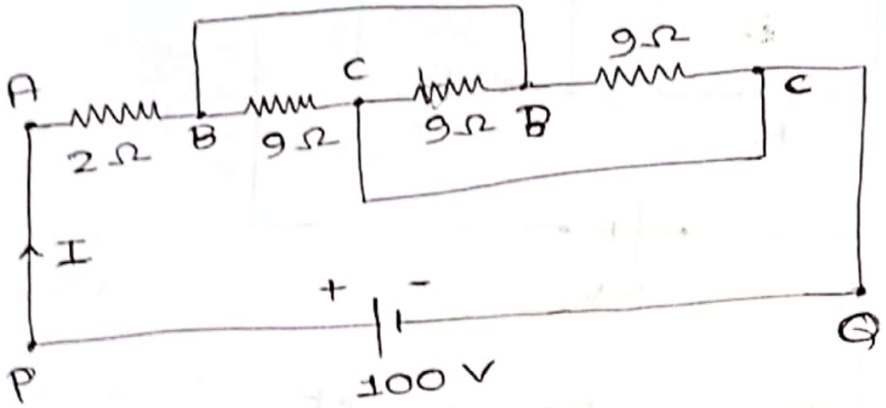
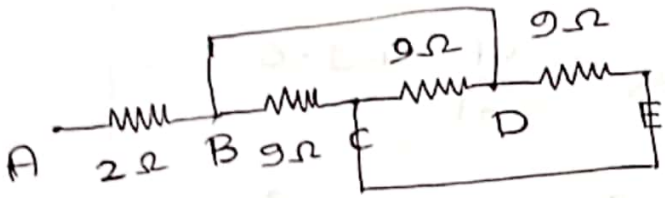
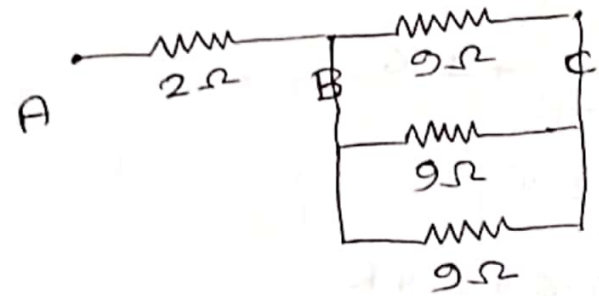
EEE - Assignment 1 - solutions

1) Find the power consumed by the combination of resistances when connected to a voltage source of 100 V at terminals P-Q.

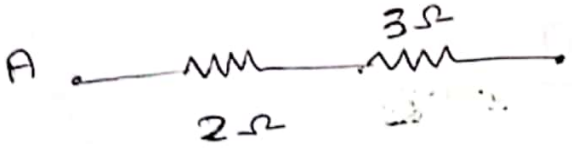


Solution :-





$$\frac{1 \quad 3}{\cancel{9} \times \cancel{9} \times 9} \quad \frac{}{2 \quad 1} \quad \frac{}{3_1}$$

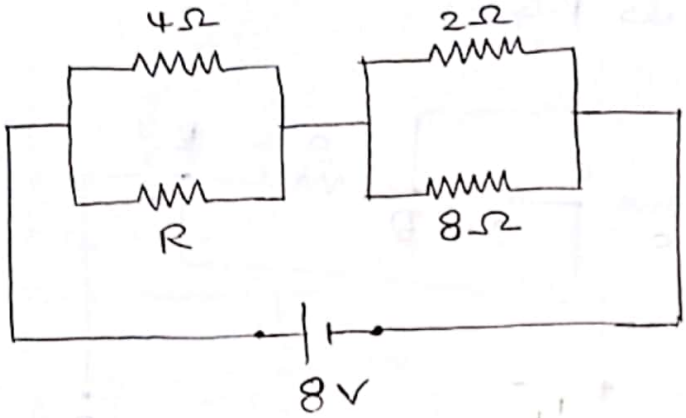


$R_{eq} = 5\ \Omega$

$$P = \frac{V^2}{R} = \frac{100 \times 100}{5} = 2\,kW$$

(2)

2) The total power consumed by the circuit is 16 W. Find the value of R if applied voltage is 8 V. Also calculate total current.



