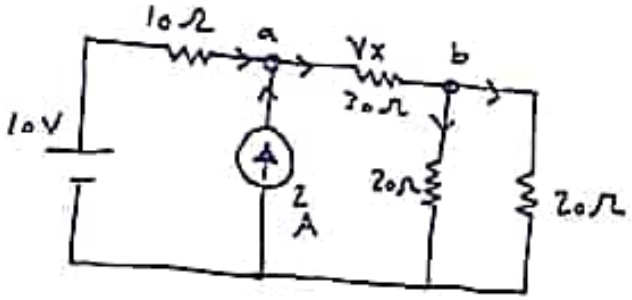
Q1) by using nodal method find V_x and Power by current source



node a

$$\frac{10 - V_a}{10} + 2 = \frac{V_a - V_b}{30} \quad \text{...①}$$

node b

$$\frac{V_a - V_b}{30} = \frac{V_b}{20} + \frac{V_b}{20} \quad \text{...②}$$

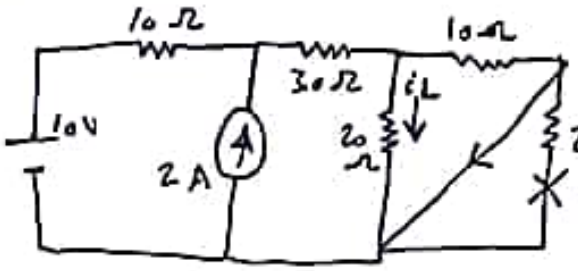
$V_a = 24\,V$

$V_b = 6\,V$

$V_x = V_a - V_b = 18V$

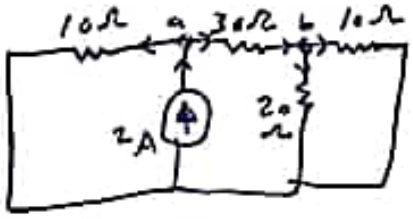
Power by current source = $P = IV = -24 \times 2 = -48\,W$ (delivered)

Q2) find i_L by using superposition



التيار يسلك أقرب وأسهل طريق

* kill voltage source



node a

$$2 = \frac{V_a}{10} + \frac{V_a - V_b}{30} \quad \text{...①}$$

node b

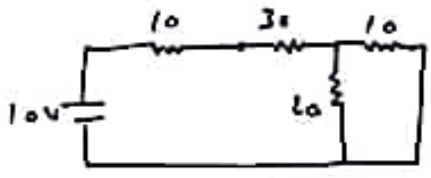
$$\frac{V_a - V_b}{30} = \frac{V_b}{20} + \frac{V_b}{10} \quad \text{...②}$$

