ECE113: BASIC ELECTRONICS
QUIZ-1 SOLUTION

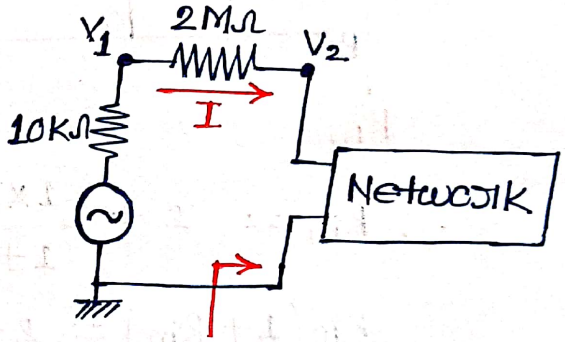
SOL(1): The value of currents I_2, I_4 & I_6 are independent of the value of resistors R_1, R_2 & R_3 respectively.

So, the value of currents I_2, I_4 & I_6 will remain 1A, 2A & 3A respectively.

[4 POINTS]

NOTE: Ideal current source in series with any element is redundant.

SOL(2):



By circuit diagram-

$$I = \frac{V_1 - V_2}{2\times10^6} = \frac{6-4}{2\times10^6}$$

$$I = 1\ \mu A$$

Input Equivalent Resistance $(R_{in})_{eq}$

∴ Input equivalent Resistance of the Network,

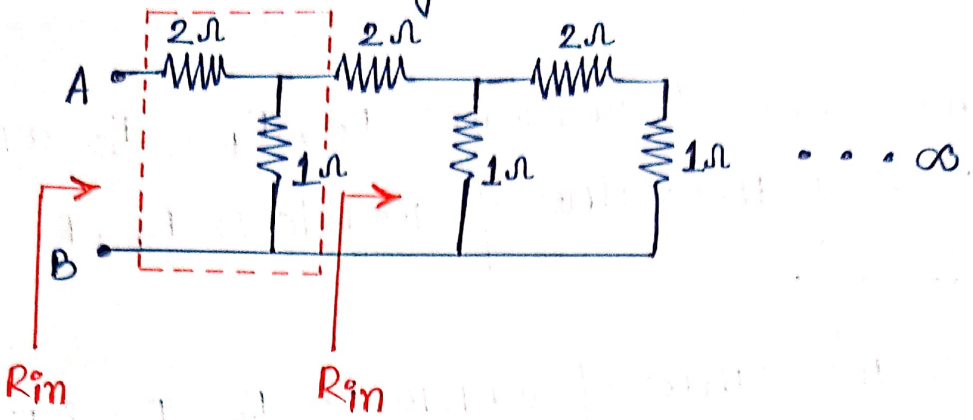
$$(R_{in})_{eq} = \frac{V_2}{I}$$

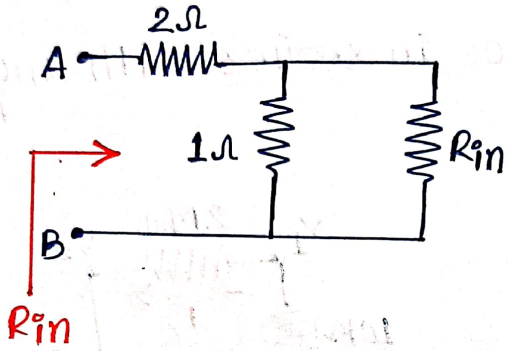
$$= \frac{4}{1\times10^{-6}} = 4\ M\Omega$$

$$\therefore (R_{in})_{eq} = 4\ M\Omega$$

[4 POINTS]

