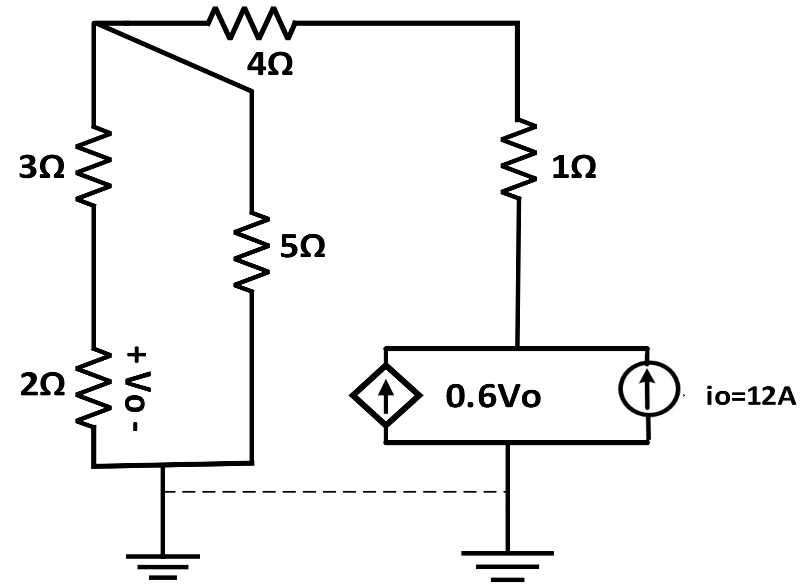
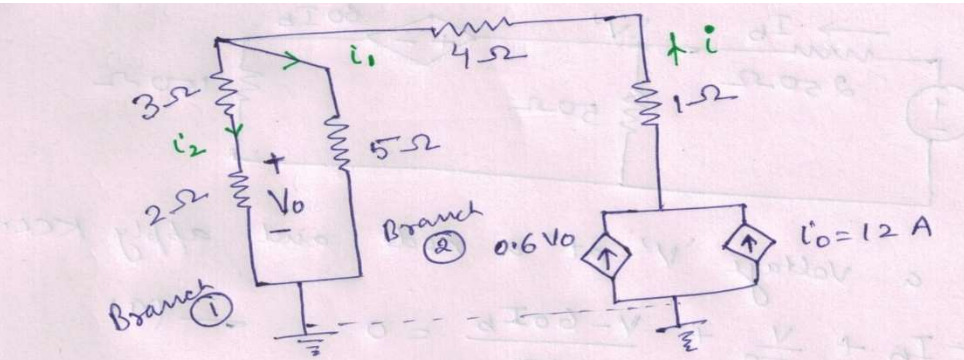
1. **Calculate the value of ‘Vo’ in the circuit shown below.**





<u>Solution</u> : Assume current values i, i_1, and 'i_2' in the branches given above.