... $V_a = 1.56\,V$

$V_b = 0.273$

$i'_L = \frac{V_b}{20} = \frac{0.273}{20} = 0.0137\,A$

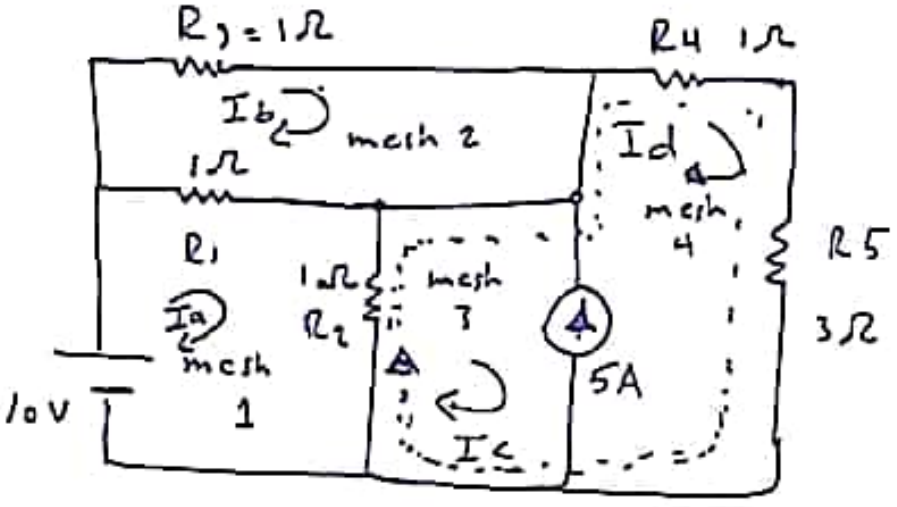
* kill current source



$i''_L = \frac{1.43}{20} = 0.071$

$i_L = i'_L + i''_L = 0.0851\,A$

Q3) by using mesh current method solve unkown current



mesh 1

$$-10 + I_a(1+1) - I_b - I_c = 0 \quad \cdots (1)$$

mesh 2

$$I_b(2) - I_a = 0 \quad \cdots (2)$$

mesh 3 and 4 super mesh

$$I_c(1) - I_a(1) + I_d(3+1) = 0 \quad \cdots (3)$$

4 equations and 4 unkowns

& $I_d - I_c = 5 \quad \cdots (4)$

by solving equations

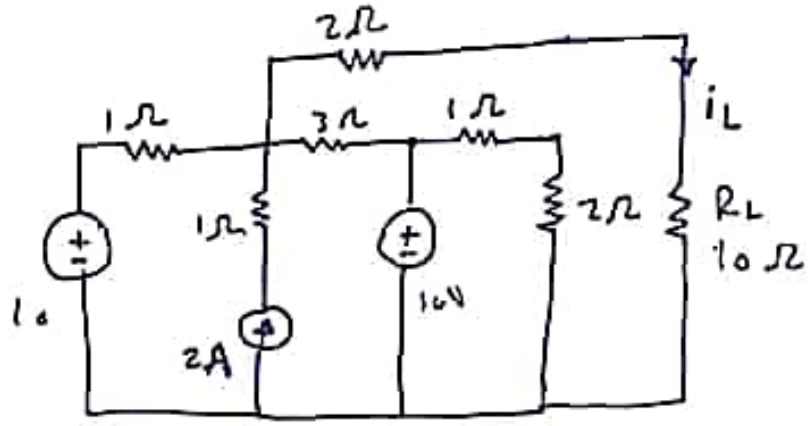
$I_a \approx 4.6$ A

$I_b \approx 2.3$ A

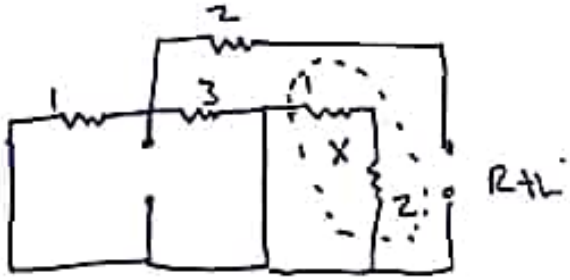
$I_c = -3$ A

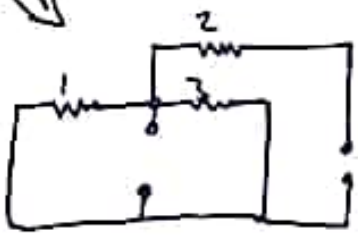
$I_d = 1.9$ A

Q4)
using thevinen equivalent circuit Find i_L



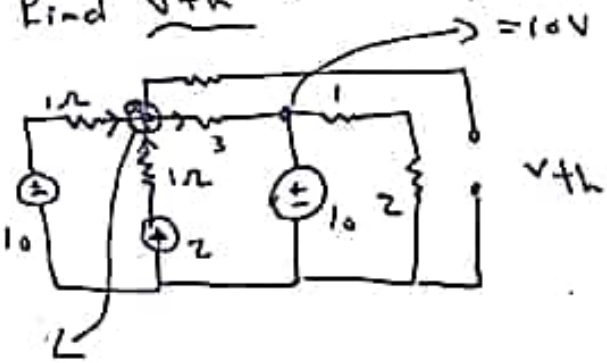
*Kill all sources and Remove RL





$(3 // 1) + 2 = 2.75\,\Omega = R_{th}$

Find V_{th}



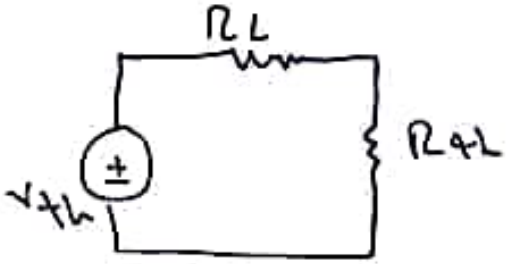
