Practice Problem

2.2

$V = IR$ | $I = 3\,mA$, $R = 10\,k\Omega$

$= 3 \times 10$

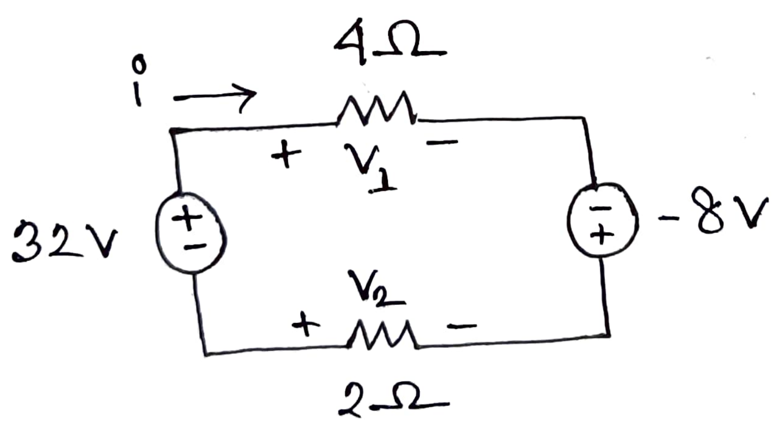
$= 30\,V$

$G = \frac{1}{R} = \frac{1}{10\,\cancel{k} \times 1000}$

$= 10^{-4}\,S = 100\,\mu S$

$P = V.I = 30 \times 3 = 90\,mW$

2.5



Let current i flows through the loop in clockwise direction.