Solution :-

$$R_{eqv} = \frac{R \times 4}{R+4} + \frac{2 \times 8}{10}$$

$$R_{eqv} = \frac{4R}{4+R} + 1.6$$

$$P = \frac{V^2}{R_{eqv}} \Rightarrow R_{eqv} = \frac{V^2}{P} = \frac{8 \times 8}{16} = 4\Omega$$

$$\boxed{R_{eqv} = 4\Omega}$$

$$4\Omega = \frac{4R}{4+R} + 1.6$$

$$\frac{4R}{4+R} = 2.4$$

$$4R = 9.6 + 2.4R$$

$$1.6R = 9.6$$

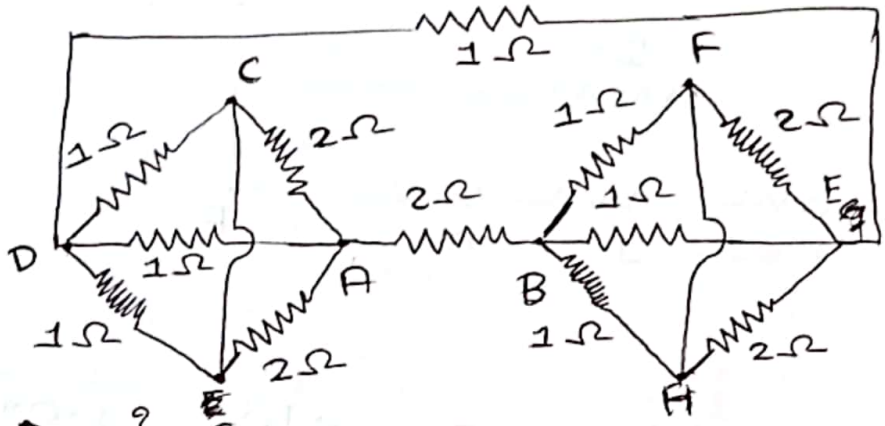
$$\boxed{R = 6\Omega}$$

$$P = I^2 \cdot R_{eqv}$$

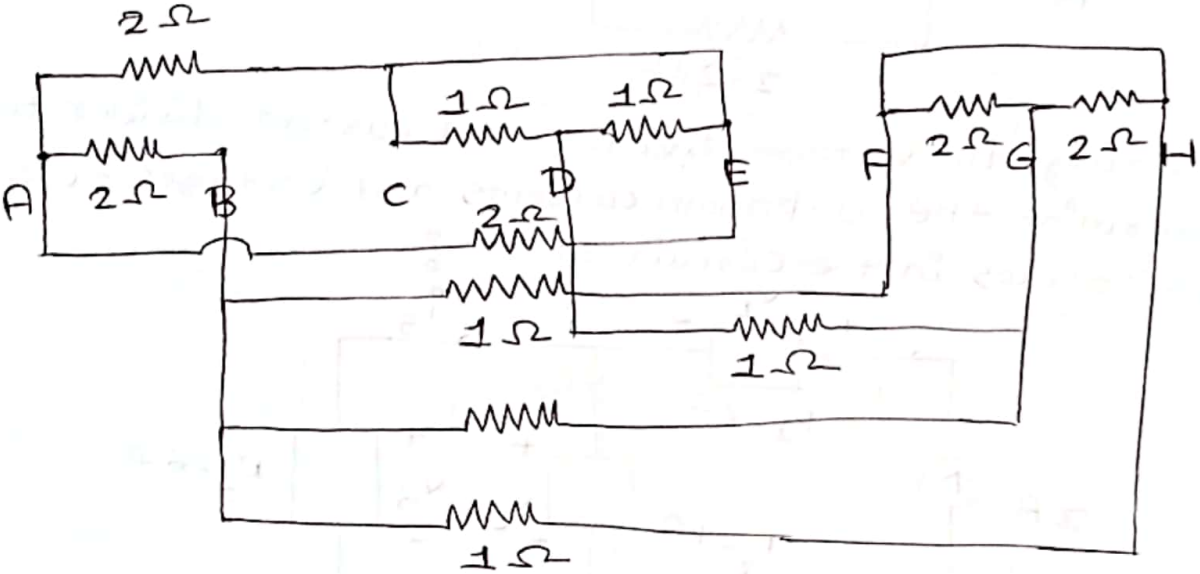
