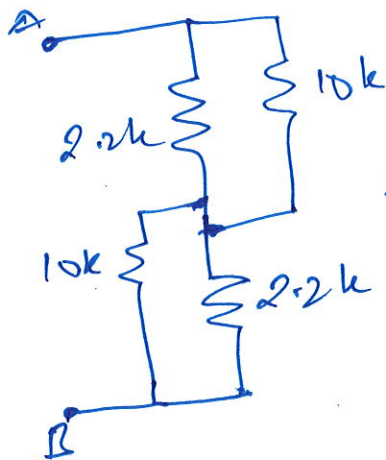
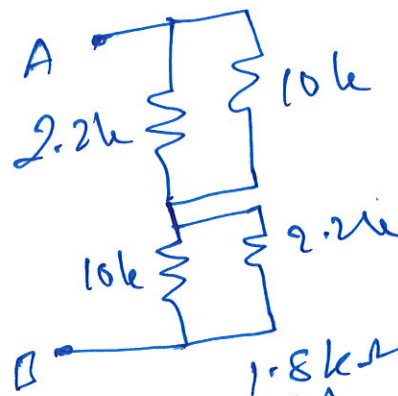


SOLUTIONS

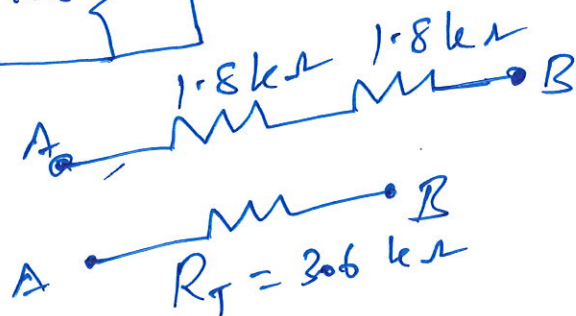
1.) fig-1:



\Rightarrow

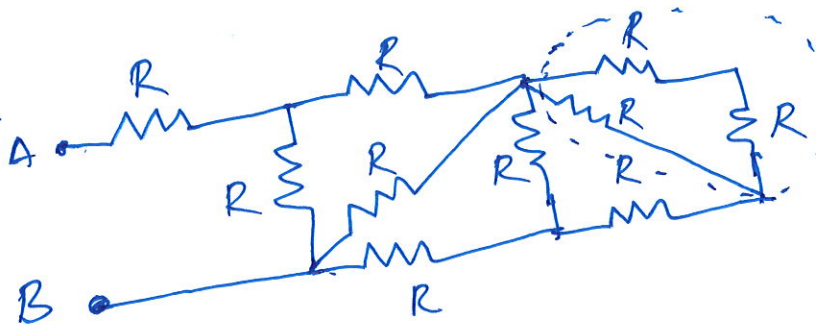


\Rightarrow



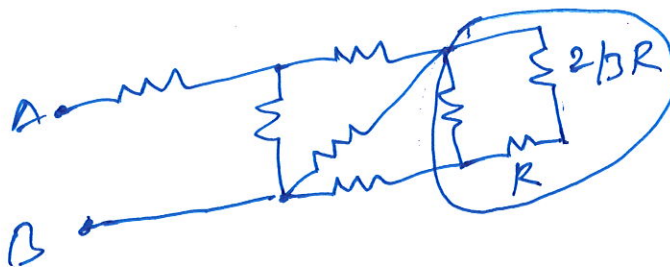
$$\frac{2.2k \parallel 10k}{(2.2k) + (10k)} = 1.8k\Omega$$

