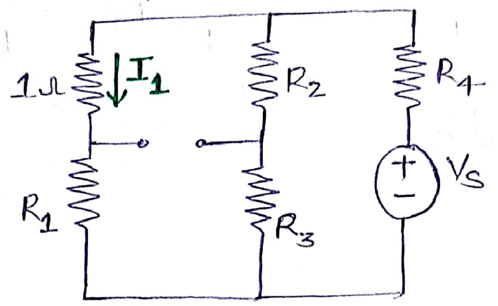
ASSIGNMENT – 2 RUBRIC

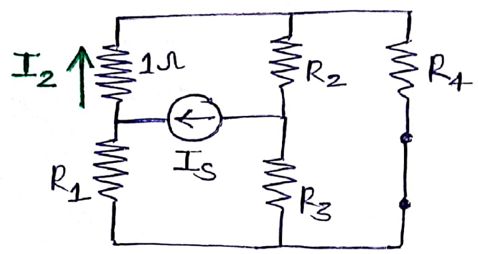
SOL(1):

Case(I): When Voltage Source (V_S) is acting alone



→ (0.5 Points)

Case(II): When current Source (I_S) is acting alone



→ (0.5 Points)

∴ Current through '1Ω' resistance, $I = (\pm I_1 \mp I_2)$ —— ①
(By using Superposition Theorem) → (1 Points)

as we know that – $P = I^2 R$

$$I = \sqrt{(P/R)} \quad \text{—— ②}$$

By eq^n ① & eq^n ②, we get –

$$\sqrt{(P/R)} = \pm\sqrt{(P_1/R)} \mp \sqrt{(P_2/R)}$$

$$\sqrt{P} = \pm\sqrt{P_1} \mp \sqrt{P_2} \qquad (\because R = 1\Omega)$$

$$P = (\pm\sqrt{P_1} \mp \sqrt{P_2})^2 \quad \text{—— ③}$$

→ (2 Points)

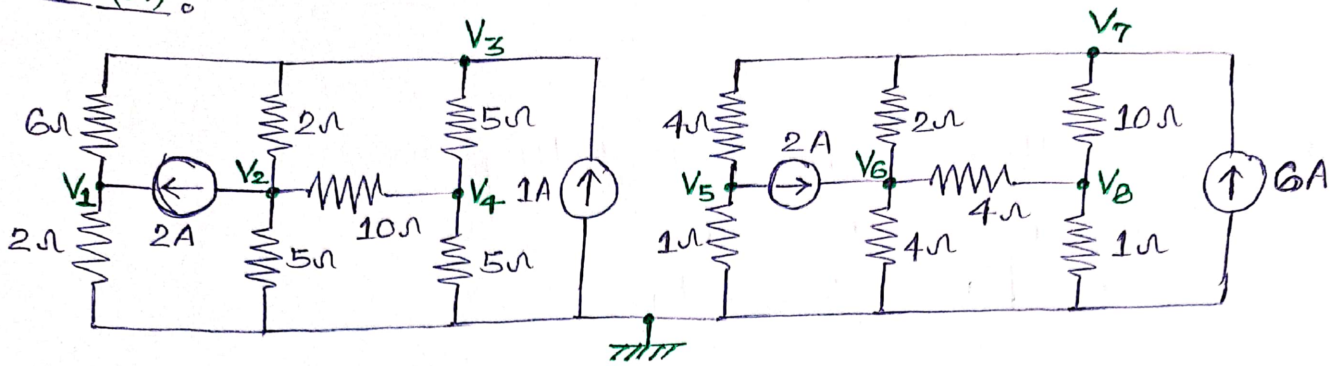
∴ Total power dissipation in 1Ω resistance,

$$P = (\sqrt{576} - \sqrt{1})^2$$

$$P = 529\ W$$

→ (1 Points)

SOL(2):



at Node ① —

$$\frac{V_1}{2} + \frac{V_1 - V_3}{6} = 2$$

$$4V_1 - V_3 = 12 \quad \text{—— ①}$$ → (0.5 Points)

at Node ② —

$$\frac{V_2}{5} + \frac{V_2 - V_3}{2} + \frac{V_2 - V_4}{10} + 2 = 0$$

$$8V_2 - 5V_3 - V_4 = (-20) \quad \text{—— ②}$$ → (0.5 Points)

at Node ③ —

$$\frac{V_3 - V_1}{6} + \frac{V_3 - V_2}{2} + \frac{V_3 - V_4}{5} = 1$$

$$-5V_1 - 15V_2 + 26V_3 - 6V_4 = 30 \quad \text{—— ③}$$ → (0.5 Points)

at Node ④ —

$$\frac{V_4}{5} + \frac{V_4 - V_2}{10} + \frac{V_4 - V_3}{5} = 0$$

$$-V_2 - 2V_3 + 5V_4 = 0 \quad \text{—— ④}$$ → (0.5 Points)

