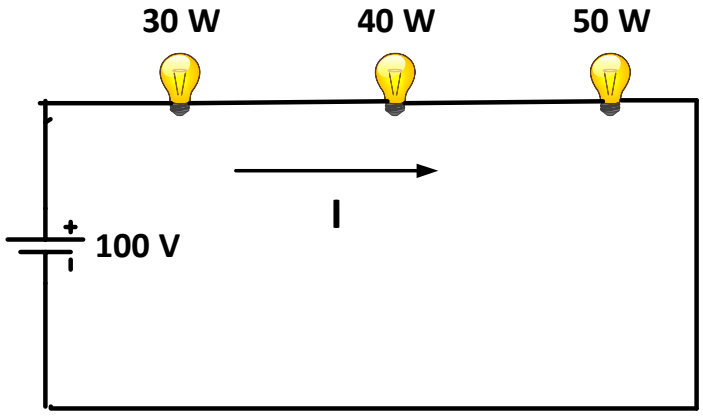
Quiz 1

1. **Three light bulbs are connected to a 100 V battery in series. The bulbs are consuming 30 W, 40 W, and 50 W power as shown below. Find the current 'I' through it.**



Solution –

Solution :

Resistance of Bulb $B_1 \rightarrow$ 'R_1'

" " " $B_2 \rightarrow$ 'R_2'

" " " $B_3 \rightarrow$ 'R_3'

$\therefore \quad R_1 = \frac{P_1}{I^2} = \frac{30}{I^2}\ \Omega$

$\sim \quad R_2 = \frac{P_2}{I^2} = \frac{40}{I^2}\ \Omega$

$\sim \quad R_3 = \frac{P_3}{I^2} = \frac{50}{I^2}\ \Omega$

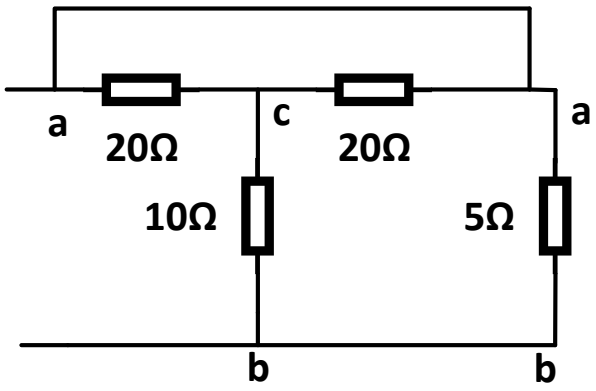
As, $\boxed{V = IR}$

$\therefore \quad 100 = I\left(R_1 + R_2 + R_3\right) = I\left(\frac{30}{I^2} + \frac{40}{I^2} + \frac{50}{I^2}\right)$