SOL(3): Given circuit diagram—





$$\therefore R_{in} = 2 + \frac{1 \times R_{in}}{1 + R_{in}}$$

$$R_{in}(1 + R_{in}) = 2 + 2R_{in} + R_{in}$$

$$R_{in} + R_{in}^2 = 2 + 3R_{in}$$

$$R_{in}^2 - 2R_{in} - 2 = 0$$

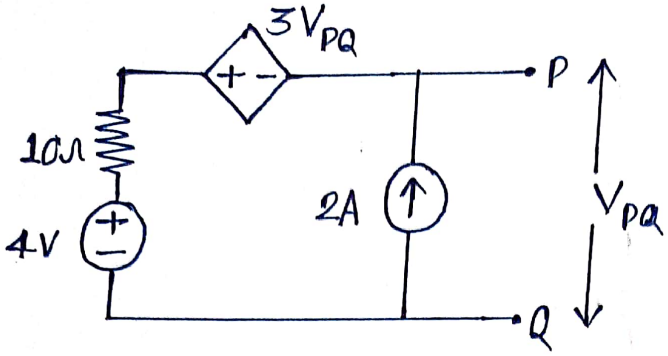
$$R_{in} = \frac{2 \pm \sqrt{4+8}}{2} = 1 \pm \sqrt{3}$$

$$\therefore R_{in} = (1 + \sqrt{3})\Omega = 2.73\Omega$$

∴ Equivalent resistance between point A & B,

$R_{AB} = R_{in} = 2.73\Omega$ [4 POINTS]

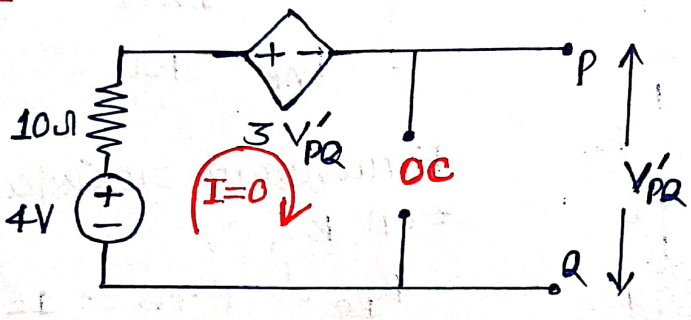
SOL(4):-



NOTE:- In the above network for applying Superposition theorem, dependent source is neither open circuit nor short circuit and it remain same as original network.

Now, By using Superposition theorem, we can —

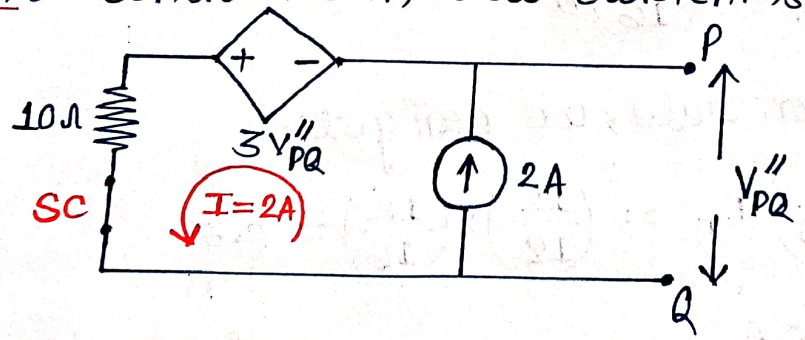
Case(I):- Consider 4 Volt, ideal voltage source only



$-4 + 3V'_{PQ} + V'_{PQ} = 0$ (apply KVL)

$\therefore V'_{PQ} = 1$ Volt [2.75 POINTS]

Case(II):- Consider 2A, ideal current source only



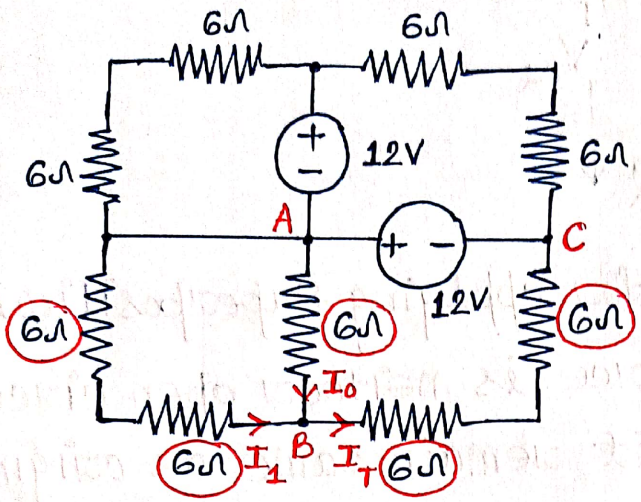
$-V''_{PQ} - 3V''_{PQ} + 10 \times 2 = 0$ (apply KVL)