By eqⁿ ①, ②, ③ & ④ — $V_2 = (-2.35)V$, $V_3 = (0.31)V$, $V_4 = (-0.35)V$, $V_1 = (3.08)V$

→ (4 × 0.125 Points)

at Node ⑤ —

$$\frac{V_5}{1} + \frac{V_5 - V_7}{4} + 2 = 0$$

$$5V_5 - V_7 = (-8) \quad \text{—— ⑤}$$ → (0.5 Points)

at Node ⑥ —

$$\frac{V_6}{4} + \frac{V_6 - V_8}{4} + \frac{V_6 - V_7}{2} = 2$$

$$4V_6 - 2V_7 - V_8 = 8 \quad \text{—— ⑥}$$ → (0.5 Points)

at Node ⑦ —

$$\frac{V_7 - V_5}{4} + \frac{V_7 - V_6}{2} + \frac{V_7 - V_8}{10} = 6$$

$$-5V_5 - 10V_6 + 17V_7 - 2V_8 = 120 \quad \text{—— ⑦}$$ → (0.5 Points)

at Node ⑧ —

$$\frac{V_8}{1} + \frac{V_8 - V_6}{4} + \frac{V_8 - V_7}{10} = 0$$

$$-5V_6 - 2V_7 + 27V_8 = 0 \quad \text{—— (8)} \qquad \rightarrow (0.5 \text{ Points})$$

By eq^n (5), (6), (7) & (8), we get —

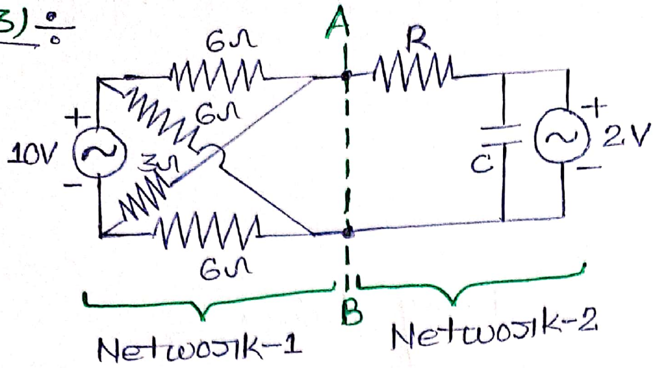
$V_6 = 9.22\ V$

$V_7 = 13.10\ V$

$V_8 = 2.68\ V$

$V_5 = 1.02\ V$ $\rightarrow (4 \times 0.125$ Points$)$

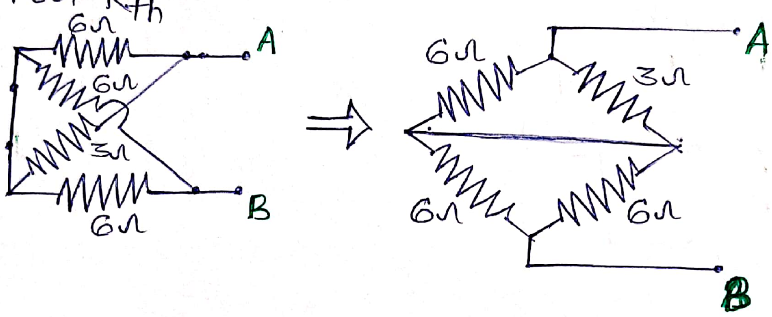
SOL(3):-



For maximum power transfer from Network-1 (work as a source) to Network-2 (work as a load), the value of eq. resistance of Network-2 is must be equal to source internal resistance (Network-1, thevenin resistance).

