The Hashemite University
Electrical Engineering Department
Circuit for non EE
Second Exam
Date:25/4/2011 Second Semester 2011

Name:......................................

Number:......................................

Instructor: Ashraf A. Ali

Note: All resistances are in homes.

Q1) (4 points) For the circuit shown in figure 1, use superposition principle to find the current Ix.

Q2) (5 Points) for the circuit shown in figure 2-a if the current I(t) is shown in figure 2-b and V(0)=0, answer the following:

a) find the equivalent capacitance as seen by the current source.
b) find and plot V(t) (the voltage across the current source).
c) find V(1.5 ms).

Q3) (7 points) for the circuit shown in Figure 3-a answer the following questions:

a) Find the Thevenin voltage and resistance as seen by the load.
b) Find the Norton current and resistance as seen by the load.
c) Assume the load is varying resistance; what is the maximum power delivered to the load.
d) Now assume that the load is **Non-linear circuit element** with I-V characteristic curve shown in **fig. 3-b**; plot the D.C.L.L and determine the current and the voltage of the load **graphically**.

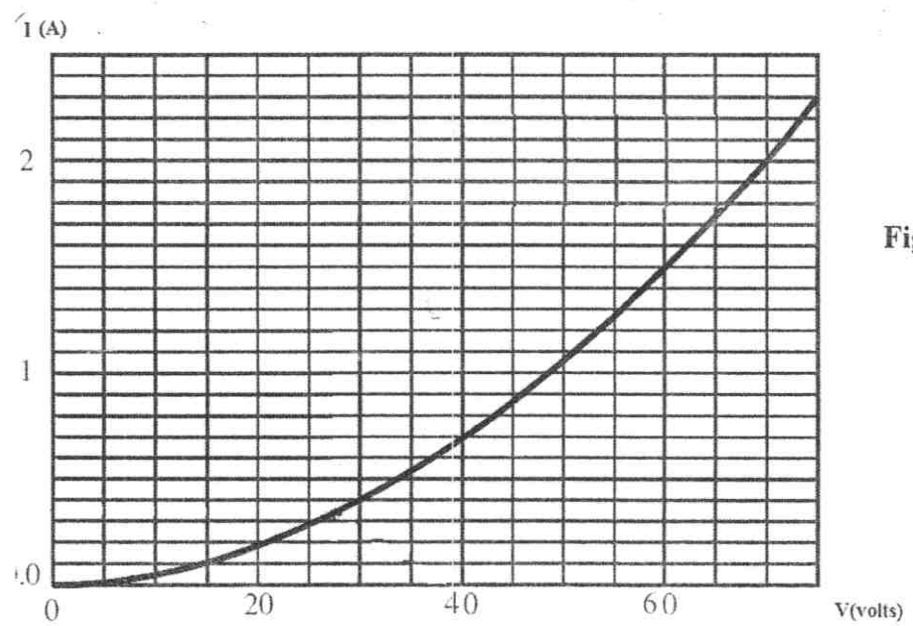


Fig. 3-b

Q4) (4 points) for the circuit shown in figure 4, answer the following questions:

a) The impedance as seen by the source.
b) IL(t) , VL(t)
c) The phase difference between I and V.