From Ohm's Law,

$V_1 = 4i$

$V_2 = -2i$

Applying KVL around the loop,

$$V_1 - (-8) - V_2 - 32 = 0$$

$$\Rightarrow 4i + 8 - (-2i) - 32 = 0$$

$$\Rightarrow 6i = 24$$

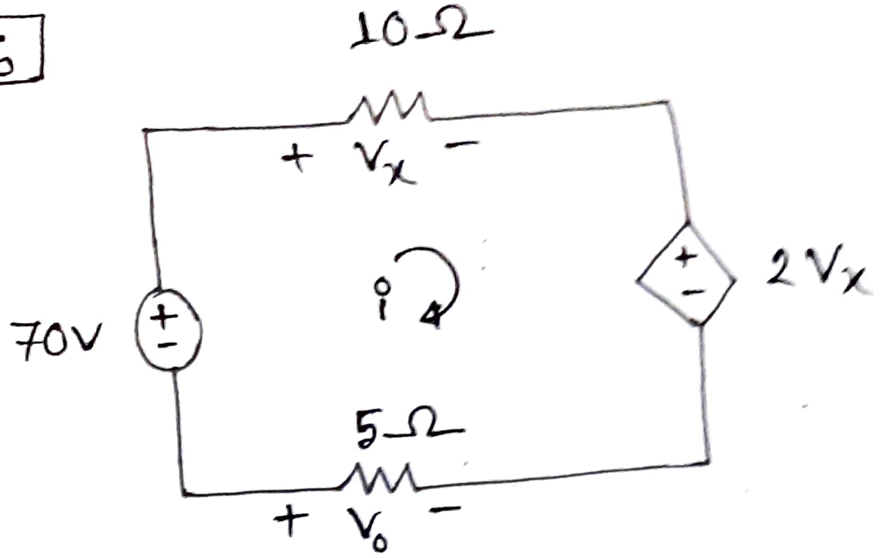
$$\therefore i = 4$$

$$\therefore i = 4A$$

$$\therefore V_1 = 4 \times 4 = 16 V$$

$$\therefore V_2 = (-2) \cdot (4) = -8 V$$

2.6



Applying Ohm's Law to 10Ω and 5Ω resistors we get,

$$V_x = 10i$$

$$V_0 = -5i$$

Applying KVL around the loop gives,

$$V_x + 2V_x - V_0 - 70 = 0$$

$$\Rightarrow 3(10i) - (-5i) = 70$$

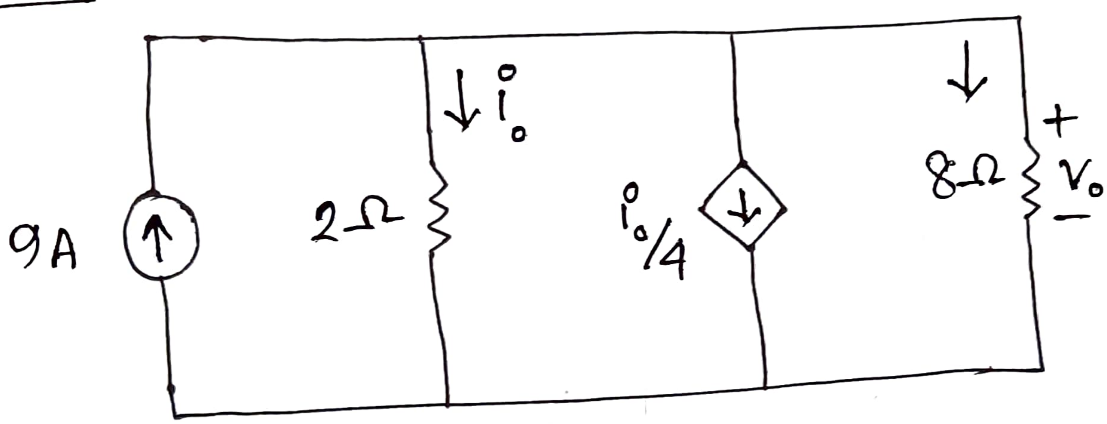
$$\Rightarrow 35i = 70$$

$$\therefore i = 2$$

$\therefore V_x = 10 \times 2 = 20\ V$

$\therefore V_o = (-5) \times 2 = -10\ V$

$\boxed{2.7}$



As 2Ω and 8Ω resistors are parallel, so ~~same voltage~~ there is same voltage across them, so,