Fig.2



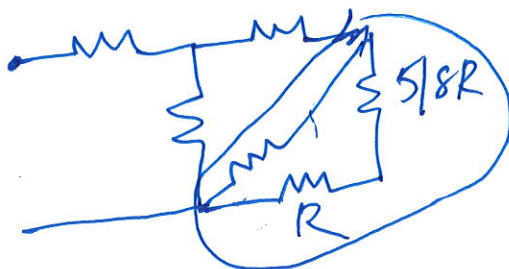
$$R \parallel 2R = \frac{2}{3}R$$

\Rightarrow



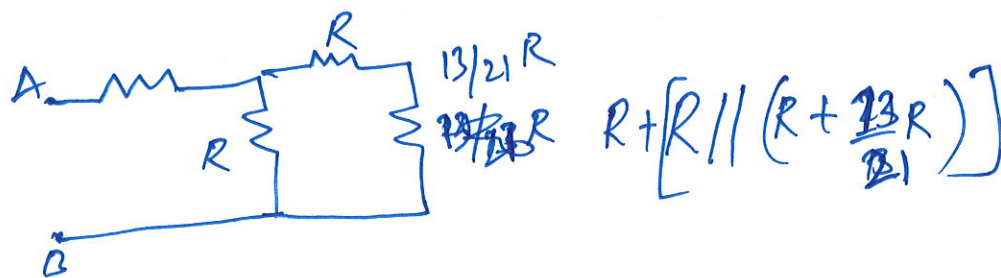
$$\frac{2}{3}R + R = \frac{5}{3}R; R \parallel \frac{5}{3}R = \frac{5}{8}R$$

\Rightarrow



$$\frac{5}{8}R + R = \frac{13}{8}R; \frac{13}{8}R \parallel R = \left(\frac{8}{21}\right)R$$

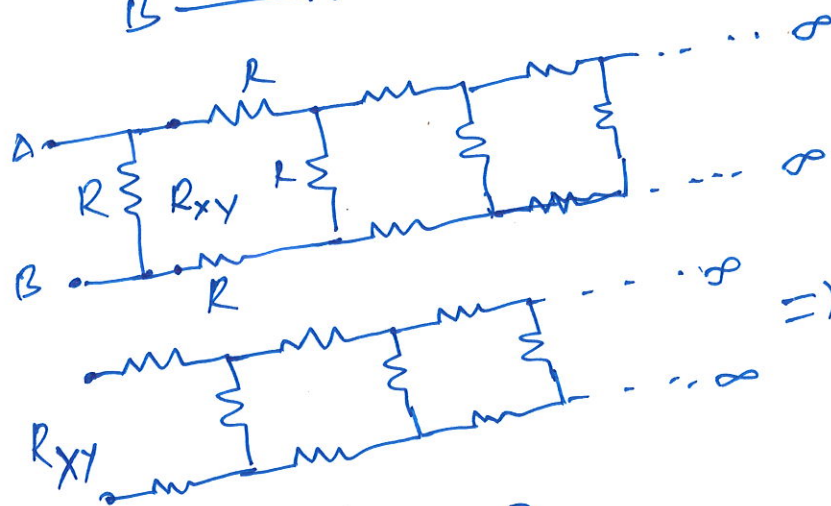
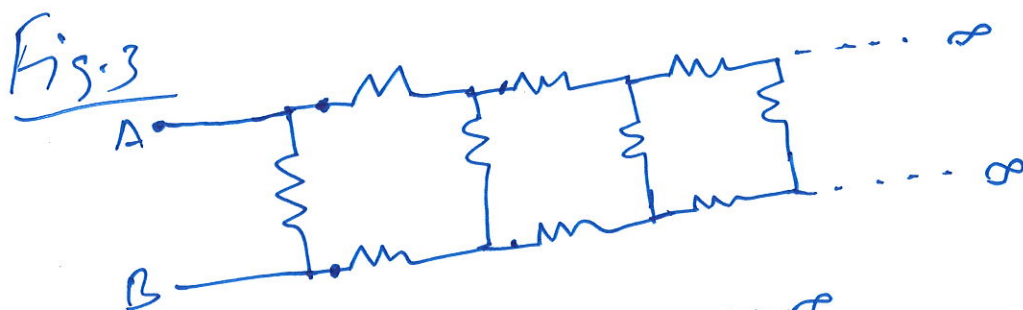
②



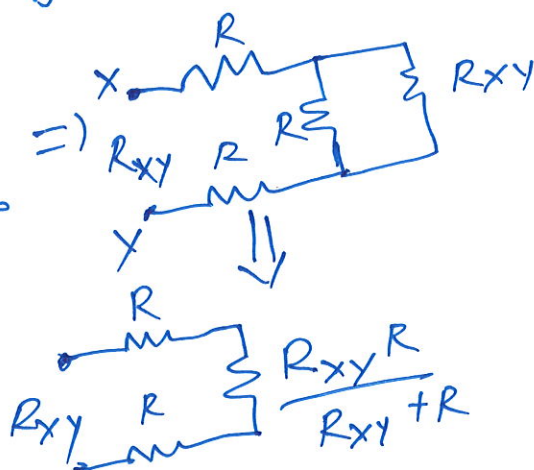
$$\Rightarrow \text{Circuit diagram showing a resistor R in series with a parallel combination of R and } \frac{34}{21}R. \quad \frac{34}{55}R \parallel R = \frac{89}{55}R = 1.62R$$