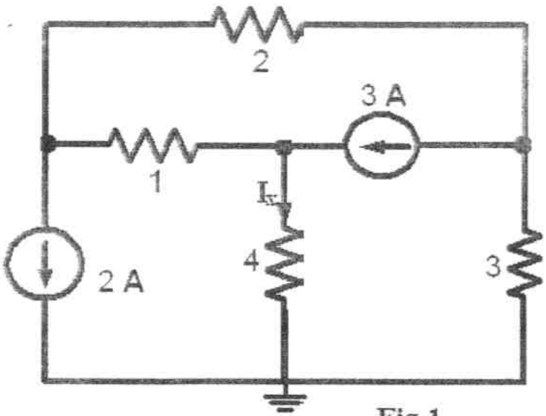


Fig 1

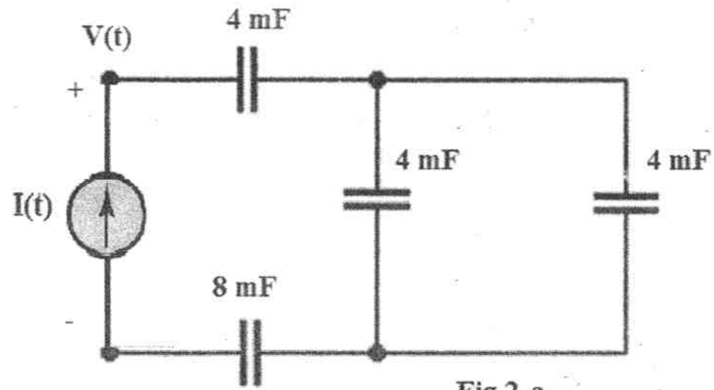


Fig 2-a

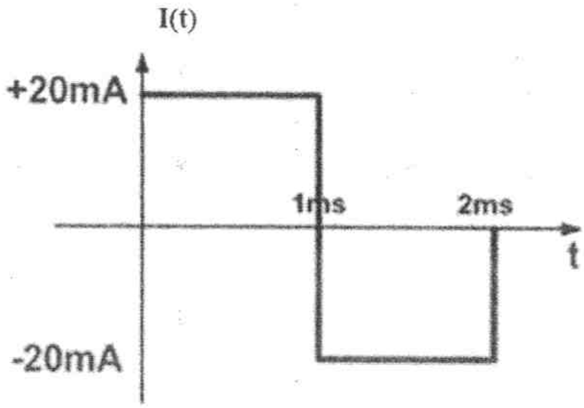


Fig. 2-b

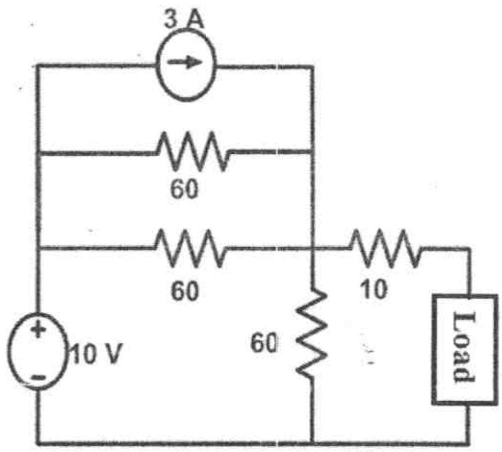


Fig 3-a

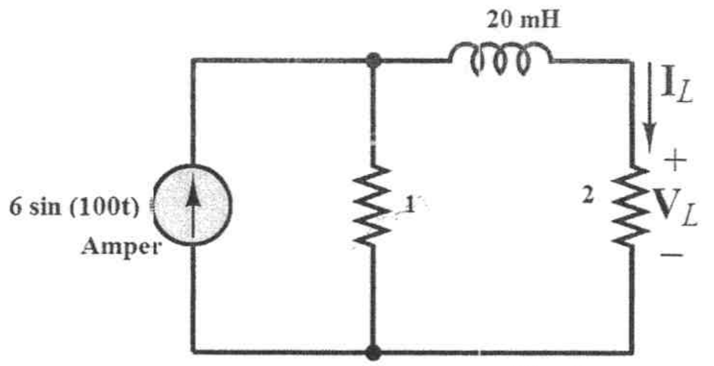
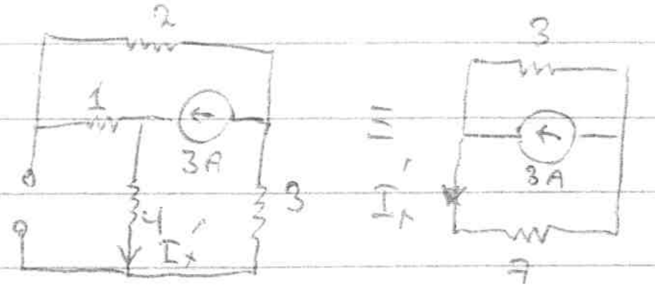