$$V_o = 2i_o$$

Applying KCL,

$$9 = i_o + \frac{i_o}{4} + \frac{V_o}{8}$$

$$\Rightarrow 9 = i_o + \frac{i_o}{4} + \frac{2i_o}{8}$$

$$\Rightarrow 9 = \frac{4i_o + i_o + i_o}{4}$$

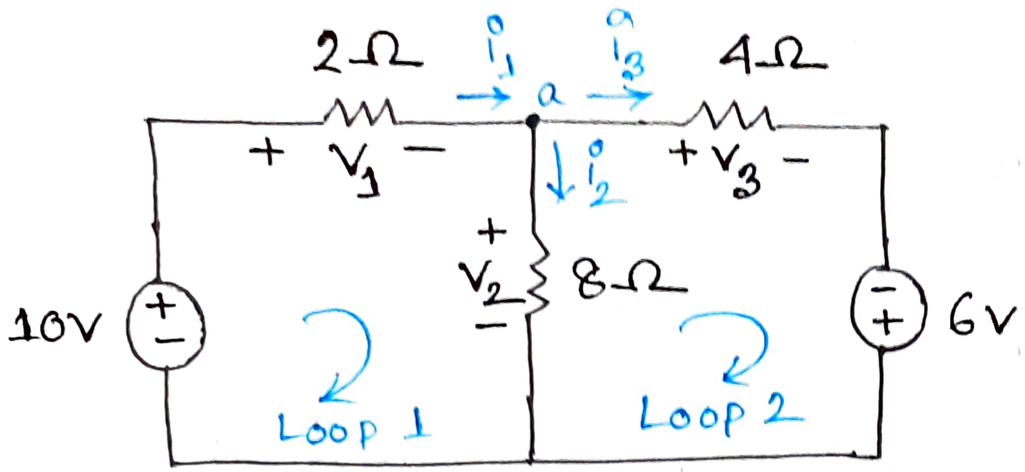
$$\Rightarrow 9 = \frac{6i_o}{4}$$

$$\Rightarrow i_o = \frac{4 \times 9}{6}$$

$$\therefore i_o = 6\ A$$

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

2.8



Applying Ohm's Law,

$$V_1 = 2i_1, \quad V_2 = 8i_2, \quad V_3 = 4i_3$$

Applying KCL at node a,

$$i_1 = i_2 + i_3$$

$$\Rightarrow \frac{V_1}{2} = \frac{V_2}{8} + \frac{V_3}{4}$$

$$\Rightarrow 4V_1 = V_2 + 2V_3$$

$$\Rightarrow 4V_1 - V_2 - 2V_3 = 0 \quad \text{——— (1)}$$

Applying KVL to loop 1,

$$V_1 + V_2 - 10 = 0$$