$$I^2 = \frac{16}{4}$$

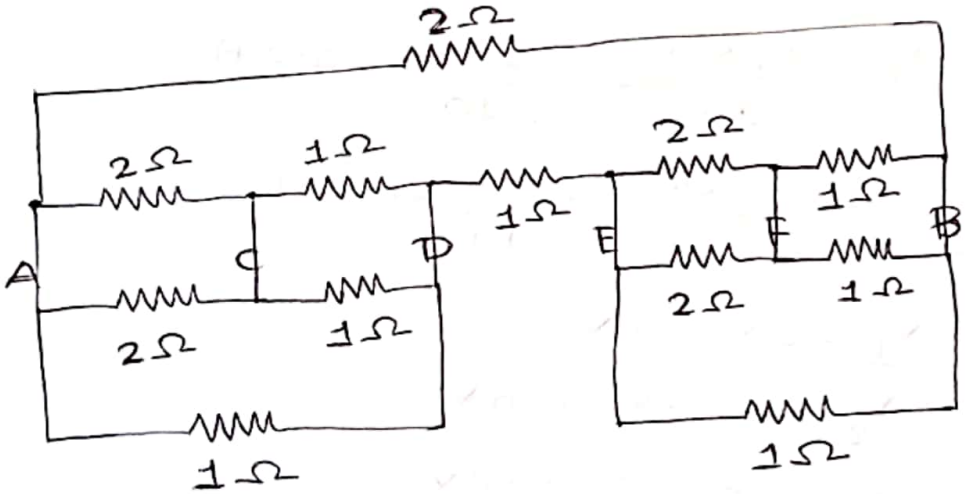
$$\boxed{I = 2A}$$

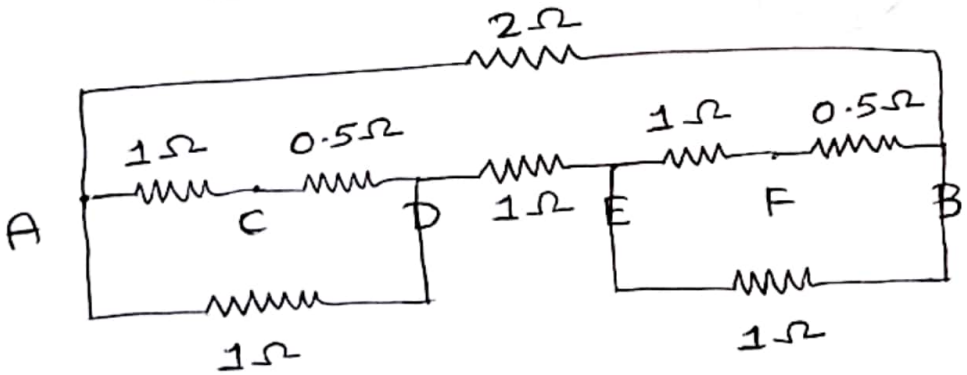
3)



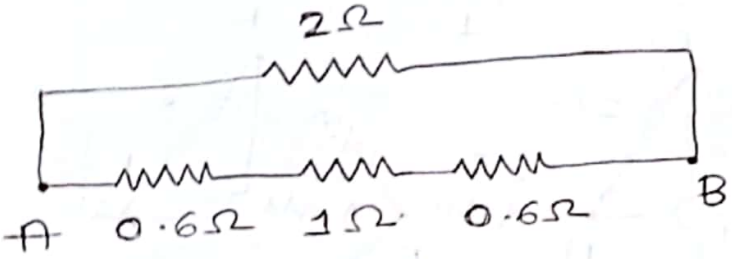
Find R_{AB} ?

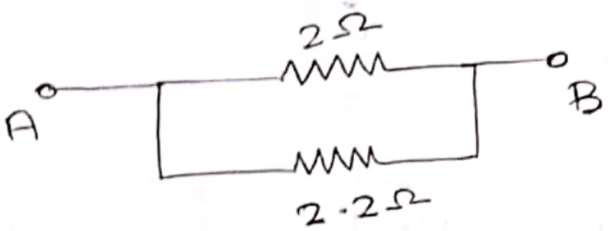






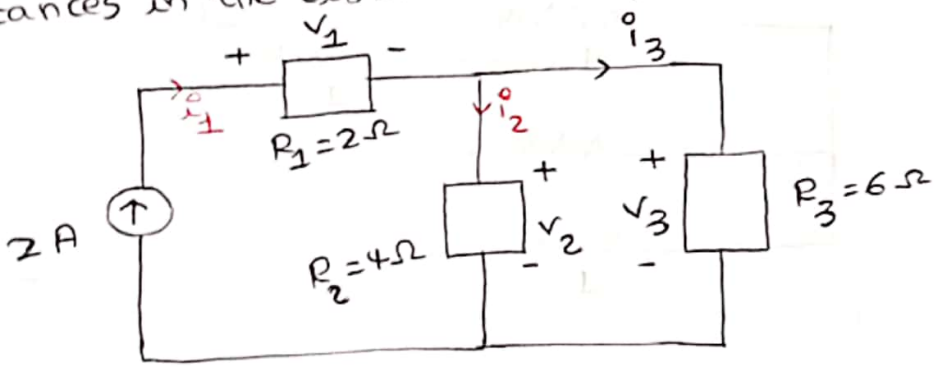
(4)





$\Rightarrow \boxed{R_{AB} = 1.04\,\Omega}$

4) using the voltage divider and current divider techniques, determine the unknown currents and voltages across the resistances in the circuit shown?