$\Rightarrow \quad 100 = I\left(\frac{120}{I^2}\right) \Rightarrow 100\,I = 120$

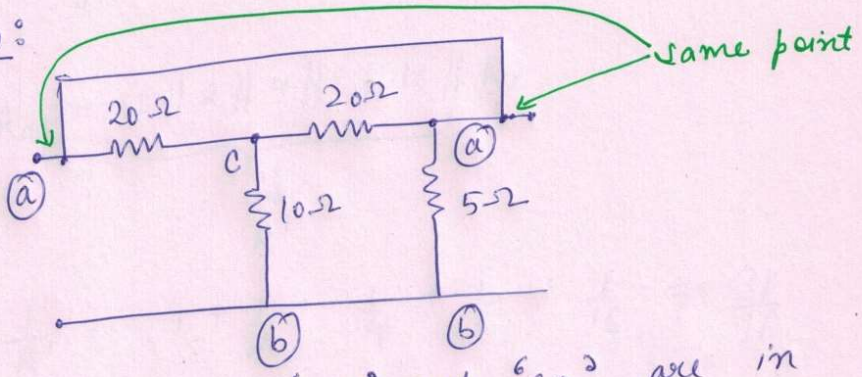
$\boxed{I = 1.2\ A}$

2. For the circuit shown below, find the equivalent resistance across a-b.



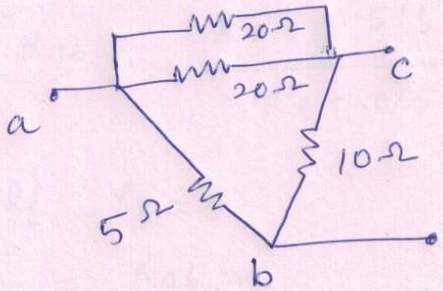
Solution –

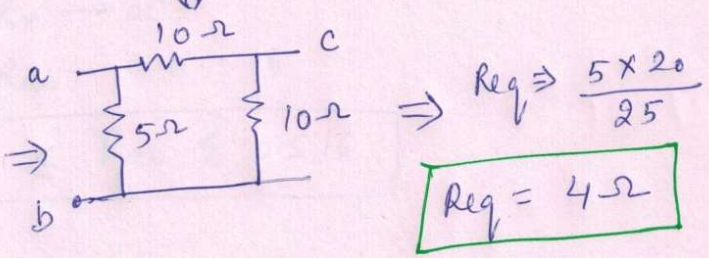
Solution:



In the circuit, 'ac' and 'ca' are in parallel.

So,

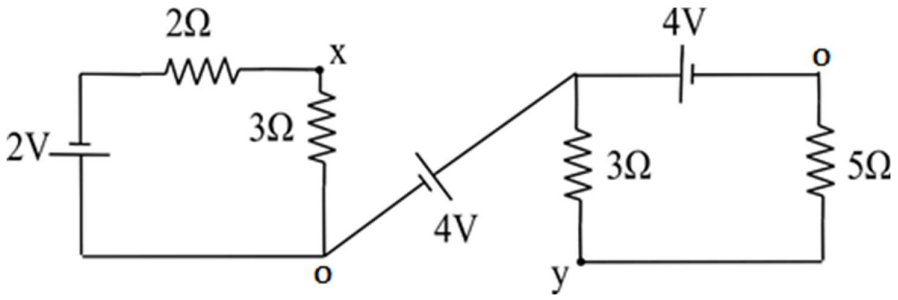




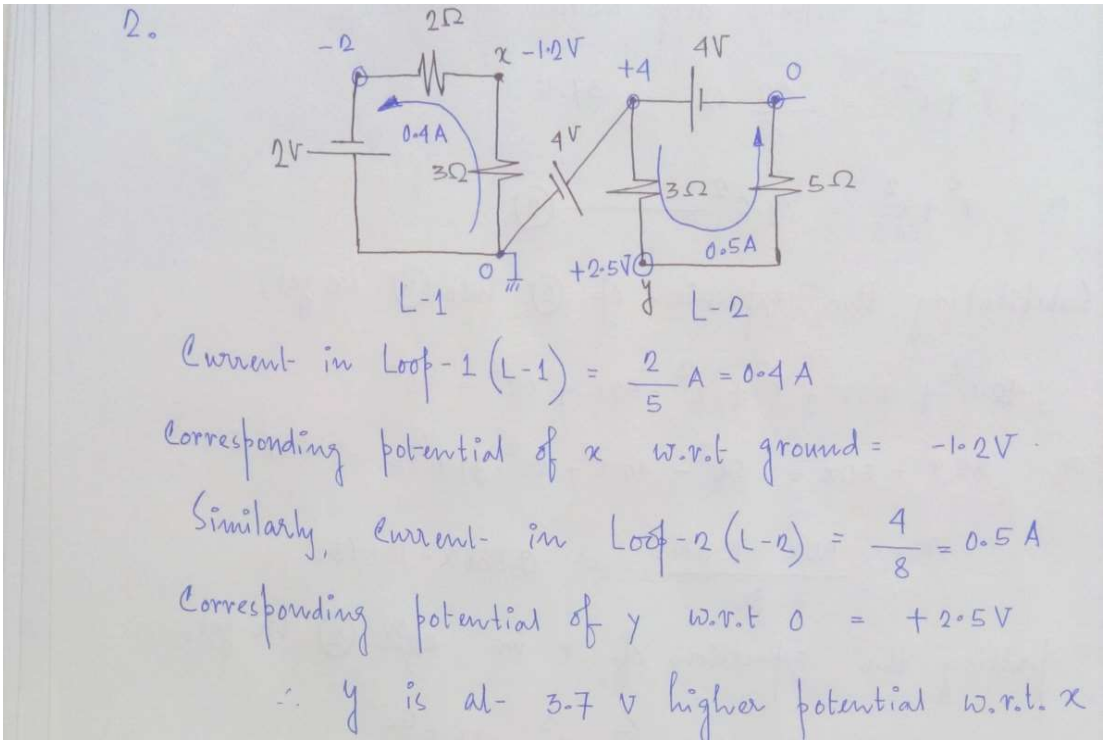
$\Rightarrow$ $R_{eq} \Rightarrow \frac{5 \times 20}{25}$

$R_{eq} = 4\Omega$

3. **What is the potential difference between the points x and y in the circuit given below (O are the grounded nodes) -**



Solution –



So, V_{xy} = 3.7 V

4. **The current through a 0.2 Henry inductor is $i(t) = 2te^{-t}$ A. Find the voltage across it and the energy stored in the inductor?**

Solution -

Given that 0.2 H inductor.