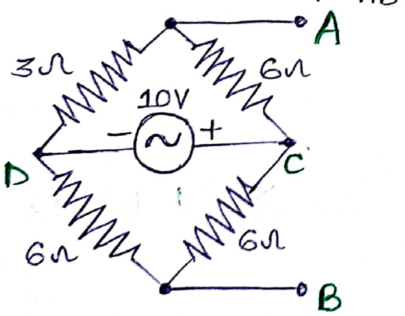
Network-1 Thevenin equivalent circuit — → (0.5 Points)

Case(I): For R_{th}



$\therefore R_{th} = 5\Omega$ — ① → (1 Points)

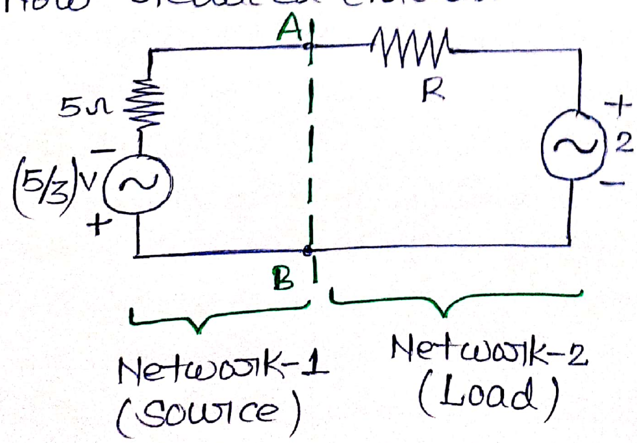
Case(II): For V_{th}/V_{AB}



$\therefore V_{th} = V_{AB} = (V_A - V_B) = \left(\frac{3}{9} \times 10\right) - \left(\frac{6}{12} \times 10\right)$

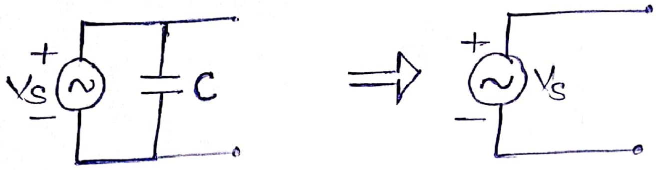
$= \left(-\frac{5}{3}\right)$ volt — ② → (1 Points)

Now reduced circuit —



→ (0.5 Points)

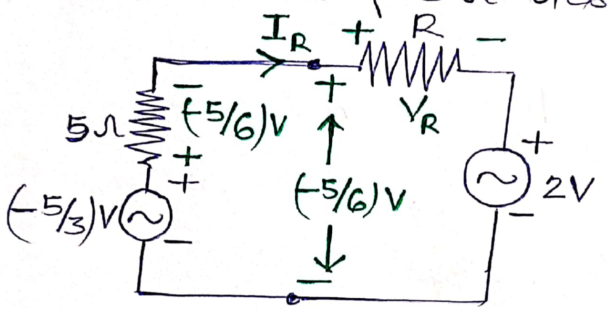
as we know, at steady state capacitor work as an open circuit.



(at steady state)

Equivalent resistance of load (Network-2) = R_{th} = 5Ω (For max^m power transfer)

Hence source voltage [(-5/3)V] will be equally distributed across load & 5Ω resistance ie [(-5/6) volt].



→ (1 Points)

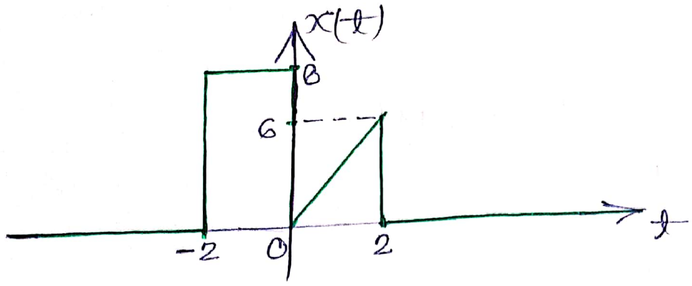
∴ Voltage across 'R' = V_R = (-17/6) volt