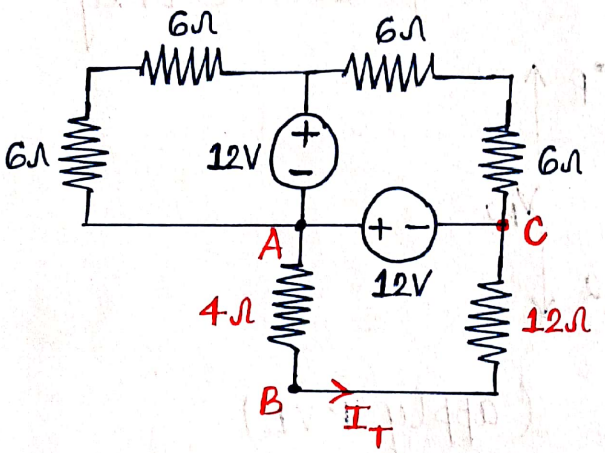
$\therefore V''_{PQ} = 5$ Volt [2.75 POINTS]

$\therefore V_{PQ} = V'_{PQ} + V''_{PQ} = 1 + 5 = 6$ Volt (Superposition theorem) [0.5 POINT]

SOL(5) :-

Given circuit diagram —





Equivalent resistance between point A & B,

$$R_{AB} = 6 \| (6+6)$$

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

$$\therefore R_{AB} = 4\Omega$$

Equivalent resistance between B & C,

$$R_{BC} = 6+6 = 12\Omega$$

$$\therefore R_{BC} = 12\Omega$$

By KVL (between points A, B & C) —

$$I_T = \frac{12}{4+12} = \left(\frac{12}{16}\right) A$$

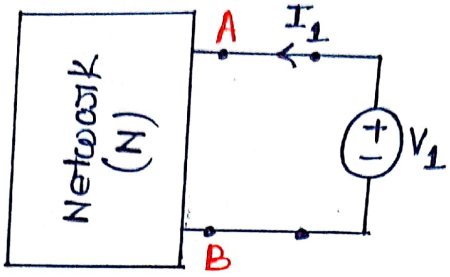
By current division rule, we can get —

$$I_o = \left(\frac{12}{12+6}\right) I_T = \left(\frac{12}{18}\right) \times \left(\frac{12}{16}\right) = 0.5$$

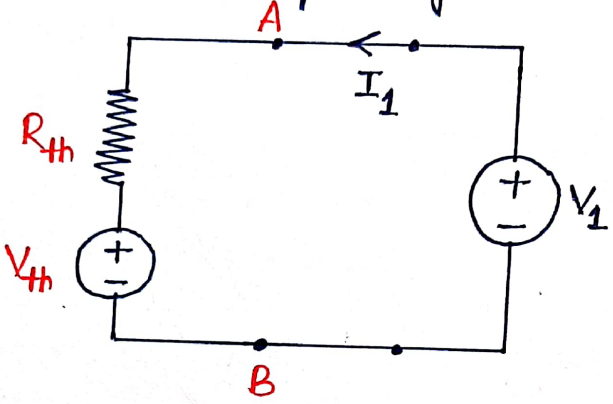
$$\therefore I_o = 0.5\ A$$

[6 POINTS]

SOL(6): By given network—



Thevenin equivalent of the given circuit can be drawn as—



Applying KVL,

$$-V_1 + I_1 \times R_{th} + V_{th} = 0$$

$$I_1 = \frac{V_1}{R_{th}} - \frac{V_{th}}{R_{th}} \quad \text{—— (1)}$$

Given that— $I_1 = 0.2V_1 - 2$ —— (2)

Comparing equation (1) & (2), we have—

$$\frac{1}{R_{th}} = 0.2$$

$$\therefore R_{th} = 5\,\Omega$$ [3 POINTS]

$$\frac{V_{th}}{R_{th}} = 2$$

$$\therefore V_{th} = 10 \text{ Volt}$$ [3 POINTS]