where, $i = i_1 + i_2$ —— ①

As resistances of Branch ① and Branch ② are equal,

$$i_1 = i_2$$

$$\therefore \quad i = 2i_1 = 2i_2 \quad —— ②$$

$$\Rightarrow i_2 = \frac{i}{2} = \frac{1}{2}(0.6\,V_o + 12)$$

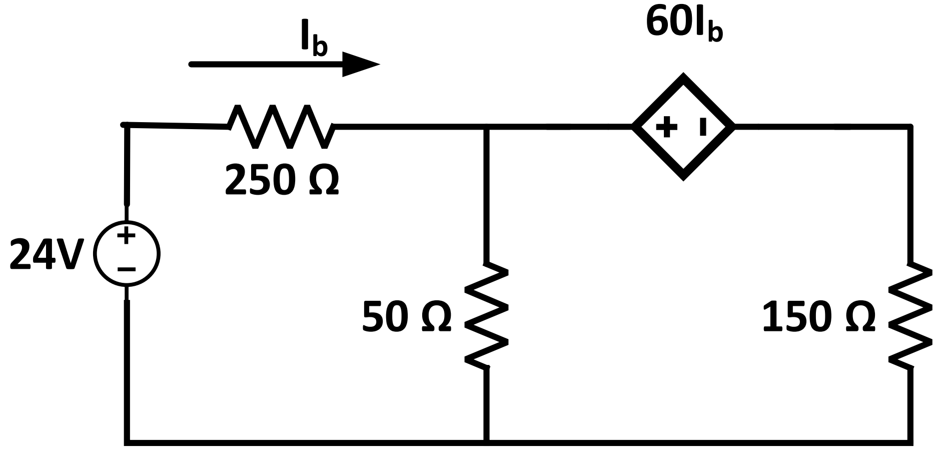
As, $V_o = 2 i_2$

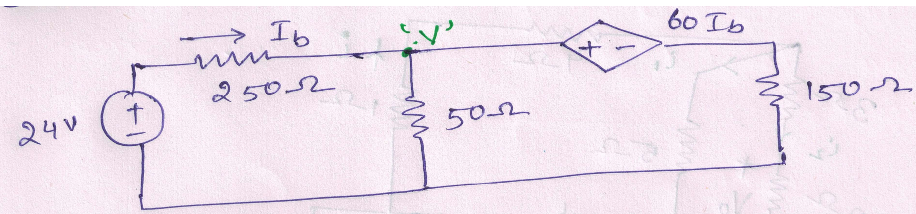
$$\therefore \quad V_o = 0.6\,V_o + 12$$

$$0.4\,V_o = 12$$

$$\boxed{V_o = 30\,V}$$

2. **Calculate the current 'I_b' in the circuit shown below:**





Assume a voltage 'V' at a node and apply KCL,

$$-I_b + \frac{V}{50} + \frac{V-60I_b}{150} = 0 \quad \text{—— (a)}$$

Also, $\frac{V-24}{250} = -I_b$ —— (1)

Substitute the value of 'V' in eqn (a).

⇒ $-I_b + \left(\frac{-250I_b+24}{50}\right) + \left(\frac{-250I_b+24-60I_b}{150}\right) = 0$

⇒ $-I_b + \left(-5I_b + \frac{24}{50}\right) + \left(-\frac{5}{3}I_b + \frac{24}{150} - \frac{2}{5}I_b\right) = 0$

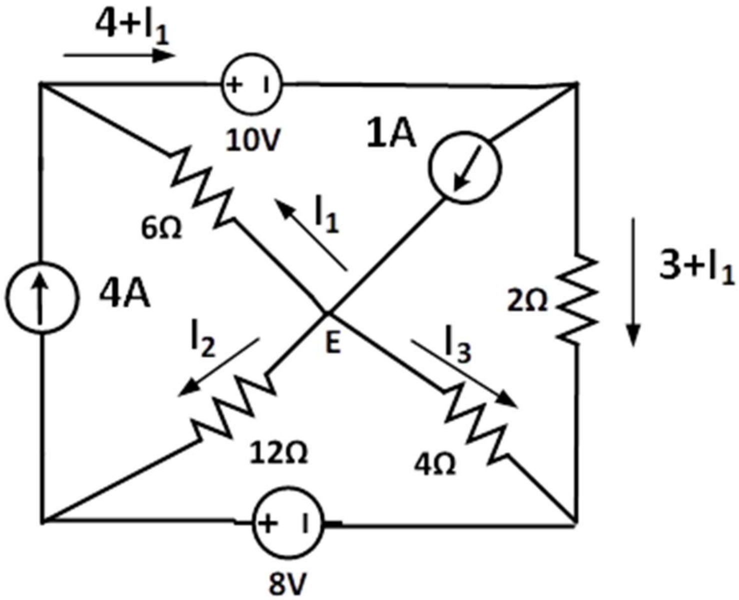
⇒ $-6I_b - \frac{31}{15}I_b = -24\left(\frac{1}{50}+\frac{1}{150}\right)$