∴ Current through 'R' = $I_R = \frac{(-5/6)}{5} = (-1/6)$ A

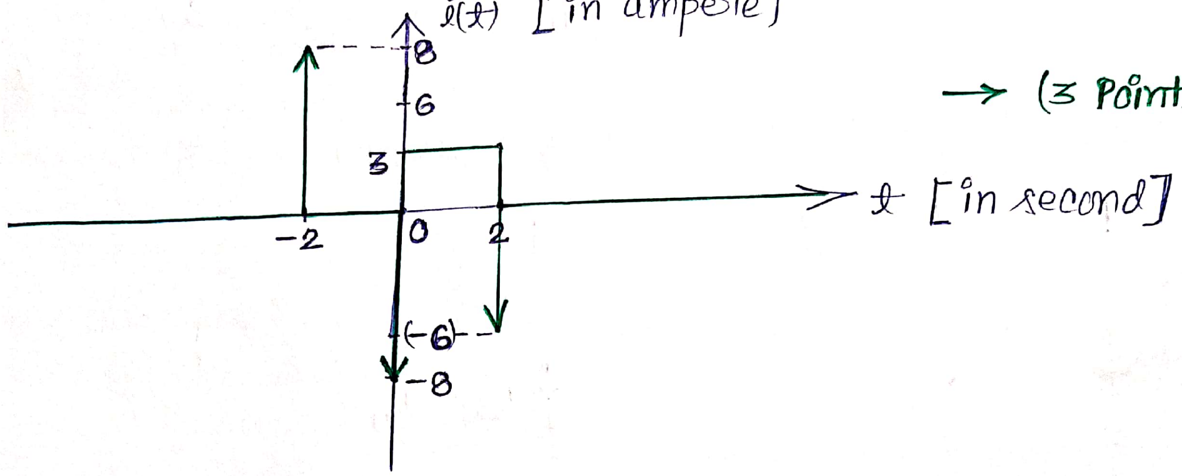
∴ Value of Resistor 'R' = $\left(\frac{V_R}{I_R}\right)$

= (17) Ω → (1 Points)

SOL(4):-



$i(t) = \frac{d}{dt}[x(t)] = $ slope of $x(t)$ w.r.t. 't'



→ (3 Points)

∴ Charge acquired by capacitor after 2 second,

$$Q = \int_{-2}^{2} i(t) \cdot dt = \text{area of } i(t) \text{ w.r.t. 't'} \quad [-2 \leq t \leq 2]$$

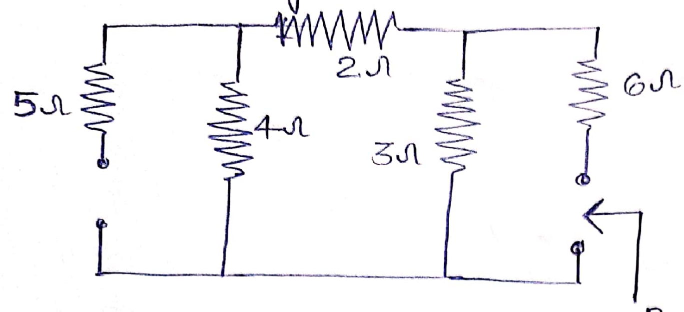
$$Q = 8 - 8 + 2 \times 3 - 6$$

$$\therefore Q = 0 \text{ Coulomb}$$

→ (2 Points)

SOL (5):-

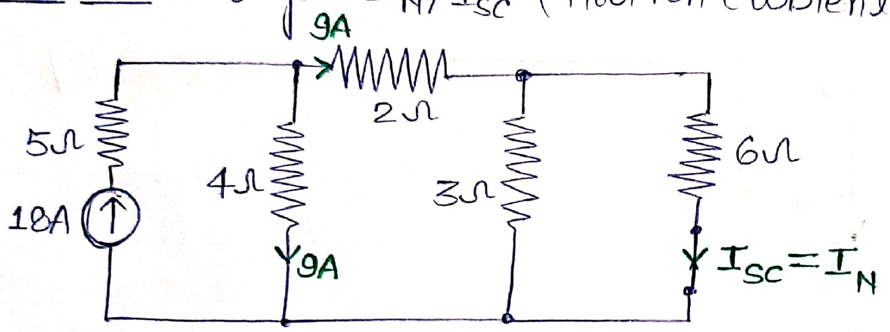
Case (I): To get R_N (Noorton Resistance)



$$R_N = 6 + \frac{3 \times 6}{3+6} = 8\Omega \quad \text{——} \quad ①$$

→ (2 Points)