$$\Rightarrow V_1 = 10 - V_2 \quad \text{——— (2)}$$

Applying KVL to loop 2,

$$V_3 - 6 - V_2 = 0$$

$$\Rightarrow V_3 = 6 + V_2 \quad \text{—— (3)}$$

Substituting eqs. (2) and (3) into eq. (1) gives,

$$4(10 - V_2) - V_3 - 2(6 + V_2) = 0$$

$$\Rightarrow 40 - 4V_2 - V_3 - 12 - 2V_2 = 0$$

$$\Rightarrow 28 = 7V_2$$

$$\therefore V_2 = 4\,v$$

Putting this value to eqs. (2) and (3) gives,

$$V_1 = 10 - 4 = 6\,v$$

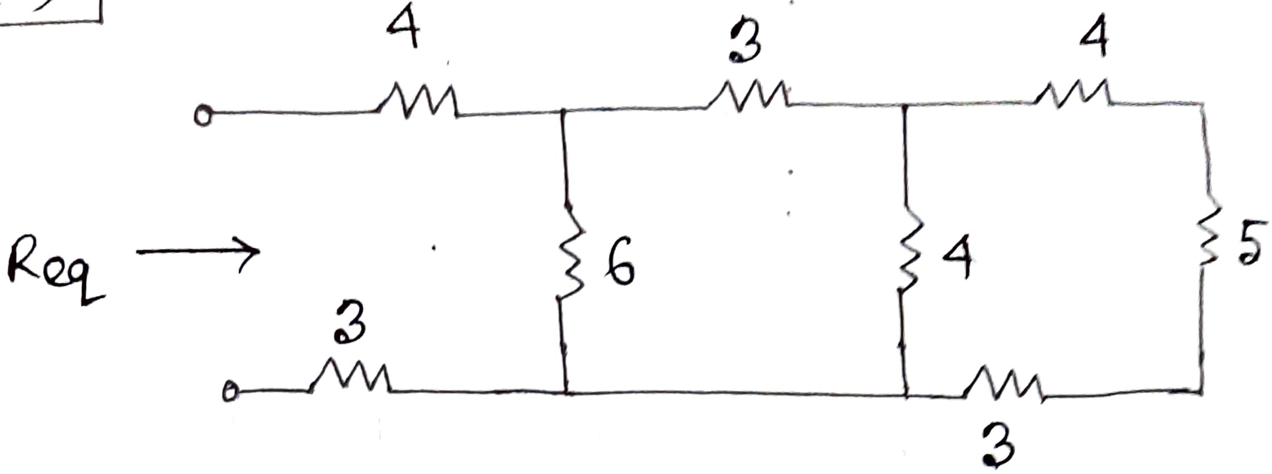
$$V_3 = 6 + 4 = 10\,v$$

$$\therefore i_1 = \frac{V_1}{2} = \frac{6}{2} = 3\text{ A}$$

$$\therefore i_2 = \frac{V_2}{8} = \frac{4}{8} = 0.5\text{ A}$$

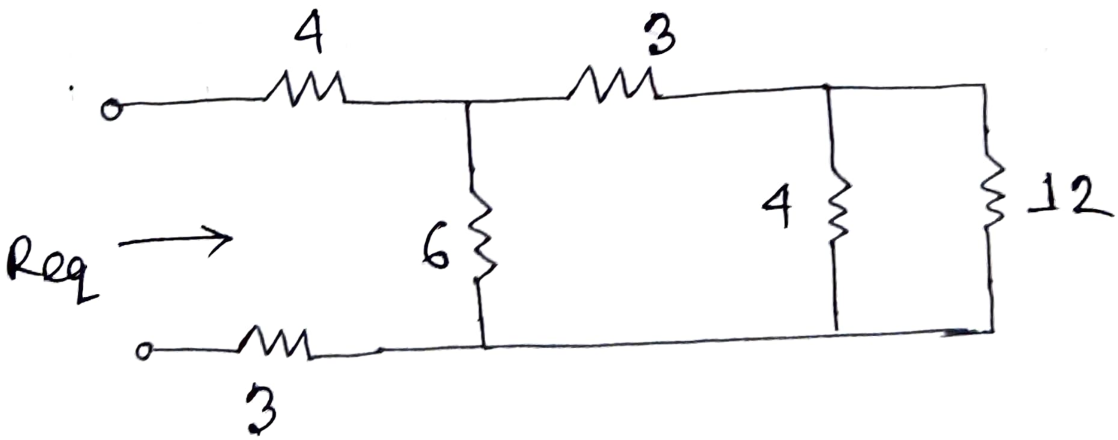
$$\therefore i_3 = \frac{V_3}{4} = \frac{10}{4} = 2.5\text{ A}$$