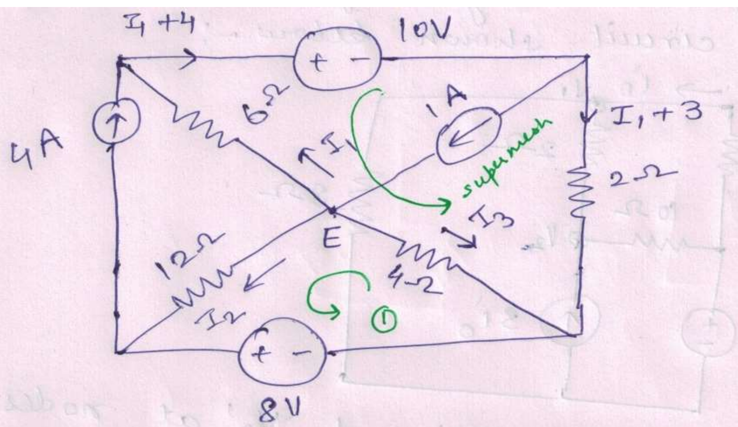
⇒ $\frac{-121 I_b}{15} = -24\left(\frac{4}{150}\right)$

⇒ $I_b = \frac{96}{121\times10} = 0.079338$ A

⇒ $\boxed{I_b = 79.34\ mA}$

3. In the circuit, find current I_1, I_2, and I_3:





Here, $I_1 + I_2 + I_3 = 1$ —— (1)

KVL in Loop - (1)

$12 I_2 + 8 - 4 I_3 = 0$ —— (2)