$$R = 1k\Omega \Rightarrow R_{AB} = \underline{1.62k\Omega}$$

Fig. 3



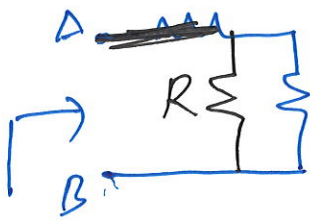
$$R \parallel R_{xy} = \frac{R_{xy}R}{R_{xy} + R}$$



$$R_{xy} = 2R + \frac{R_{xy}R}{R_{xy} + R} \Rightarrow R_{xy}^2 - 2RR_{xy} - 2R^2 = 0$$

Solving for R_{xy} : $R_{xy} = (\sqrt{3} + 1)R$

(3)

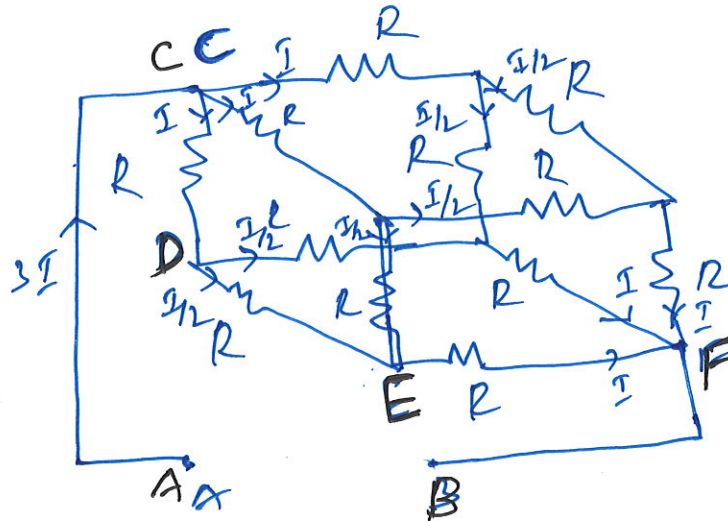


$$R_{AB} = (\sqrt{3} + 2)R$$

$$R_{AB} = R \parallel (\sqrt{3} + 1)R = \left(\frac{\sqrt{3} + 1}{\sqrt{3} + 2} \right) R$$

Fig. 4

Cuboid



Let $V_{AB} = V$
 Current through
 circuit be $3I$.

KVL for loop ACDEFBA :

$$IR + \frac{I}{2}R + IR = V$$

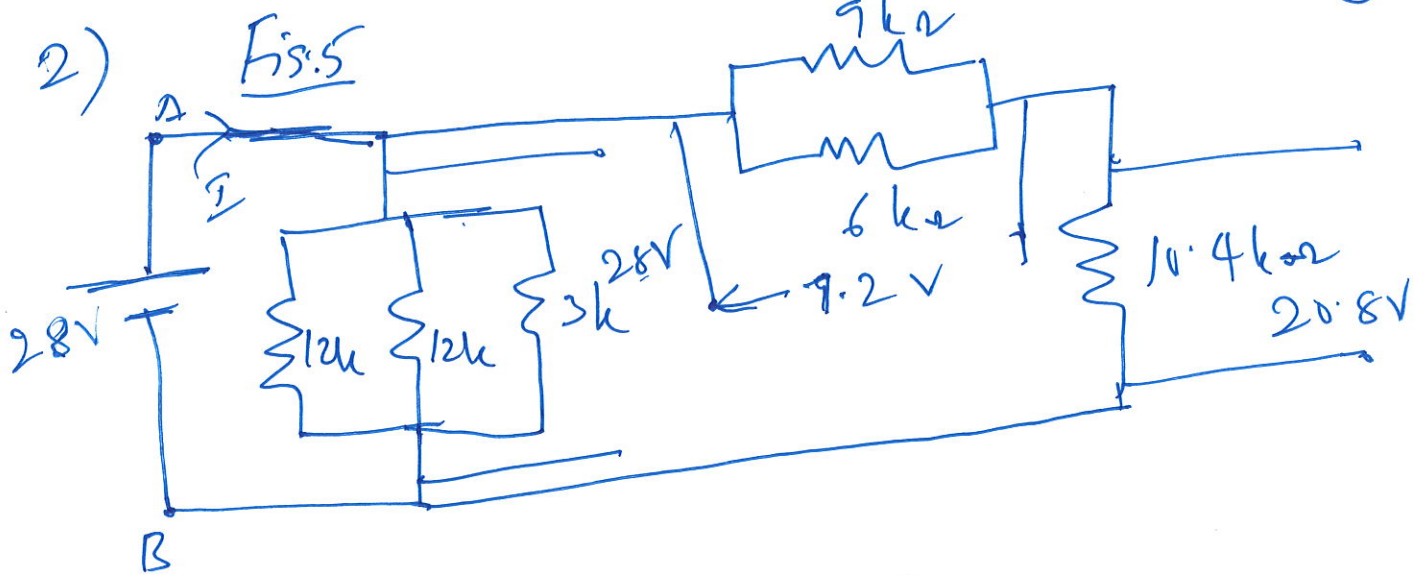
$$\frac{5IR}{2} = V \quad \text{--- (1)}$$