2.9



Here, 4Ω, 5Ω and 3Ω resistors are in series,

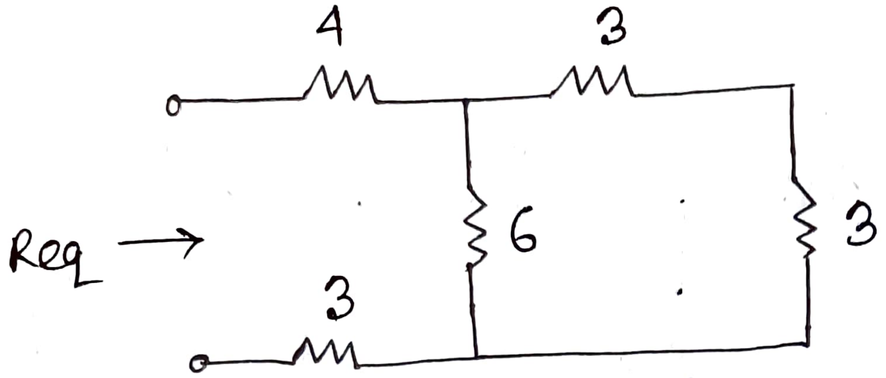
$$4 + 5 + 3 = 12\,\Omega$$



4Ω and 12Ω resistors are in parallel,

$$4 \parallel 12 = \frac{4 \times 12}{4 + 12}$$

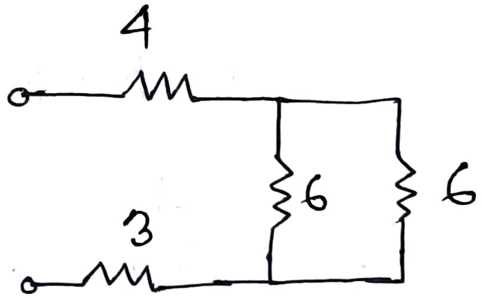
$$= 3\,\Omega$$



3Ω and 3Ω resistors are in

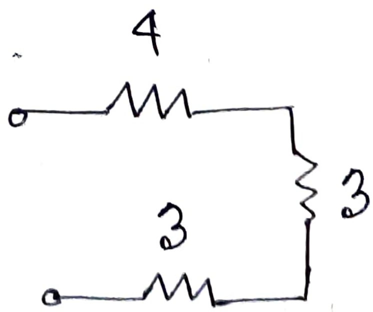
~~parallel,~~ series,

$$3+3 = 6\Omega$$



6Ω and 6Ω resistors are in parallel,

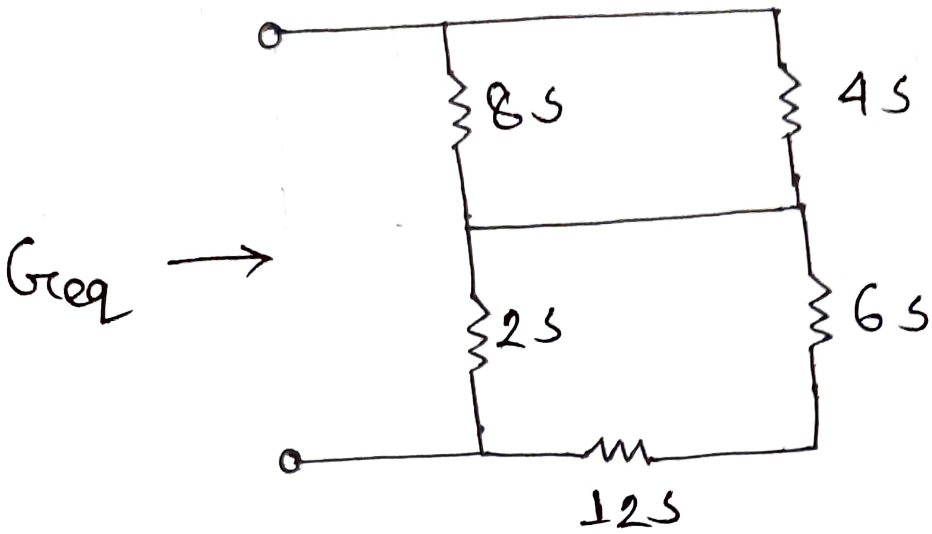
$$6 \parallel 6 = \frac{6\times 6}{6+6} = 3\Omega$$



Now, 4Ω, 3Ω and 3Ω resistors are in series,

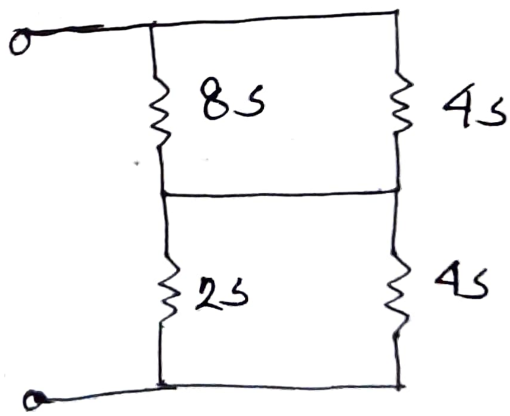
$$\therefore R_{eq} = 4+3+3 = 10\Omega$$

