Q1: 5 marks

Slot 1

Using superposition theorem, calculate the value of **V** in the figure 1. You must use superposition. Otherwise, no mark will be given.

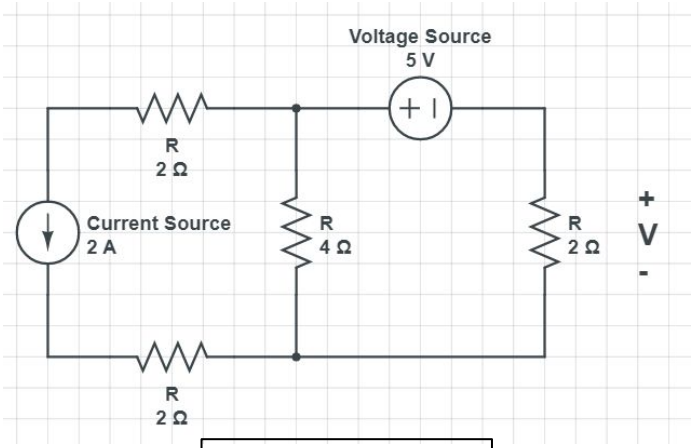


Figure 1

Q2: 10 marks

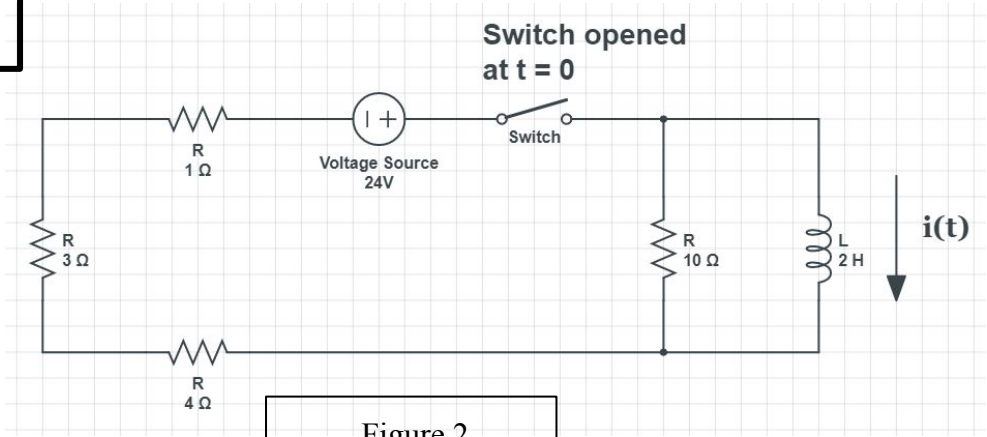


Figure 2

(i) What do you know about Time Constant? How do you measure it?

(ii) From figure 2 calculate i(t) for t>0. What will be the value of i(t) at t=10ms?

Q1

Using superposition theorem, calculate the value of i in the Figure 1. You must use superposition. Otherwise, no mark will be given.