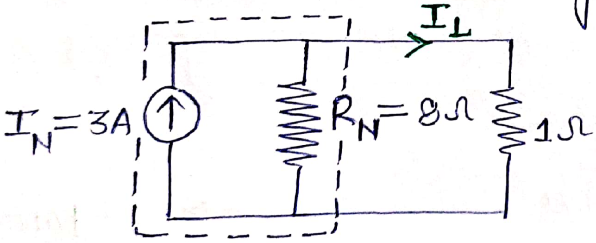
Case (II): To get I_N/I_{SC} (Noorton Current)



$$\therefore I_{SC} = I_N = \frac{3}{3+6} \times 9 = 3A \quad \text{——} \quad ②$$

→ (2 Points)

Now reduced circuit diagram—

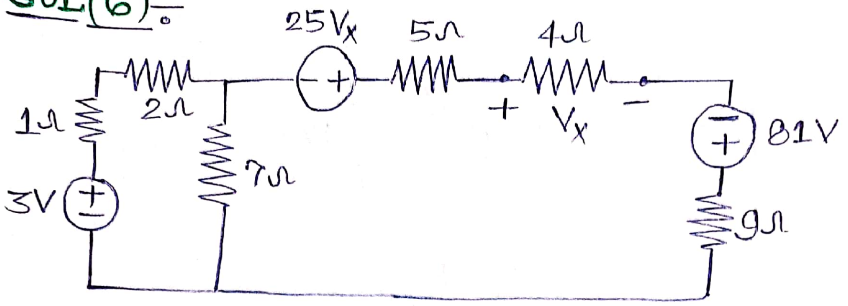


$\therefore$ Current in 1Ω resistance $= I_L = \left(\frac{8}{8+1}\right)3$

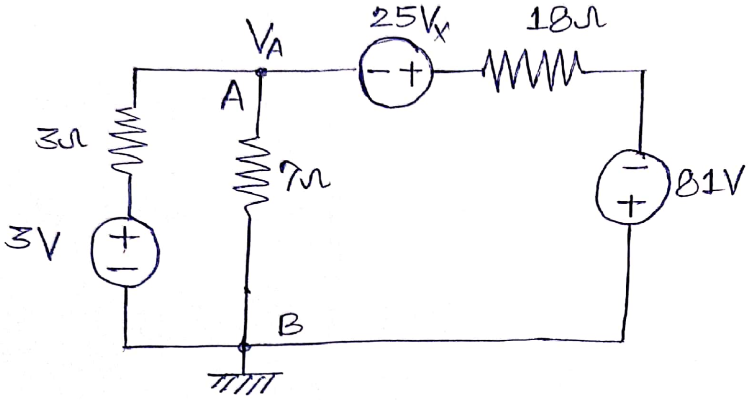
$= \left(\frac{8}{3}\right)A$

→ (1 Points)

SOL(6):-



⇓



→ (1 Points)

By using Nodal analysis (at node A),

$$\left(\frac{V_A-3}{3}\right)+\left(\frac{V_A}{7}\right)+\left(\frac{V_A+25V_x+81}{18}\right)=0$$

$$67V_A+175V_x=(-441) \quad \text{———} \quad (1)$$

→ (1.5 Points)

By circuits diagram—

$$\left(\frac{V_A+25V_x+81}{18}\right)=\left(\frac{V_x}{4}\right)$$

$$4V_A+82V_x=(-324) \quad \text{———} \quad (2)$$

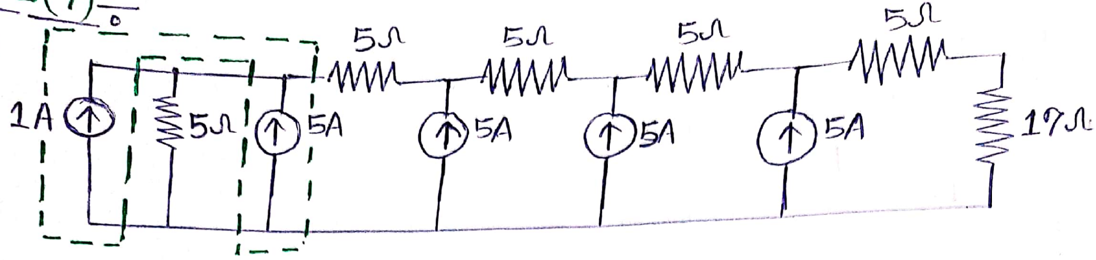
→ (1.5 Points)