2.11



Here 6s and 12s ~~con~~ are in series,

$$\frac{12 \times 6}{12+6} = 4s$$



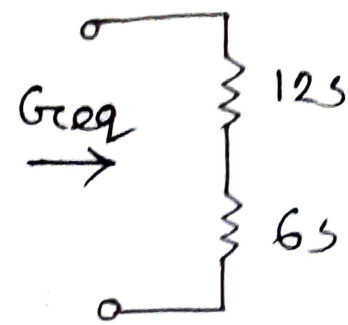
Here 8s and 4s are in parallel,

$8 + 4 = 12s$

And 2s and 4s are in parallel,

$2 + 4 = 6s$

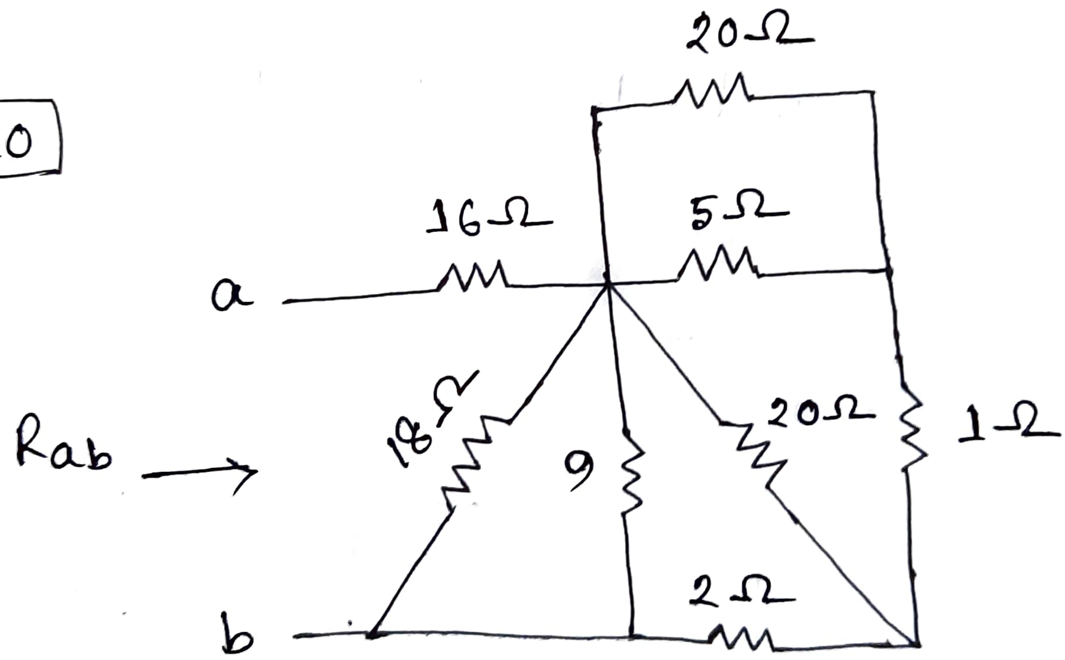
Now, 12s and 6s are in series,



$$\therefore G_{eq} = \frac{12 \times 6}{12 + 6}$$

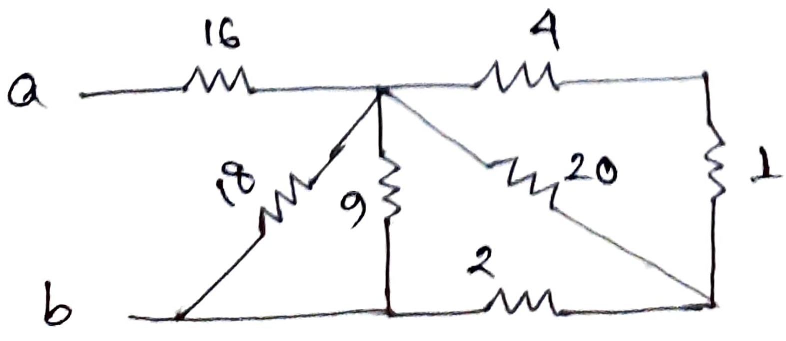
$$= 4s$$

2.10



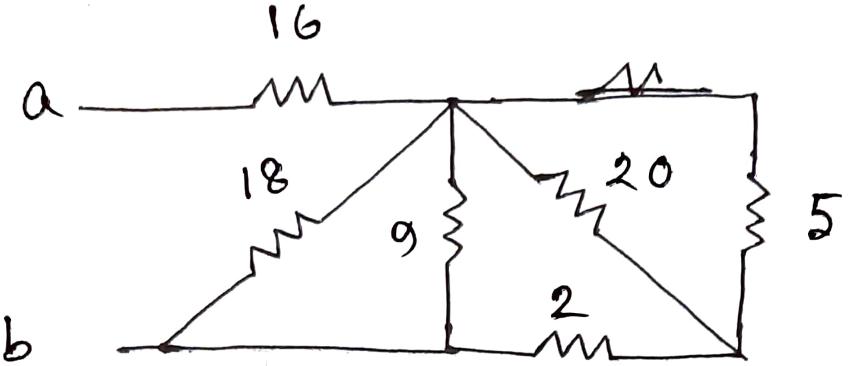
Here; 20 Ω and 5 Ω are in parallel,