$i(t) = 2te^{-t}$ Amp.

⇒ voltage across inductor:

$$v(t) = L\frac{di}{dt} = 0.2\frac{d}{dt}(2te^{-t})$$

$$= 0.2\left[2t(-1)e^{-t} + e^{-t}2\right]$$

$$= 0.4e^{-t}(1-t) \text{ V}$$

⇒ Energy stored:

$$W(t) = \frac{1}{2}Li^2$$

$$= \frac{1}{2}0.2 \times 2^2 t^2 e^{-2t}$$

$$= 0.4t^2e^{-2t} \text{ J}$$

5. **Calculate the phase angle between v1= -5 cos(50t+20) and v2= 20 sin(50t+240)? Also find which voltage is leading?**

Solution -

Given $v_1 = -5\cos(50t + 20)$

$= 5\cos(50t + 20 + 180)$

$= 5\cos(50t + 200)$

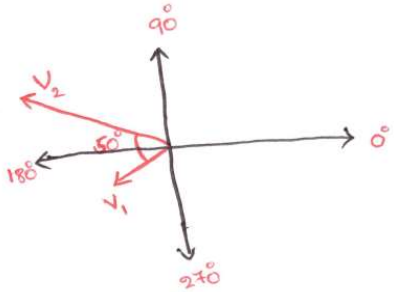
$v_2 = 20\sin(50t + 240)$

$= 20\cos(50t + 240 - 90)$

$= 20\cos(50t + 150)$

$\Rightarrow$ Phase angle difference $= 200^\circ - 150^\circ$

$= 50^\circ$



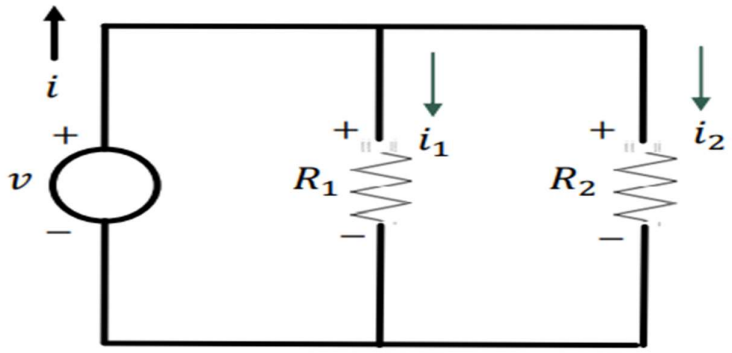
$\Rightarrow$ v_1 leads v_2 by 50°.

$\Rightarrow$ Phasor form:

$v_1 = 5 \angle 200^\circ$

$v_2 = 20 \angle 150^\circ$

6. **In Figure below, Let R1 : R2 =1 : 2, and total current *i*=15 A. Find the branch currents *i*1 and *i*2 ? Let v is the supply voltage; v1, v2 are the voltage across R1 and R2 respectively. If v : v1 : v2 = a: b: c , then, find a, b, and c?**



Given $R_1 : R_2 = 1 : 2$; total current $i = 15$ A.

⇒ Branch Currents :

$$i_1 = i \frac{R_2}{R_1 + R_2}$$

$$= i \frac{1}{\left(\frac{R_1}{R_2}\right) + 1}$$

$$= i \frac{1}{1.5}$$

$$= \frac{15}{1.5} = 10 \text{ A}$$

$$i_2 = i \frac{R_1}{R_1 + R_2}$$

$$= i \frac{1}{1 + \frac{R_2}{R_1}}$$

$$= i \frac{1}{1 + 2}$$

$$= 15/3 = 5 \text{ A}$$

⇒ voltage across all the parallel branches is same.

So $v = v_1 = v_2$.

So, $a = b = c = 1$.