Let the resistance between AB be R_{AB} .

$$R_{AB} \cdot 3I = V \quad \text{--- (2)}$$

from (1) & (2) $\boxed{R_{AB} = \frac{5}{6}R}$

(4)



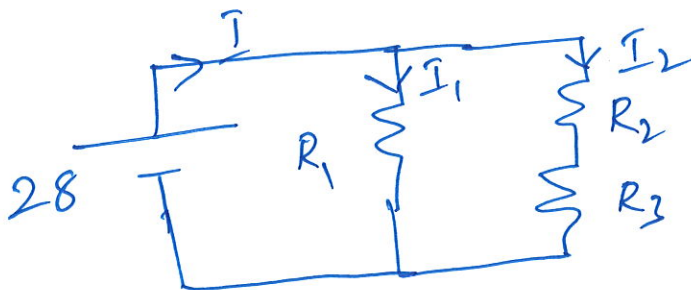
$$R_1 = 12k \parallel 12k \parallel 3k = 2k\Omega$$

$$R_2 = 9k\Omega \parallel 6k\Omega = 3.6k\Omega$$

$$R_3 = 10.4k\Omega$$

$$R_{AB} = R_1 \parallel (R_2 + R_3) = 2k\Omega \parallel (14k\Omega) = 1.75k\Omega$$

$$I_0 = \frac{V}{R_{AB}} = \frac{28}{1.75k} = 16mA$$



$$I_1 = \frac{28}{R_1} = 14mA$$

$$I_2 = I - I_1 = 2mA$$

Current through R_3 : $2mA$, $V_{R3} = 20.8V$

Voltage across $R_2 = 28 - 20.8 = 7.2V$

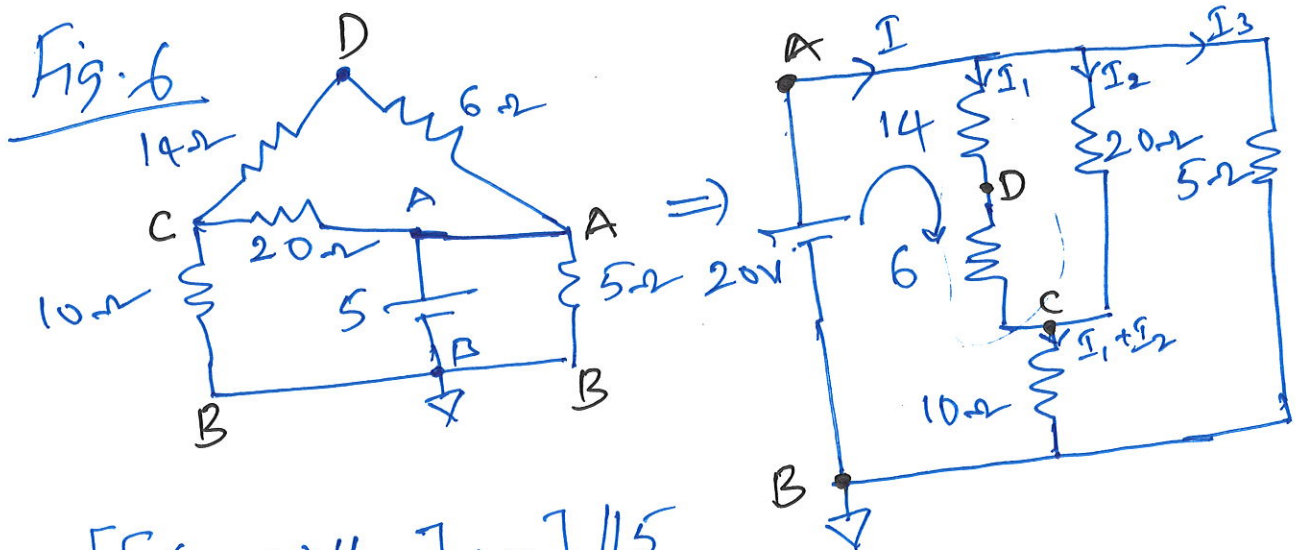
$$I_{9k\Omega} = \frac{2 \times 6}{9+6} = 0.8mA \quad V_{9k\Omega} = 7.2V$$