$$20 \parallel 5 = \frac{20 \times 5}{20 + 5} = 4\,\Omega$$



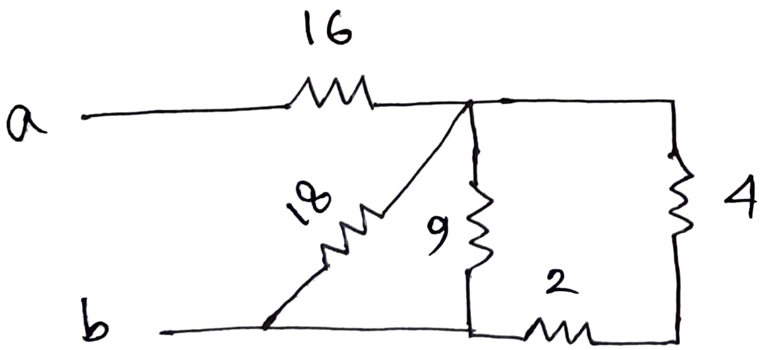
4 Ω and 1 Ω are in series,

$4 + 1 = 5\ \Omega$



5 Ω and 20 Ω are in ~~series,~~ parallel,

$$20 \parallel 5 = \frac{20 \times 5}{20 + 5} = 4\ \Omega$$

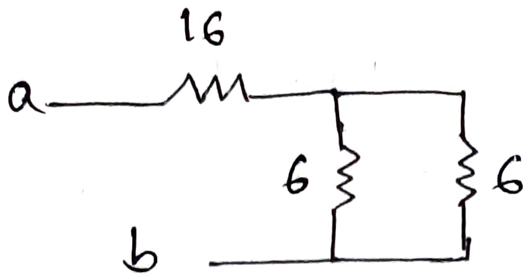


4 Ω and 2 Ω are in series, and

18 Ω and 9 Ω are in parallel,

$2 + 4 = 6\ \Omega$

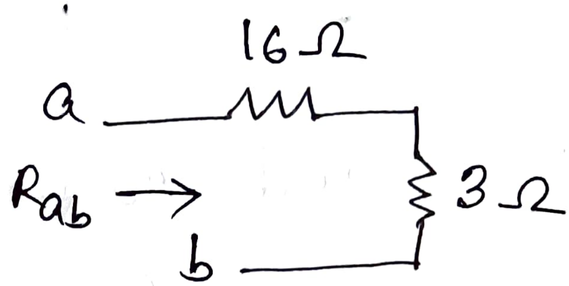
$$9 \parallel 18 = \frac{9 \times 18}{9 + 18} = 6\ \Omega$$