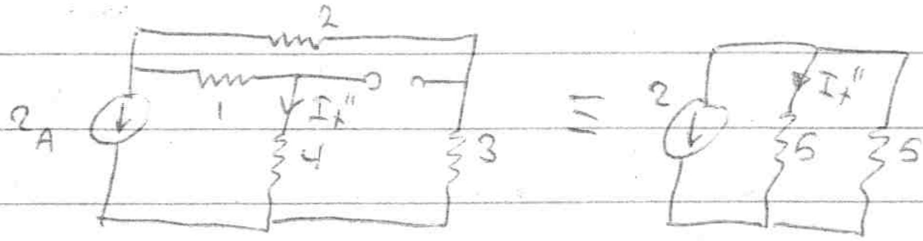
Fig. 4

Q1 $I_x = I_x' + I_x''$



$$\Rightarrow I_x' = \frac{3 \parallel 7}{7}(3) \quad \text{(Current Divider)}$$

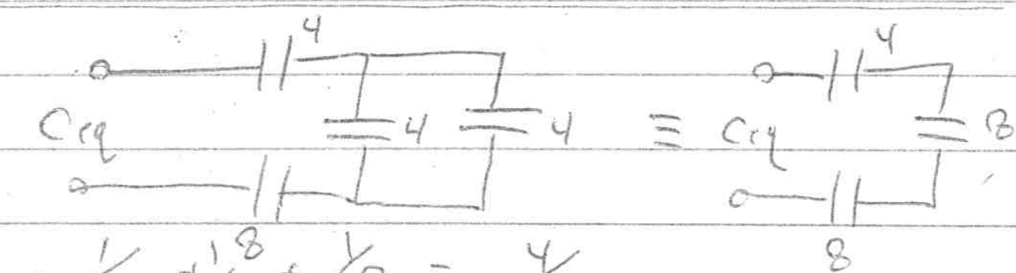
$$I_x' = 0.9\ A$$



$$I_x'' = -1\ A \quad \text{(Current Divider)}$$

$$I_x = I_x' + I_x'' = -1 + 0.9 = -0.1\ A$$

Q2 a)



$$\frac{1}{C_{eq}} = \frac{1}{4} + \frac{1}{8} + \frac{1}{8} = \frac{4}{8}$$

$$\Rightarrow C_{eq} = 2\ mF$$

b) $V(0) = 0$

$$0 < t \leq 1\,ms \Rightarrow V(t) = V(0) + \frac{1}{C_{eq}}\int_0^t I(t)\,\partial t = \frac{1}{2(10)^{-3}}\int_0^t 20(10)^{-3}\,\partial t$$

$$= 10t$$

$$1\,ms < t < 2\,ms \Rightarrow V(t) = V(1) + \frac{1}{C_{eq}}\int_1^t -20(10)^{-3}\,\partial t$$

$$V(1\,ms) = 10(10)^{-3}\ V$$

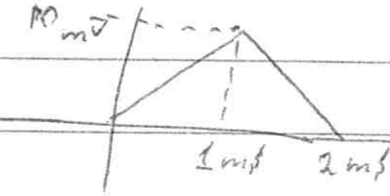
$$\Rightarrow V(t) = 20(10)^{-3} - 10t \quad \text{Volt}$$

$$1^{ms} < t \Rightarrow V(t) = V(2\,ms) + \frac{1}{C_{eq}}\int_2^t I(t)\,\partial t$$

$$= 0$$

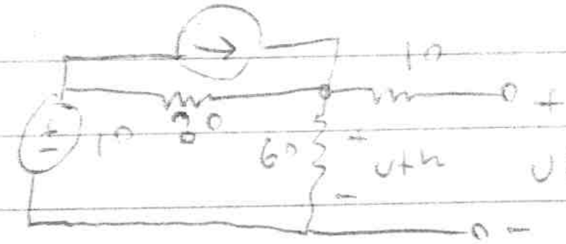
c) $V(1.5\,ms) = V(0) + \frac{1}{C}\int_0^1 20(10)^{-3} + \frac{1}{C}\int_1^{1.5} -20(10)^{-3}\,\partial t$

$$= 5\ mV$$



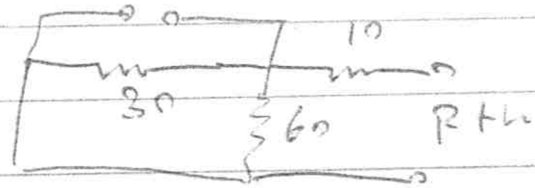
33

(a)



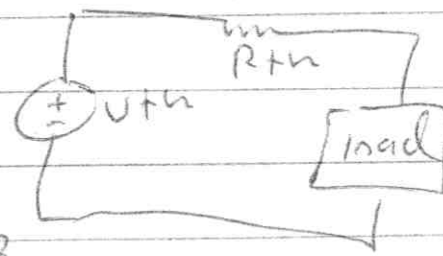
$+3 - \frac{U_{th}}{60} - \frac{U_{th}-10}{30} = 0$