$V_a = V_{th}$

by using nodal method

$$\frac{10 - V_a}{1} + 2 = \frac{V_a - 10}{3}$$

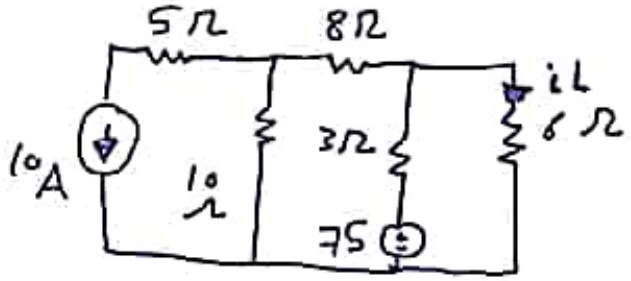
$V_a = 11.5 = V_{th}$

Draw thevinen equivalent

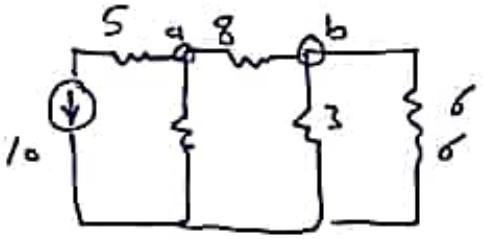


$$i_L = \frac{V_{th}}{R_{th} + R_L} = \frac{11.5}{10 + 2.75} = 0.90196\,A$$

Q5) Find i_L by using superposition



1) Kill V_s



by using nodal

node a

$$\frac{V_b - V_a}{8} = 10 + \frac{V_a}{10}$$

node b

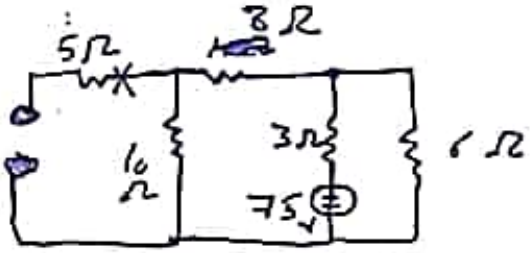
$$-\frac{V_b}{3} = \frac{V_b}{6} + \frac{V_b - 9}{8}$$

$V_a = 50V$

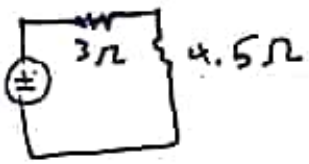
$V_b = 10V$

$$i_L = \frac{V_b}{6} = \frac{10}{8} A = \frac{5}{3} A$$

2) Kill current source



$$\frac{18 \times 6}{24} + 3$$

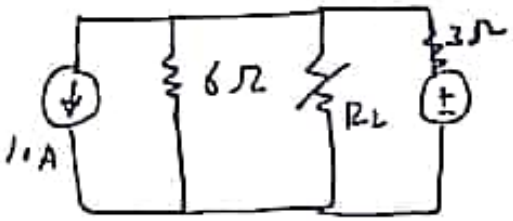


$$V = 75 \times \frac{4.5}{7.5} = 45$$

$$I''_L = \frac{45}{6} = 7.5$$

$$I''_L = 7.5 + \frac{5}{3} = 9.166 A$$

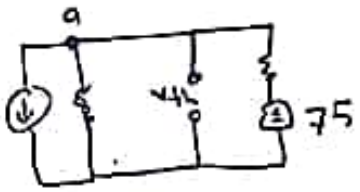
Q6) Find R_L to transfer max Power of R_L and Power