$$I_{6k\Omega} = \frac{2 \times 9}{9+6} = 1.2 \text{ mA} \quad V_{6k\Omega} = 7.2 \text{ V} \quad \textcircled{5}$$

$$I_{12k\Omega} = \frac{V_{12k\Omega}}{12k\Omega} = \frac{28}{12} = 2.33 \text{ mA}$$

$$I_{3k\Omega} = \frac{28}{3} = 9.34 \text{ mA}$$

$$I_{1k\Omega} + I_{1k\Omega} + I_{3k\Omega} = 2.33 + 2.33 + 9.34 \\ = \underline{\underline{14 \text{ mA}}}$$



$$R_{AB} = \left[\left[(14+6) \parallel 20 \right] + 10 \right] \parallel 5$$

$$= \left[(20 \parallel 20) + 10 \right] \parallel 5 = (10+10) \parallel 5 = 20 \parallel 5 = 4 \Omega$$

$$I = \frac{20}{4} = 5 \text{ A} \quad I_3 = \frac{20 \text{ V}}{5 \Omega} = 4 \text{ A} \quad \underline{V_{5\Omega} = 20 \text{ V}} \\ \underline{I_{5\Omega} = 4 \text{ A}}$$

$$I_1 + I_2 = I - I_3 = 5 - 4 = \underline{1 \text{ A}}$$

$$I_1 = I_2 = 0.5 \text{ A}$$

$$\underline{V_{20\Omega} = 10 \text{ V}} \quad \underline{V_{14\Omega} = 7 \text{ V}} \quad \underline{V_{6\Omega} = 3 \text{ V}}$$

$$I_1 = I_2 = 0.5 \text{ A} \quad \underline{V_{20\Omega} = 10 \text{ V}} \quad \text{(or Ohm's law } 10\Omega \times 1\text{A} = \underline{10 \text{ V}})$$

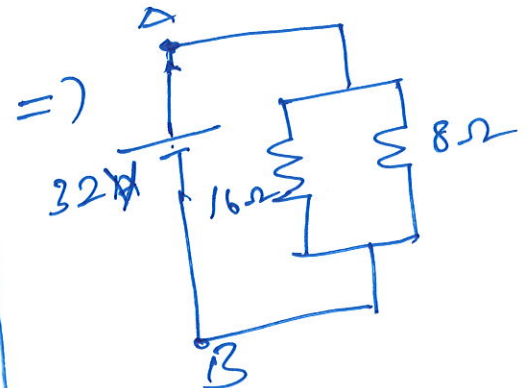
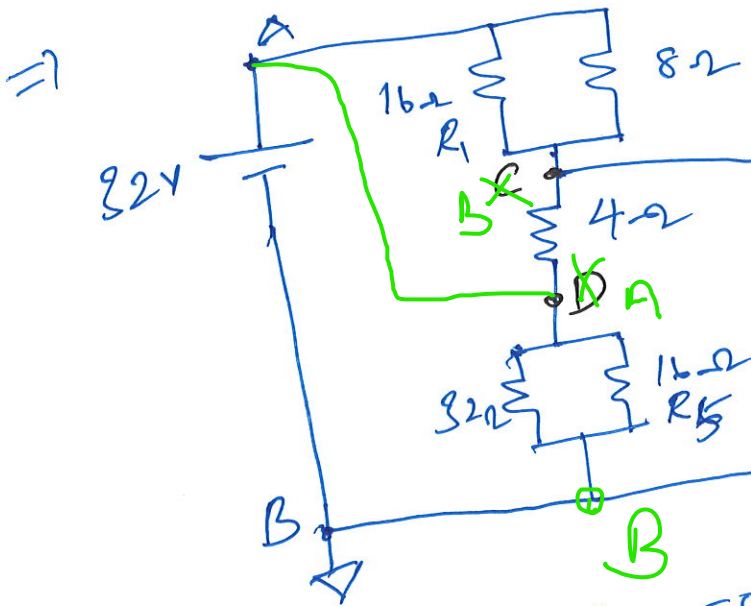
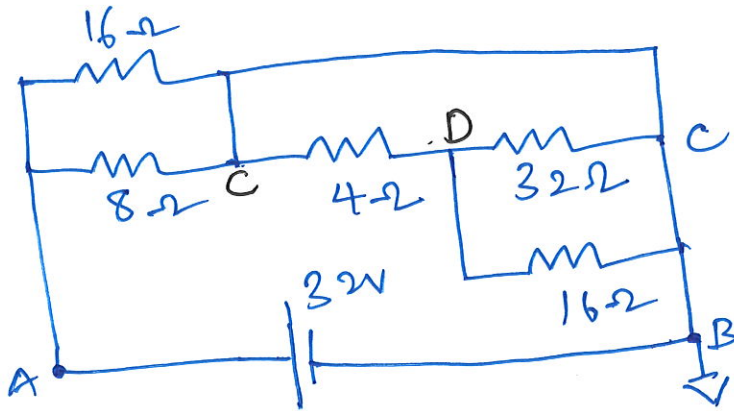
(by KVL) $\underline{V_{10\Omega} = 20 - 10 = 10 \text{ V}}$ (or Ohm's law $10\Omega \times 1\text{A} = \underline{10 \text{ V}}$)