By solving eqn (1) & (2), we get—

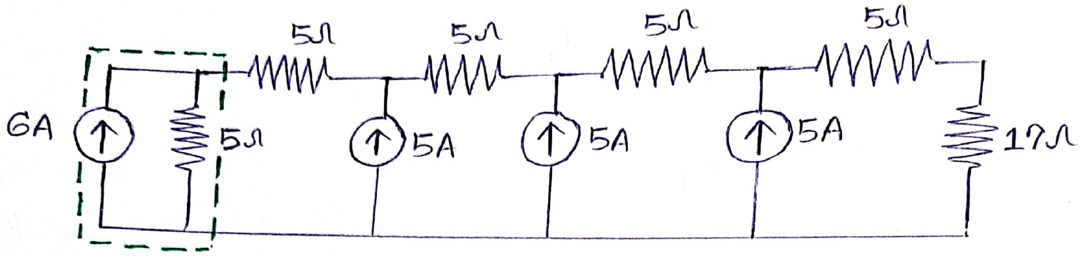
$\therefore$ $V_x=(-4.16)$ Volt → (1 Points)

SOL(7):

(a)



(0.25 Points)



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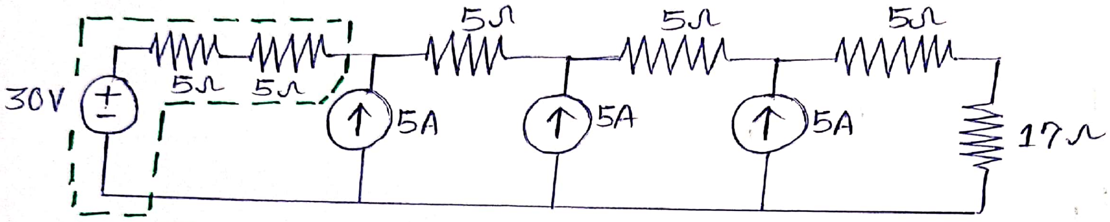

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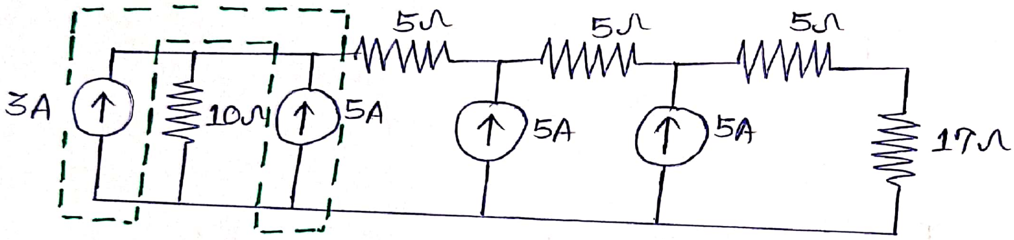
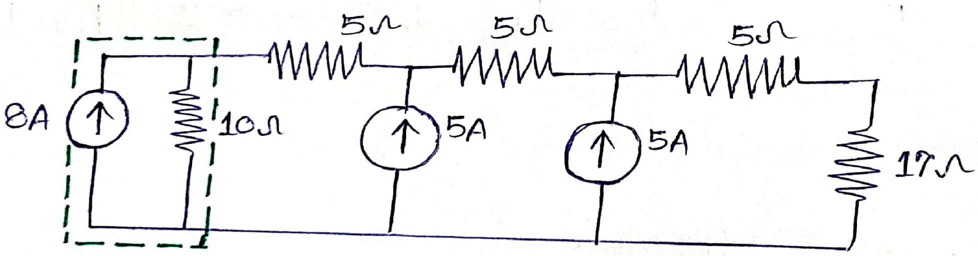
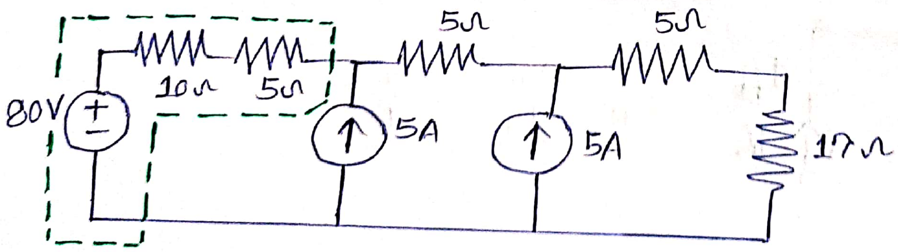