$R_L = R_{th}$

$R_{th} = \frac{3 \times 6}{3+6} = 2\Omega$

Find V_{th}



$\frac{75 - V_a}{3} = 10 + \frac{V_a}{6} \Rightarrow V_a = V_{th} = 30$

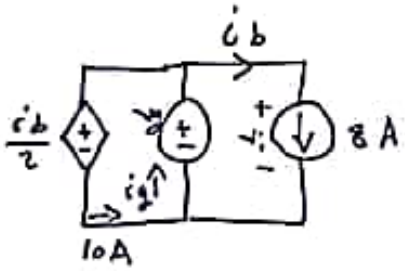
draw thevinin equivalent

use

$P_L = \frac{V_{th}^2}{4R_{th}} = \frac{30^2}{4 \times 2} = 112.5W$

$P_L = I_L^2 \times R_L = \frac{30^2}{4} \times 2 = 112.5V$

Q7) Find Power by each source (~~developed~~ / supplied / consumed) and Prove $\Sigma P = 0$



$i_g = 8 + 10 = 18 \uparrow A$

$\frac{i_b}{2} = V_g = V_i = 4V$

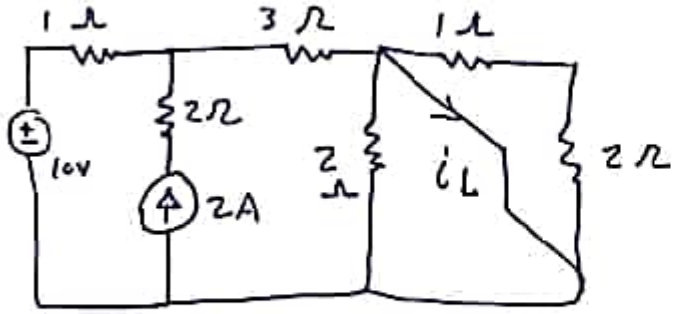
$P_g = -4 \times 18 = -72$ supplied

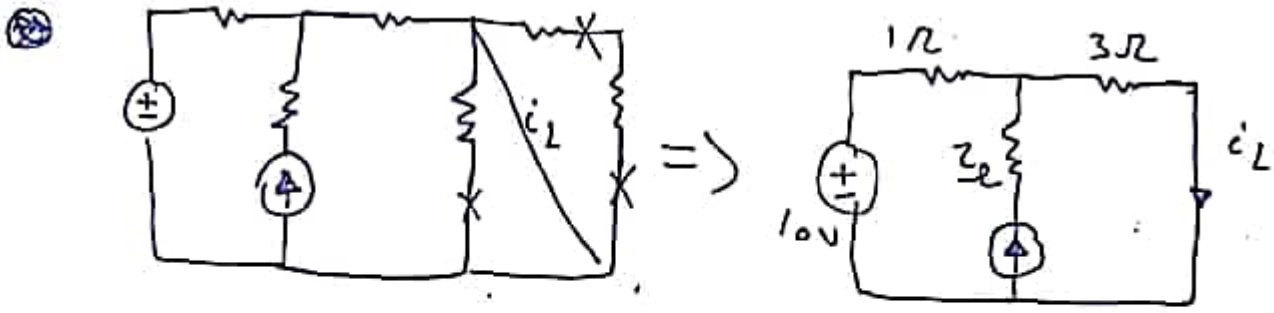
$P_2 = 4 \times 10 = 40W$ consumed

$P_1 = 8 \times 4 = 32W$ consumed

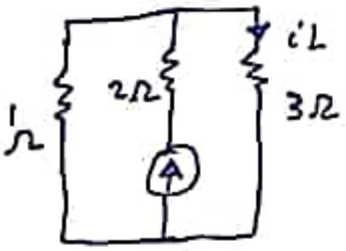
$\Sigma P = -72 + 40 + 32 = 0$

Q8) using superposition to find i_L



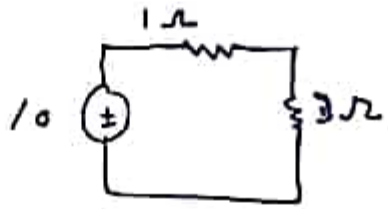