KVL in super mesh

$-10 - 6 I_1 + 4 I_3 - 2(I_1 + 3) = 0$

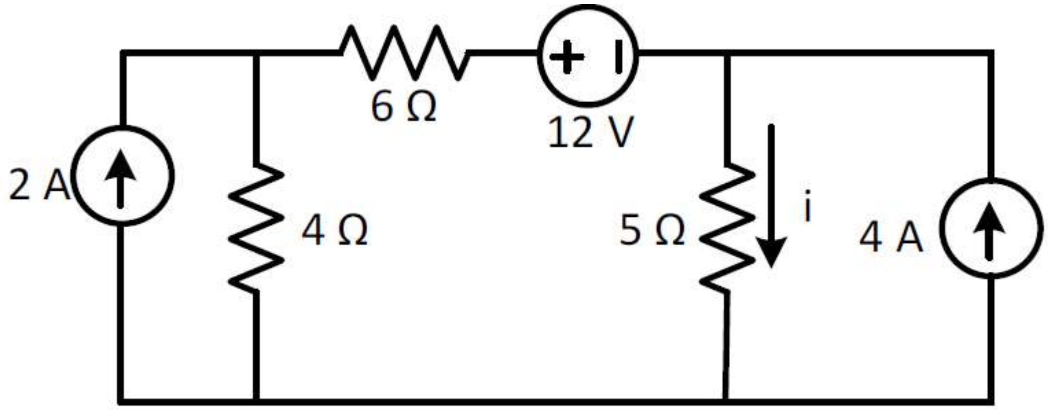
$\Rightarrow -8 I_1 + 4 I_3 - 16 = 0$

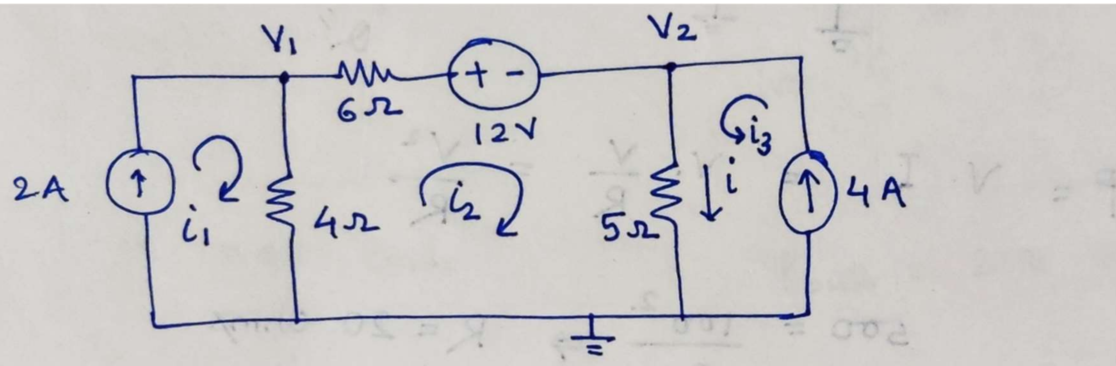
$\Rightarrow -2 I_1 + I_3 = 4$ —— (3)

solving eq^{n}s (1), (2), and (3) we get,

$$\boxed{\begin{aligned} I_1 &= -1A \\ I_2 &= 0 \\ I_3 &= 2A \end{aligned}}$$

4. **Find the current i of the following circuit.**





Here, $\quad i_1 = 2A, \quad i_3 = 4A, \quad i = i_2 + i_3$

also, $\quad V_1 = 4(i_1 - i_2) = 4(2 - i_2)$

$V_2 = 5 \times i = 5 \times (i_2 + i_3) = 5 \times (i_2 + 4)$

$V_1 - V_2 = 4(2 - i_2) - 5(i_2 + 4)$

$V_1 - V_2 = 8 - 4i_2 - 5i_2 - 20$

$V_1 - V_2 = -9i_2 - 12 \quad$ — (I)

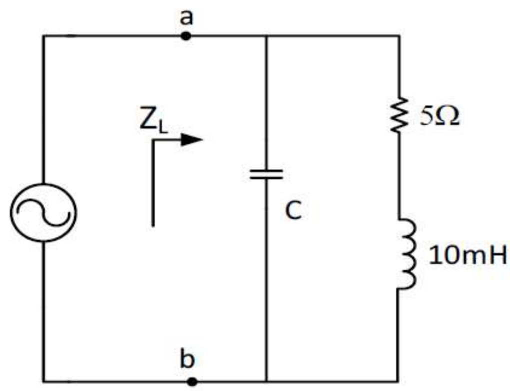
also, $\quad V_1 - V_2 = 6i_2 + 12 \quad$ — (II)

$-9i_2 - 12 = 6i_2 + 12$

$i_2 = \dfrac{-24}{15} = -\dfrac{8}{5} = -1.6$ Amp

$\therefore \quad i = i_2 + i_3 = -1.6 + 4 = \underline{2.4 \text{ Amp}}$

5. **A source (ω= 314 rad/s) is connected to a load Z_L as shown in Figure. Find the value of the capacitance for the load Z_L to be completely resistive.**



$$Z_L = \frac{-j}{wC} \;||\; (5 + j\omega L)$$

$$Z_L = \frac{(5 + j\omega L)\left(\frac{-j}{wC}\right)}{5 + j\omega L - \frac{j}{wC}}$$

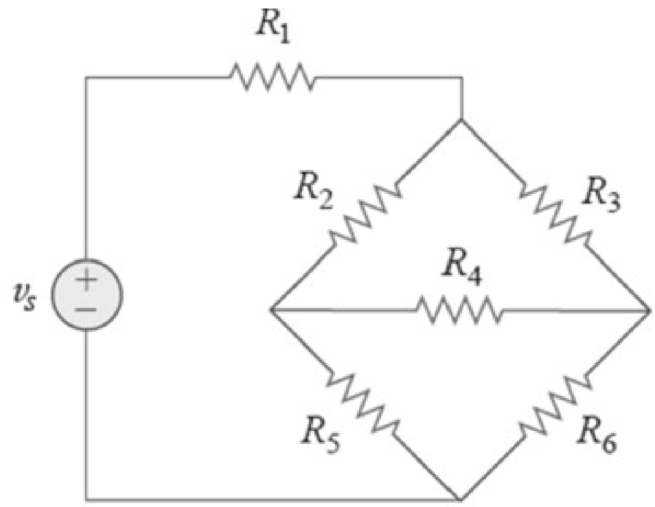
$$Z_L = \frac{\frac{L}{C} - j\frac{5}{wC}}{5 + j\left(\omega L - \frac{1}{wC}\right)} \times \frac{5 - j\left(\omega L - \frac{1}{wC}\right)}{5 - j\left(\omega L - \frac{1}{wC}\right)}$$