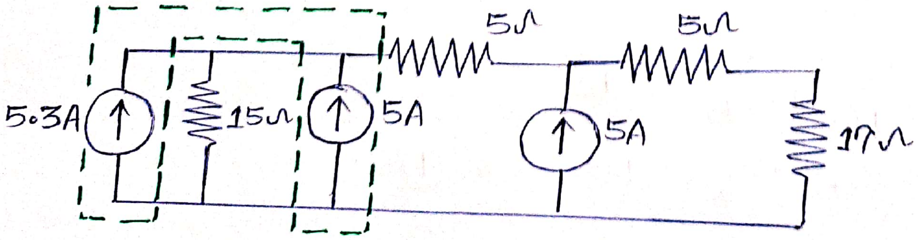
(0.25 Points)



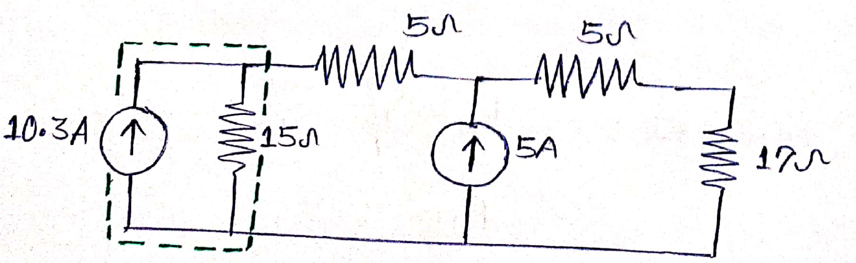
(0.25 Points)



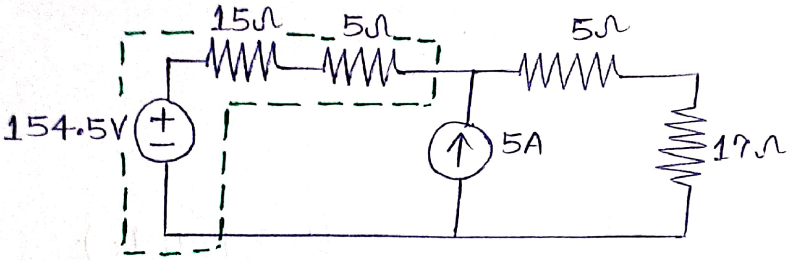
(0.25 Points)



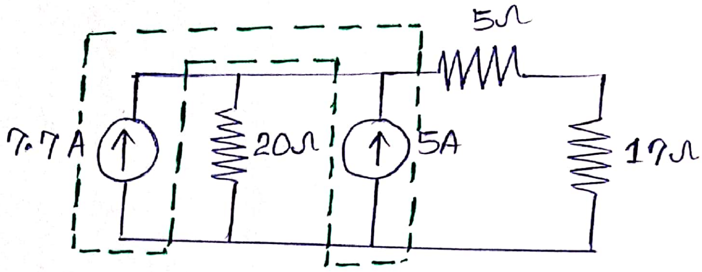
(0.25 Points)



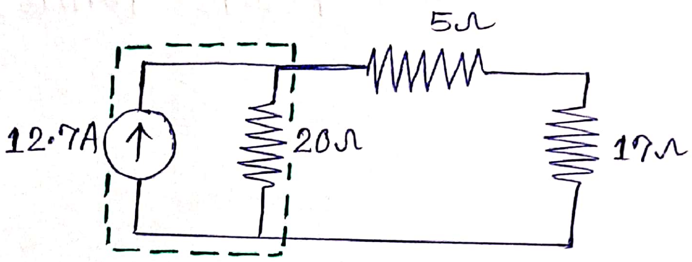
(0.25 Points)



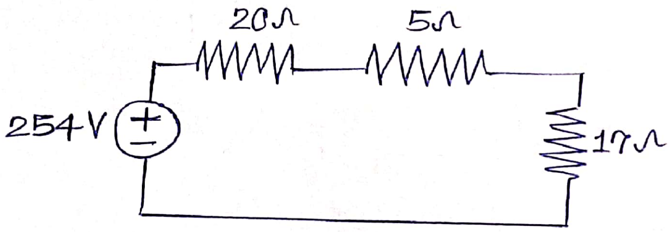
(0.25 Points)