6 Ω and 6 Ω are in parallel,

$$6 \parallel 6 = \frac{6 \times 6}{6+6}$$

$$= 3\ \Omega$$

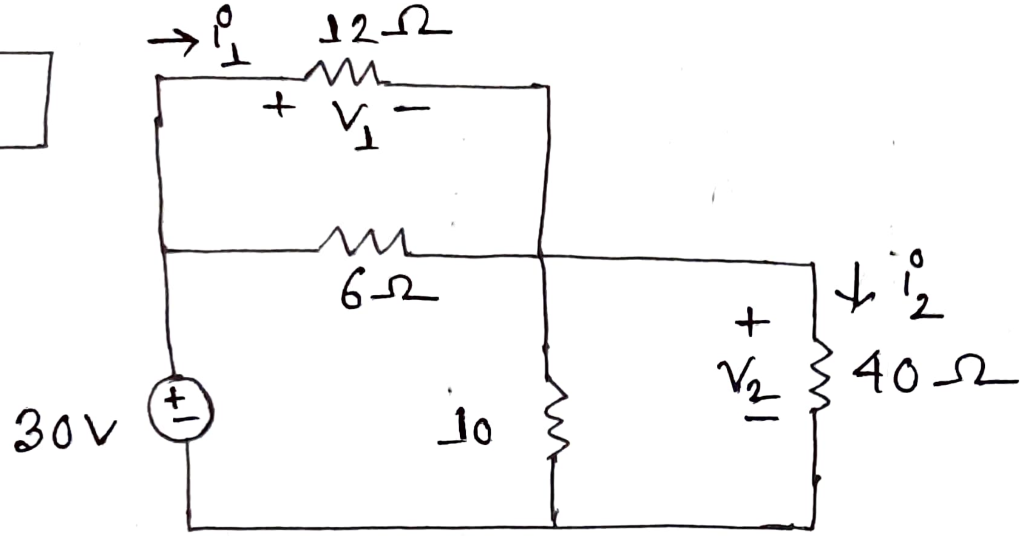


16 Ω and 3 Ω resistors are in series,

$$R_{ab} = 16 + 3$$

$$= 19\ \Omega$$

2.12



Applying Ohm's Law to 12 Ω and 40 Ω resistors,

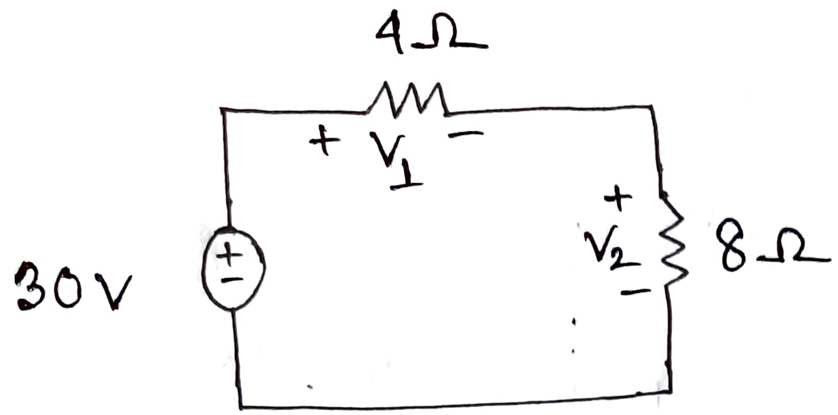
$$i_1 = \frac{V_1}{12}$$

$$i_2 = \frac{V_2}{40}$$

Here 12 Ω and 6 Ω resistors are in parallel, and 10 Ω and 40 Ω resistors are in parallel, so,

$$12 \parallel 6 = \frac{12 \times 6}{12+6} = 4\ \Omega$$

$$10 \parallel 40 = \frac{10 \times 40}{10+40} = 8\ \Omega$$



Applying voltage division rule,

$$V_1 = \frac{4}{4+8} \times 30 = 10\,V$$

$$V_2 = \frac{8}{4+8} \times 30 = 20\,V$$

$$\therefore i_1 = \frac{10}{12} = 0.833\,A$$

$$\therefore i_2 = \frac{20}{40} = 0.5\,A$$

$$\therefore P_1 = V_1 i_1 = 10 \times 0.833 = 8.33\,W$$

$$\therefore P_2 = V_2 i_2 = 20 \times 0.5 = 10\,W$$