* Kill Vs



$$i'_L = 2 \times \frac{1}{3+1} = 0.5\ A$$

* Kill is



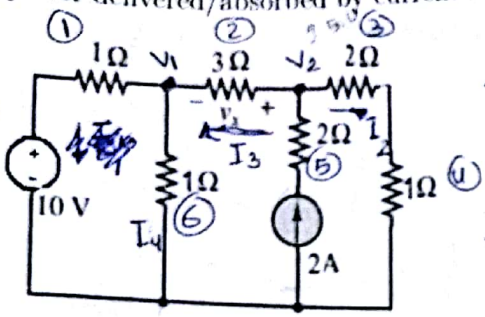
$$i'' = \frac{10}{4} = 2.5$$

$$i_L = i'_L + i''_L = 3\ A$$

Jordan University
Electrical Engineering Department
1st Exam, 4th Semester
Electric Engineering, 0903203

St.Name: Sama Obead St.#: 0142121 ; Seat/Section: ; Aug. 2nd, 2017; Exam lasts 1 0/60 h

Problem 1: In the circuit shown,find the voltage v_x by using nodal voltage analysis, then determine the power delivered/absorbed by current source.



$$\frac{V_2-0}{2+1}+\frac{V_2-V_1}{3}+2=0 \quad \cdots (1)$$

$$\frac{V_1-10}{1}+\frac{V_1-V_2}{3}+\frac{V_1-0}{1}=0 \quad \cdots (2)$$

$$V_2\left[\frac{1}{3}+\frac{1}{3}\right]-\frac{1}{3}V_1=2 \quad \cdots (1)$$

$$V_2\left[-\frac{1}{3}\right]+V_1\left[1+\frac{1}{3}+1\right]=10 \quad \cdots (2)$$