$$Z_L = \frac{\left(\frac{L}{C} - j\frac{5}{wC}\right)\left(5 - j\left(\omega L - \frac{1}{wC}\right)\right)}{5^2 + \left(\omega L + \frac{1}{wC}\right)^2}$$

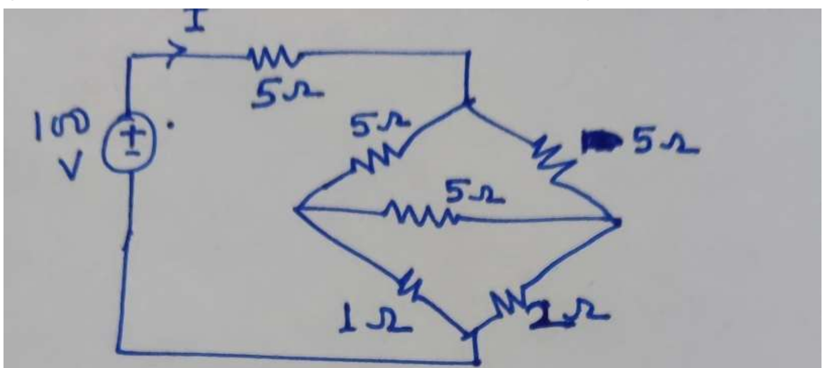
Comparing Imaginary part of Z_L to zero,

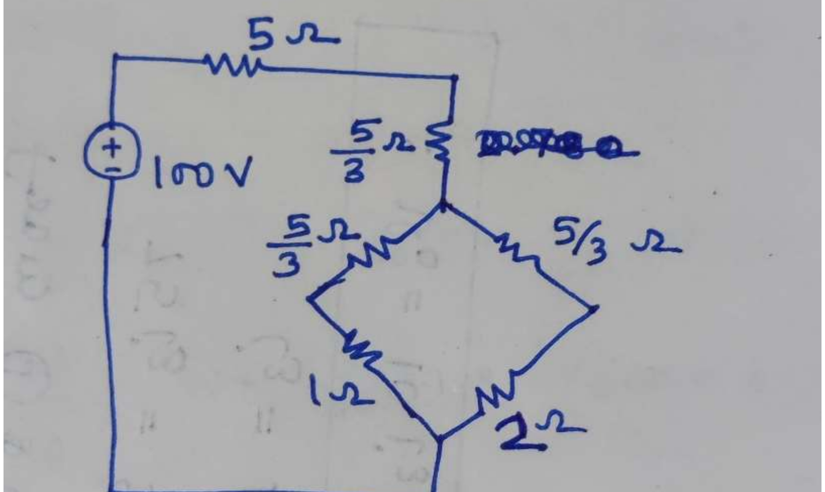
$$\boxed{C = 287\ \mu F}$$

6. **Find the current flowing through resistor R1. Given that –**
Vs = 100 Volts, R1 = R2 = R3 = R4 =5 Ω, R5 = 1 Ω, R6 = 2 Ω.



(Use Star – Delta Transformation)





$$I = \frac{100}{5 + \frac{5}{3} + \left(\frac{11}{3} \,\|\, \frac{8}{3}\right)}$$

$$\boxed{I = 12.179 \text{ Amp}}$$