Midterm Solutions

Wednesday, 26 April 2017 07:56

Question 1: $R_{eq} = 10\Omega$

- 8Ω → short circuited

$4 \| 4 = 2\Omega$

$4+4 = 8\Omega$

$24 \| 8 = 6\Omega$

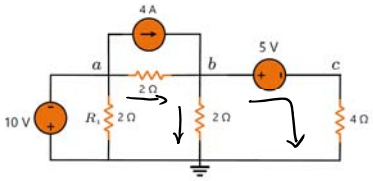
$10+6+4 = 20\Omega$

$20 \| 5 = 4\Omega$

$2+4+4 = 10\Omega$

$$R_{eq} = (4 \,||\, 4)+4+(5 \,||\, [10+(8||24)+4])$$

Question 2:



i)

$V_a = -10V$ $\quad V_b = V_c + 5$

KCL at supernode:

$$\frac{-10 - V_b}{2} + 4 = \frac{V_b}{2} + \frac{V_c}{4} \Rightarrow$$

$$\frac{-10 - V_c - 5}{2} + 4 = \frac{V_c + 5}{2} + \frac{V_c}{4} \Rightarrow$$

$$-20 - 2V_c - 10 + 16 = 2V_c + 10 + V_c \Rightarrow$$

$$\Rightarrow 5V_c = 40 - 16 \Rightarrow 5V_c = 24 \Rightarrow V_c = -4.8V$$

$V_b = 0.2V$

ii) Current source

$V = 10.2V$

$I = 4$ $\quad p = v \cdot i$ or $p = -vi$

$P = -10.2 \times 4 = -40.8W$

or $40.8W$ generates

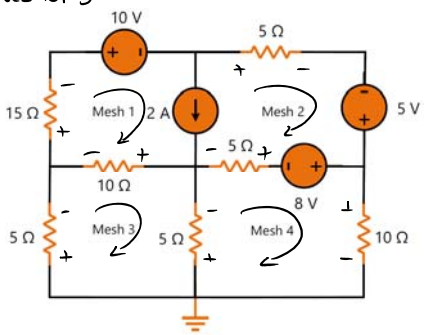
iii) Resistor

$p = \frac{v^2}{R}$ or i^2R or $v \cdot i$

$P = 50W$ or

absorbs $50W$

Question 3:



Meshes 1 and 2

$i_1 - i_2 = 2$ (1)

$+25i_1 + 10i_2 - 10i_3 - 5i_4 = -13$ (2)

Mesh 3:

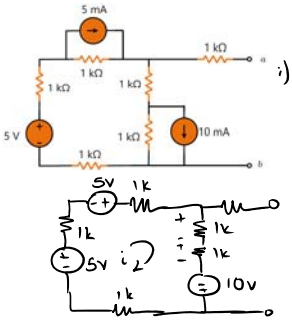
$-10i_1 + 20i_3 - 5i_4 = 0$ (3)

Mesh 4:

$-5i_2 - 5i_3 + 20i_4 = 8$ (4)

Question 4:

$R_{Th} = 1 + 2 \| 3 = 2.2k\Omega$



i) V_{oc}: Different methods

most probable: source transf.

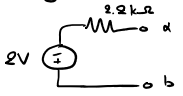
ii) Mesh analysis

4 or 3 equations

iii) Superposition

Too many calculations

$i = \frac{20}{5} = 4mA$ $\quad V_{ab} = -2V$ iv) V_{oc} and I_{sc}



Question 5 i)

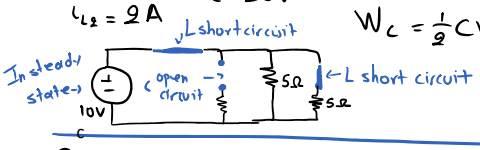
$i_{L1} = 4A$

$i_{L2} = 2A$ $\quad V_c = 10V$

$W_{L1} = \frac{1}{2}Li^2 = 16J$

$W_{L2} = \frac{1}{2}Li^2 = 4J$

$W_C = \frac{1}{2}CV^2 = 50J$



Question 5 ii)

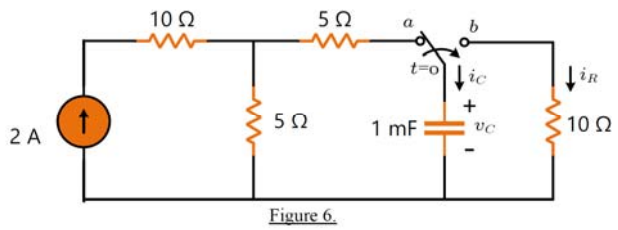


Figure 6.

$V_c(0-) = V_c(0+) = 10V$

$V_c(\infty) = 0V$

$\tau = 1mF \cdot 10\Omega = 10 \cdot 10^{-3}$ sec

or 10 ms

$V_c(t) = 10\,e^{-t/10^{-2}}$ V, t → sec

or $10\,e^{-100t}$ V, t → sec

or $10\,e^{-t/10}$ V, t → msec

$i_R = -i_C$

$i_C = C \cdot \frac{dV}{dt}$ or $\frac{V_c(t)}{R}$

$i_R = e^{-100t}$ A, t → sec

etc...

UNITS IN ALL ANSWERS?