$V_2 = 5.54$ V $V_1 = 5.1$ V

$V_x = V_2 - V_1 \Rightarrow 5.54 - 5.1$

$V_x = 0.44$ V

$I_1 = \frac{V_1-10}{1} \Rightarrow = -4.9$ A

$I_3 = \frac{V_2-V_3}{3} = 0.147$

$I_4 = \frac{V_1-0}{1} \Rightarrow 5.1$ A

$I_2 = \frac{V_2-0}{3} \Rightarrow 1.85$ A

$P_{10V} = IV \Rightarrow -4.9 \times 10 \Rightarrow -49$ W

$P_{2A} = IV_2 \Rightarrow 2 \times 5.54 \Rightarrow 11.08$ W

$\Sigma P_{absbe} = 68.34$

$P_{R_1} = I^2R = (4.9)^2 \times 1 = 24.01$ W

$P_{R_2} = I_3^2 \times 3 \Rightarrow (0.147)^2 \times 3 = 0.065$

$P_{R_3} = (1.85)^2 \times 2 = 6.845$ W

$P_{R_4} = (1.85)^2 \times 1 = 3.42$ W

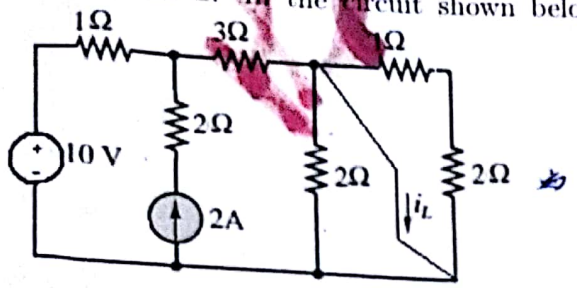
$P_{R_5} = (2)^2 \times 2 = 8$ W

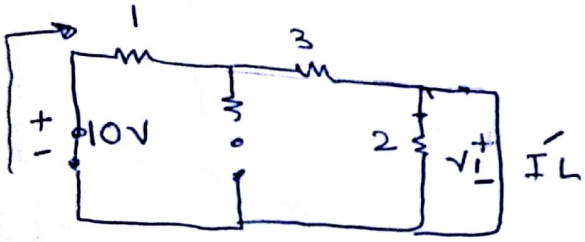
$P_{R_6} = (I_4)^2 \times 1 \Rightarrow (5.1)^2 \times 1 = 26$ W

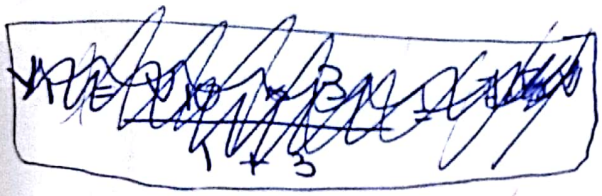
$P_{delive} = 49 + 11.08 = 60.08$ W

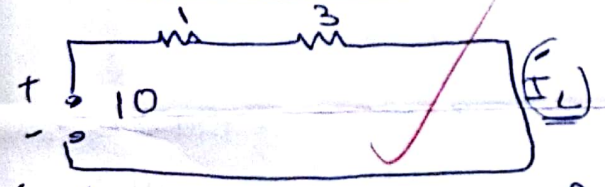
$\Sigma P_{abs} = 24.01 + 0.065 + 6.845 + 8 + 26 + 16.8 + 3$

Problem 2: In the circuit shown below find the value of i_L, by using principle of superposition.

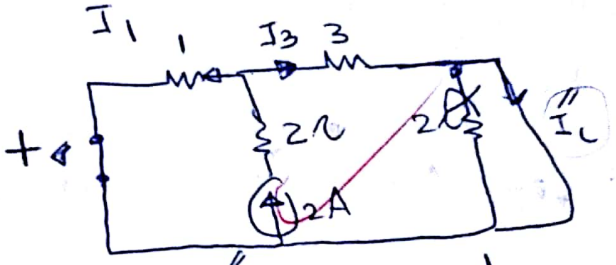








$i_L' = \frac{10}{1+3} \Rightarrow 2.5\ A$



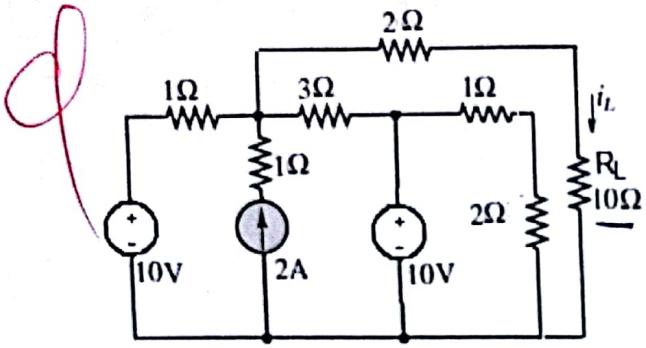
$I_3 = i_L'' = I_{2A} \times \frac{1}{1+3}$