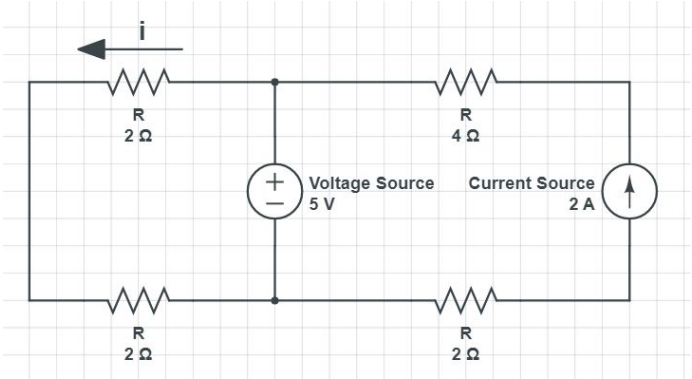


Figure 1

Q2

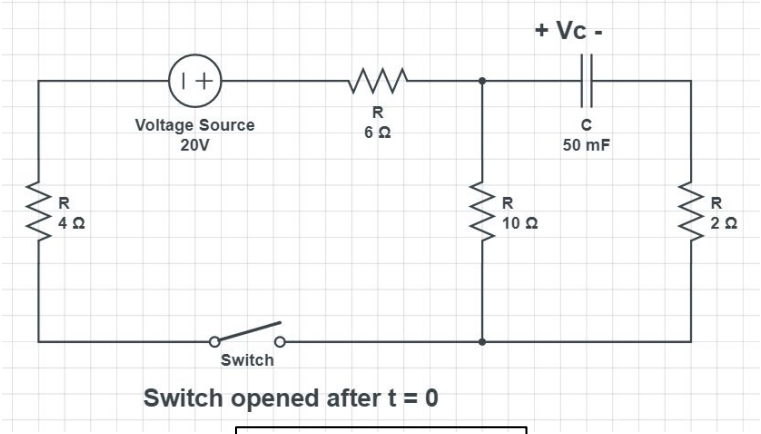


Figure 2

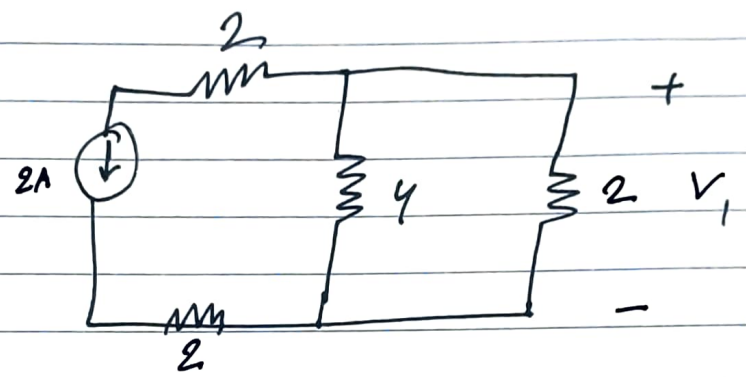
(i) Why is a source free RC circuit called a "First Order" circuit?

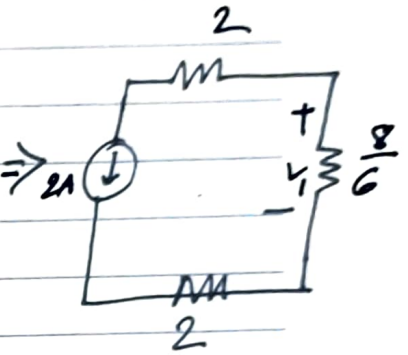
(ii) From Figure 2 calculate v(t) for t>0. What will be the value of v(t) at t=25ms?

Slot 1

(1)

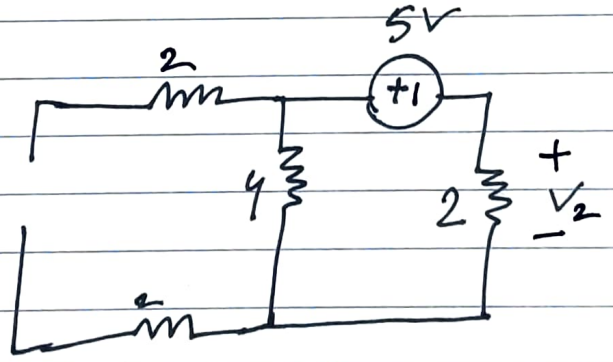
5V source short:





$$\therefore V_1 = IR = -2 \times \frac{8}{6} = -\frac{8}{3} = -2.667V$$

2A source open:



$$V_2 = \frac{2}{6}(-5)$$

$$= -\frac{10}{6}$$

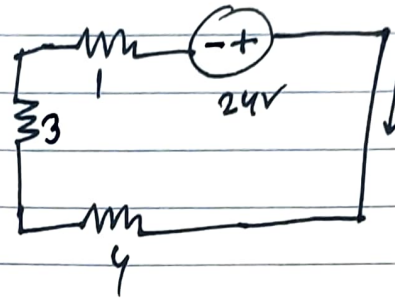
$$= -1.667V$$

$$\therefore V = V_1 + V_2 = -4.333V$$

(2) i) $\tau = RC$ or, $\tau = \frac{L}{R}$. So two ways to measure for a first order ckt.