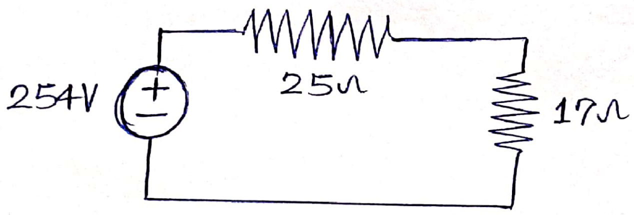
(0.25 Points)



(0.25 Points)



(0.25 Points)



(1.25 Points)

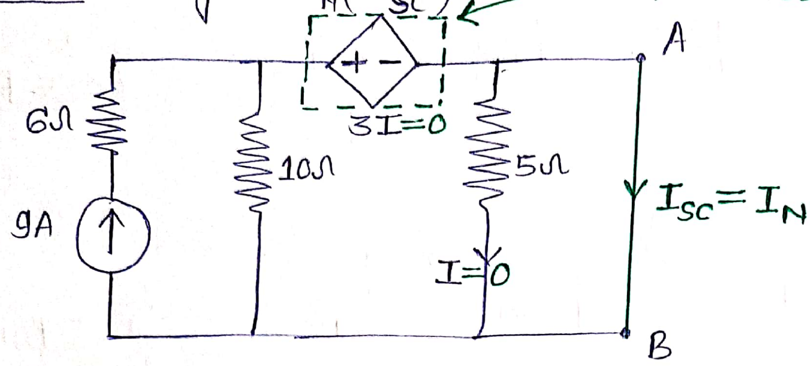
(b) $\therefore$ Power dissipated by 17 Ω resistor $= \left(\frac{254}{25+17}\right)^2 \times 17$

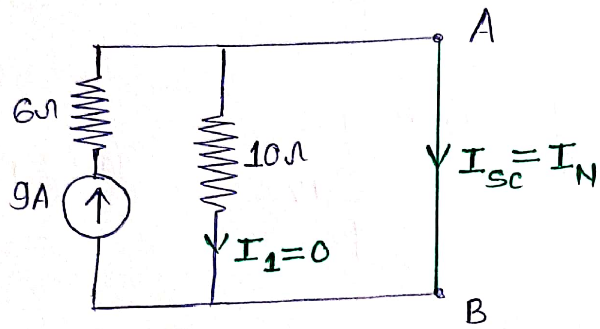
$= 621.75$ Watt

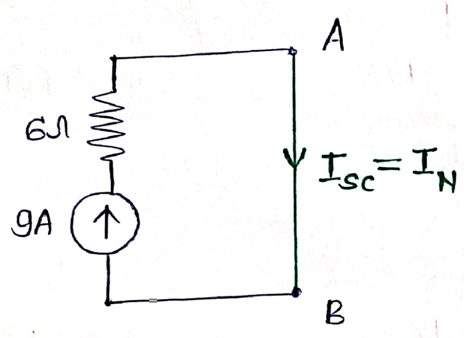
(0.75 Points)

SOL(B):-

Case(I): To get $I_N (I_{SC})$ ← Short Circuit

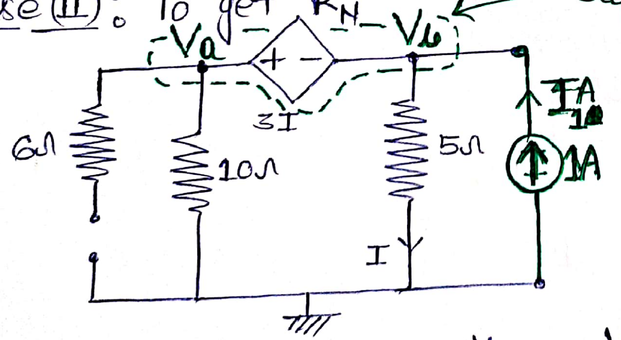






$\therefore I_{SC} = I_N = 9A$ → (2.5 Points)

Case (II): To get R_N ← Supernode



$$R_N = \left(\frac{V_b}{I_1}\right) = \left(\frac{V_b}{1}\right)$$

KCL at Supernode – $\frac{V_a}{10} + \frac{V_b}{5} = 1$

$V_a + 2V_b = 10$ —— ①

$V_a - V_b = 3I$ —— ②

$(V_b/5) = I$ —— ③

By using eqⁿ ①, ② & ③, we get – $R_N = \frac{V_b}{1} = \frac{50}{18} = 2.8\Omega$

$\therefore R_N = 2.8\Omega$

→ (2.5 Points)