Solution

$$i_2 = \frac{i_1 \times 6}{10} = \frac{2 \times 6}{10} = 1.2\ A$$

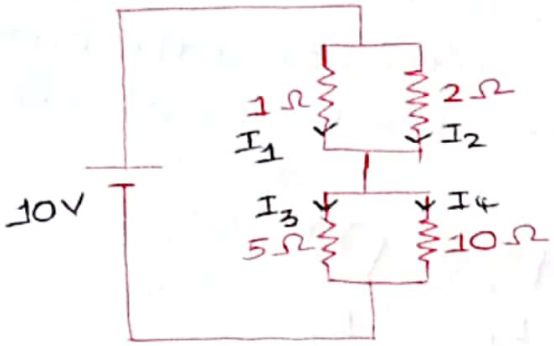
$$i_3 = \frac{i_1 \times 4}{6+4} = \frac{8}{10} = 0.8\ A$$

$$V_1 = 2 \times 2 = 4V$$

$$V_2 = 1.2 \times 4 = 4.8V$$

$$V_3 = 0.8 \times 6 = 4.8V$$

5) Find all the currents & voltages across resistors as shown in the network below:

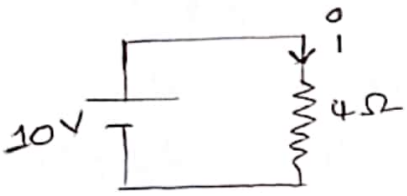


Solution

$1\Omega \| 2\Omega = \frac{1 \times 2}{1+2} = \frac{2}{3}\ \Omega$

$5\Omega | 10\Omega = \frac{5 \times 10}{5+10} = \frac{50}{15} = \frac{10}{3}\ \Omega$

$R_{eq} = \frac{2}{3} + \frac{10}{3} = \frac{12}{3} = 4\Omega$



$i = 2.5\ A$

$i_1 = \frac{2.5 \times 2}{3} = 1.67\ A$

$i_2 = \frac{2.5 \times 1}{3} = 0.83\ A$

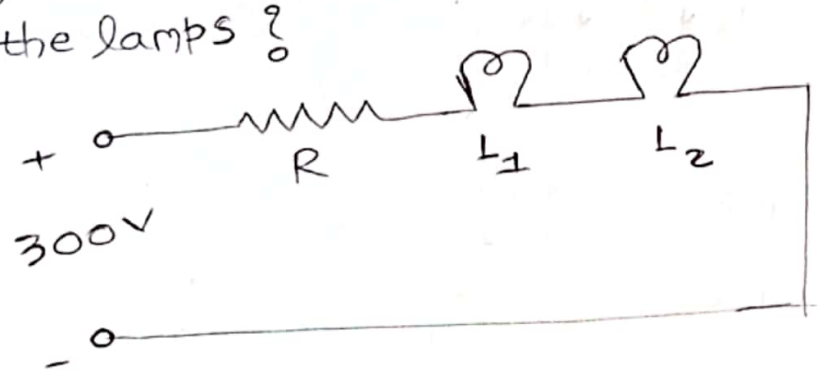
$i_3 = \frac{2.5 \times 10}{15} = 1.67\ A$

$i_4 = \frac{2.5 \times 5}{15} = 0.83\ A$

$V_1 = 1.67V\ ;\ V_2 = 8.34V$

(6)

(6) In the circuit shown, find the value of the resistor R so that the lamps L_1 and L_2 operate at rated conditions. The rating of each of the lamps is 12V, 9W. If L_2 becomes short circuited, find the current through the circuit and the power dissipated in each of the lamps?



$P = 9W$

$V = 12V$

$P = \frac{V^2}{R}$

$I = \frac{P}{V}$

$R_{eq} = R + R_1 + R_2$

$R_{eq} = \frac{300}{I}$

$R_1 = R_2 = \frac{V^2}{P}$

current through $L_1, R, L_2 = \frac{9}{12} = \frac{P}{V} = 0.75A$

$R_1 = R_2 = \frac{V^2}{P} = \frac{12^2}{9} = 16\Omega$

$R_{eqr} = R + R_1 + R_2$

$R_{eqr} = \frac{300}{I} = 400\Omega$

$R = R_{eqr} - R_1 - R_2$

$R = 400 - 32$

$\boxed{R = 368\Omega}$

If L_2 is short,

$I = \frac{300}{R+16}$

$\boxed{I = 0.78A}$

Power dissipated in each of the lamps

$= 0.75^2 \times 16$

$= 9W$