$\Rightarrow U_{th} = 66.67$ volt



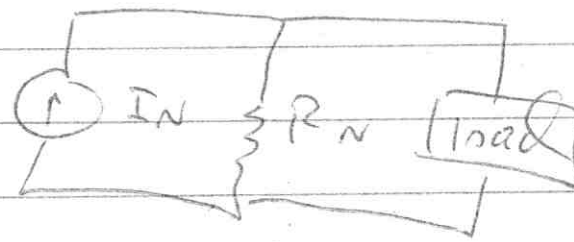
$R_{th} = (30 // 60) + 10$

$= 30\ \Omega$



(b) $I_N = \frac{U_{th}}{R_{th}} = \frac{66.67}{30} = 2.23$ A

$R_N = R_{th} = 30\ \Omega$



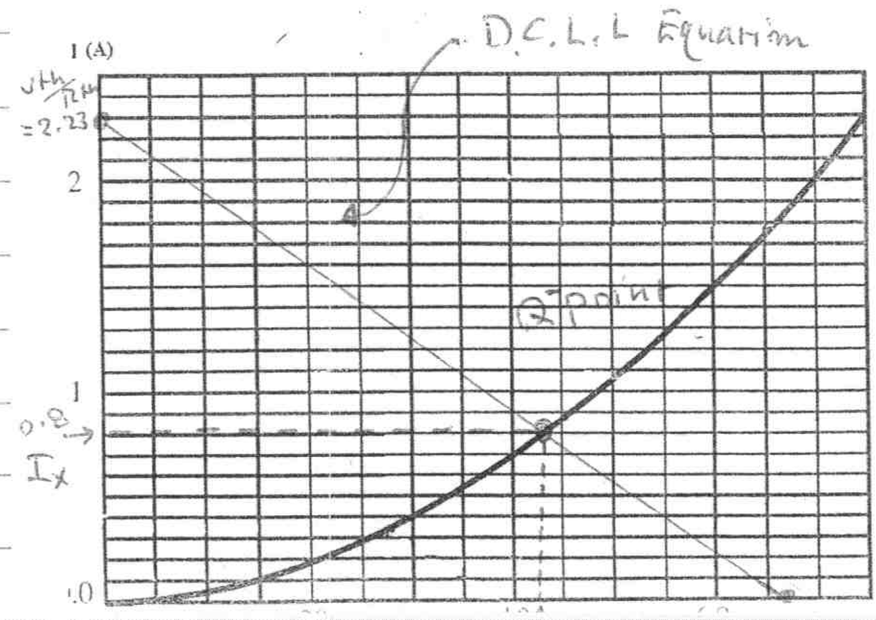
(c) $P_{max} = \frac{U_{th}^2}{4 R_{th}}$

$= 37$ W

(D) D.C.L.L equation:

$-V_{th} + R_{th} I_x + V_x = 0 \Rightarrow I_x = \frac{U_{th}}{R_{th}} - \frac{U_x}{R_{th}}$

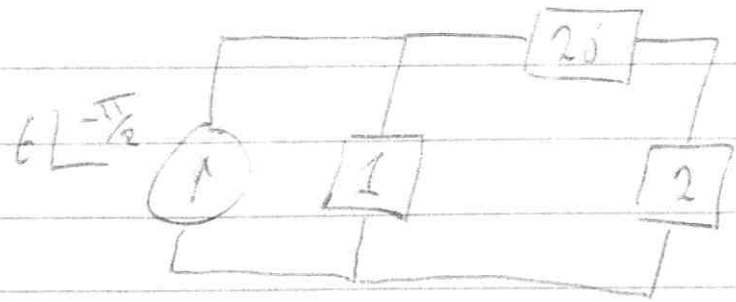
$\Rightarrow I_x = 2.23 - \frac{U_x}{30}$



Q 4

$\omega = 100$

$j\omega L = 2j$



a) Impedance $Z_{eq} = 1 \,//\, (2+2j) = \frac{2+2j}{3+3j}$

$= 0.77 + 0.15j \equiv 0.78 \angle 11^\circ$

b) $\tilde{I}_L = 6 \angle -\pi/2 \left[\frac{Z_{eq}}{2+2j} \right] = 1.67 \angle -123^\circ$

$\Rightarrow I(t) = 1.67 \cos(100t - 123^\circ)$

$\tilde{V}_L = 2 \tilde{I}_L = 3.32 \angle -1.23^\circ$

$V_L(t) = 3.32 \cos(100t - 1.23^\circ)$

c) Phase Difference between $\tilde{I}_L$ & $\tilde{V}_L$ is 0°.