$$\underline{I_{14\Omega} = I_{6\Omega} = 0.5 \text{ A}} \quad \underline{I_{20\Omega} = 0.5 \text{ A}}$$

$$\underline{I_{10\Omega} = 1 \text{ A}}$$

Fig. 7

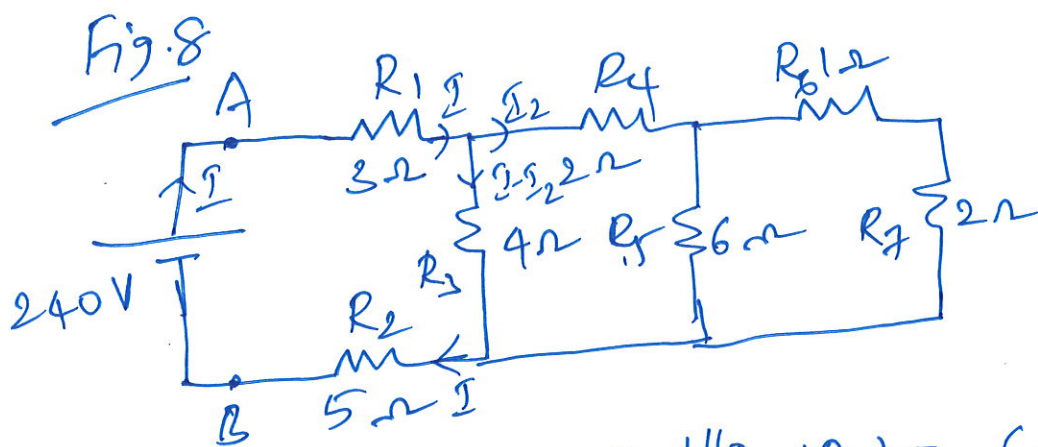
6



$$I_{4\Omega} = 0 \quad I_{32\Omega} = 0 \quad I_{16\Omega(R5)} = 0 \Rightarrow V_{4\Omega} = 0, V_{32\Omega} = 0 \\ V_{16\Omega(R5)} = 0$$

$$R_{AB} = (16 \parallel 8) = \frac{16}{3} \Omega \quad I = \frac{32}{16/3} = 6A$$

$$I_{16\Omega} = 6 \times \frac{8}{16+8} = 2A \quad I_{8\Omega} = 6 - 2 = 4A$$



$$R_6 + R_7 = 2\Omega \quad R_5 \parallel (R_6 + R_7) = 6 \parallel 2 = 2\Omega$$

$$R_4 + [R_5 \parallel (R_6 + R_7)] = 4\Omega$$

$$R_3 \parallel [R_4 + (R_5 \parallel (R_6 + R_7))] = 4 \parallel 4 = 2\Omega$$

$$R_1 + [R_3 \parallel [R_4 + [R_5 \parallel (R_6 + R_7)]]] + R_2 = 3 + 2 + 5 = 10\Omega$$