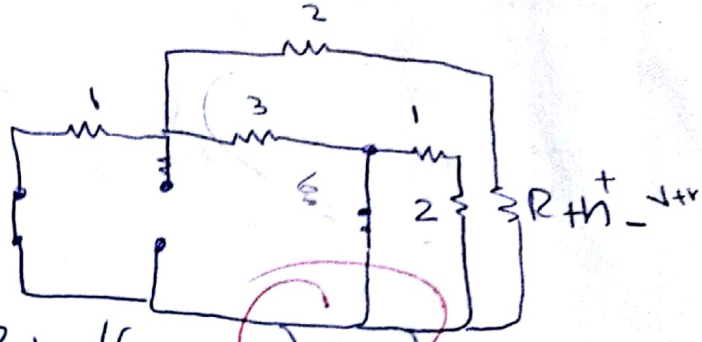
$= 2 \times \frac{1}{4}\ A$

$i_L'' = 0.5\ A$

$\therefore\ i_L = i_L' + i_L'' \Rightarrow 0.5A + 2.5A = 3A$

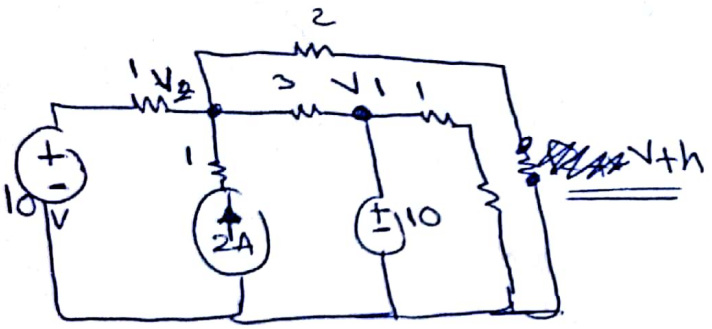
Problem 3 : For the circuit shown below find the current i_L, flown through the resistance of R_L, by using thevinen equivalent circuit.





$R_{th} = ((3+1+2) \,//\, 1) + 2$

$R_{th} = 2.86\ \Omega$



$V_{th} = V_2 - 0$

$R_{th} = 2.75$

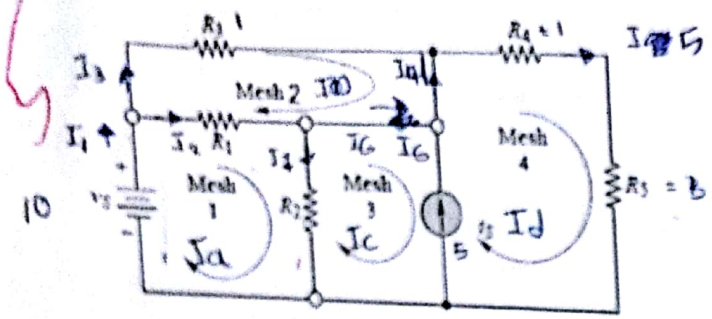
$V_1 = 10\ V$

$$\frac{V_2 - 10}{3} + \frac{V_2 - 10}{1} - 2 = 0 \quad -(1)$$

$$V_2\left[\frac{1}{3} + 1\right] = 2 + 10 + \frac{10}{3} \Rightarrow \boxed{V_2 = 11.5\ V} \Rightarrow V_{th} = 11.5\ V$$

$$I_L = \frac{V_{th}}{R_{th} + R_2} = 0.894\ A$$

Problem 4 : In the circuit shown, use mesh current method to solve for the unknown currents.
Data: $R_1 = R_2 = R_3 = R_4 = 1\Omega, R_5 = 3\,\Omega, v_s = 10V, \& i_s = 5A$



$2I_a - I_b - I_c = 10$ ... (1)

$2I_b - I_a = 0$ ... (2)

$(1+3)I_d + 1I_c - I_a = 0$ ... (3)

$5 + I_c = I_d$ ... (4)

$(1+3)(5+I_c) + I_c - I_a = 0$ (3) → $5I_c - I_a = -20$ (3')

$I_a = 4.62\,A$

$I_b = 2.31\,A$

$I_c = -3.07\,A$

$I_d = -3.07 + 5 = 1.93A$

$I_1 = I_a = 4.62A$

$I_2 = I_a - I_b = 2.3A$

$I_3 = I_b = 2.31A$

$I_4 = I_d - I_b = -0.38A$

$I_5 = I_d = 1.93A$

$I_6 = I_c - I_b = -5.38$

$I_7 = I_a - I_c = 7.69A$