τ is the time required for a i/v to reach 63.2% of its starting strength.

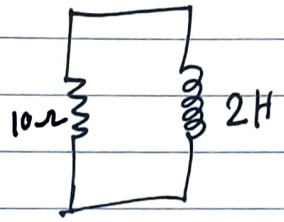
ii) for $t < 0$,



$i(0^-) = \frac{+24}{8} = 3A$

$\therefore i_0 = i(0^-) = 3A$

for $t > 0$



$R = 10$

$\therefore \tau = \frac{L}{R} = \frac{2}{10}$

$\therefore i(t) = i_0 e^{-t/\tau} = 3e^{-\frac{10}{2}t} = 3e^{-5t}$ A

$\therefore i(t)\Big|_{t=10ms} = 3e^{-0.05} = 2.853$ A.

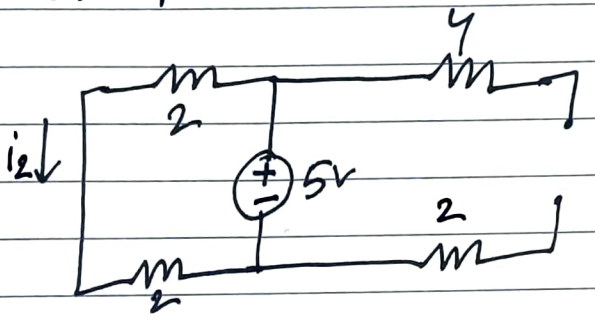
Slot 2

① 5V short:

the branch will not have any current flow.

$\therefore i_1 = 0$

2A open:

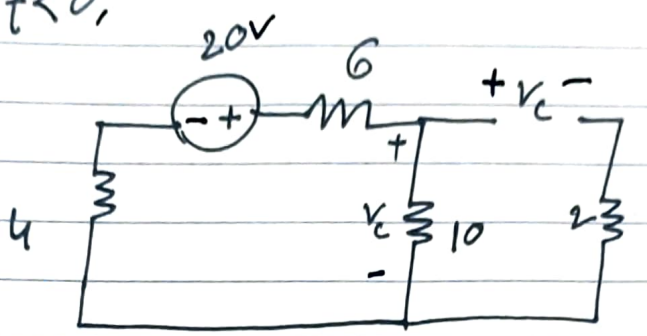


$\therefore i_2 = \frac{5}{4} = 1.25$

$\therefore i = i_1 + i_2 = 1.25A.$

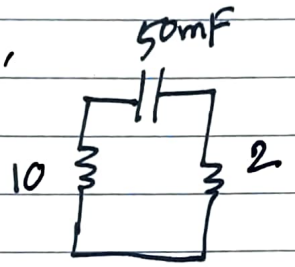
② i) because analyzing the circuit of a RC or RL ckt, we can come up with a first order differential equation.

11) $t<0$,



$$V_c = \frac{10}{20} \times 20$$
$$= 10V$$
$$\therefore V_c(0) = 10V$$

$t>0$,



$R = 10+2 = 12\Omega$

$C = 50mF$

$\therefore \tau = RC = 600m = 0.6 = \frac{6}{10}s$

$$\therefore v(t) = 10e^{-\frac{10}{6}t} = 10e^{-1.6667t} \quad V$$

$$v(t)\Big|_{t=25ms} = 10e^{-1.6667 \times 0.025} = 9.59189V$$