$$I = \frac{240V}{10\Omega} = 24A$$

$$I_{R1} = 24A \quad \cancel{V_{R1} = 72V} \quad V_{R1} = 24 \times 3 = 72V$$

$$I_{R2} = 24A \quad \cancel{I_1} \quad V_{R2} = 24 \times 5 = 120V$$

3. Fig. 9 $I_{R4} = I_{R1} =$

$$I_{R1} = 40mA$$

$$I_{R2} = 40 - 10 = 30mA$$

$$I_{R3} = 30 - 20 = 10mA$$

$$I_{RL1} = 10mA \quad I_{RL2} = 20mA$$

$$I_{R5} = 40mA \quad I_{R4} = 40 - 4 = 36mA$$

(8)

$$R_1 = \frac{V_{R1}}{I_{R1}} = \frac{120 - 100}{40 \text{ mA}} = 0.5 \text{ k}\Omega$$

$$R_2 = \frac{V_{R2}}{I_{R2}} = \frac{100 - 40}{30 \text{ mA}} = 2 \text{ k}\Omega$$

$$R_3 = \frac{V_{R3}}{I_{R3}} = \frac{40}{10 \text{ mA}} = 4 \text{ k}\Omega$$

$$R_4 = \frac{V_{R4}}{I_{R4}} = \frac{36 \text{ V}}{36 \text{ mA}} = 1 \text{ k}\Omega$$

$$R_5 = \frac{V_{R5}}{I_{R5}} = \frac{180 - 20 - 60 - 40 - 36}{36 \text{ mA}} = \frac{24 \text{ k}\Omega}{36} = 0.67 \text{ k}\Omega$$

Power:

$$P_{R1} : V_{R1} \cdot I_{R1} = 20 \times 40 \text{ mA} = 0.8 \text{ W}$$

$$P_{R2} \quad 60 \text{ V} \cdot 30 \text{ mA}$$

$$= 1.8 \text{ W}$$

$$P_{R3} : 40 \text{ V} \cdot 10 \text{ mA}$$

$$= 0.4 \text{ W}$$

$$P_{R4} = 36 \text{ V} \cdot 36 \text{ mA}$$

$$= 1.296 \text{ W}$$

$$P_{R5} = 24 \text{ V} \cdot 36 \text{ mA}$$

$$= 0.864 \text{ W}$$

Fig. 10

$$V_S = 40 \text{ mA} \cdot 1.6 \text{ k}\Omega = \underline{64 \text{ V}}$$

$$R_{L2} = \frac{48 \text{ V}}{12 \text{ mA}} = 4 \text{ k}\Omega \quad V_{R1} = V_S$$

$$R_{L3} = \frac{24 \text{ V}}{8 \text{ mA}} = 3 \text{ k}\Omega$$

$$I_{R1} = 72 - 40 = \cancel{60 \text{ mA}} \quad 32 \text{ mA}$$

$$I_{R2} = 32 - 12 = 20 \text{ mA}$$

$$I_{R3} = 20 - 8 = 12 \text{ mA}$$

$$R_1 = \frac{V_{R1}}{I_{R1}} = \frac{64 - 48}{32 \text{ mA}} = 0.5 \text{ k}\Omega$$

$$R_2 = \frac{V_{R2}}{I_{R2}} = \frac{48}{20 \text{ mA}} = 1.2 \text{ k}\Omega$$

$$R_3 = \frac{V_{R3}}{I_{R3}} = \frac{24}{12 \text{ mA}} = 2 \text{ k}\Omega$$

$$\text{Power } P_{R1} = I_{R1} V_{R1} = 16 \times 32 \text{ mA} = 0.512 \text{ W}$$

$$P_{R2} = I_{R2} V_{R2} = 48 \times 20 \text{ mA} = 0.96 \text{ W}$$

$$P_{R3} = V_{R3} I_{R3} = 24 \times 12 \text{ mA} = 0.288 \text{ W}$$

$$P_{R1} = 64 \times 40 \text{ mA} = 2.56 \text{ W}$$

$$P_{R2} = V_{R2} I_{R2} = 48 \times 12 \text{ mA} = 0.576 \text{ W}$$

$$P_{R3} = V_{R3} I_{R3} = 24 \times 8 \text{ mA} = 0.192 \text{ W}$$