Solution U218-136(T1)

Total No. of Questions – [4] Total No. of Printed Pages 05

G.R. No.	

OCTOBER 2018/IN-SEM (T1)

S. Y. B. TECH. (E & TC) (SEMESTER - I)

COURSE NAME: NETWORK THEORY

COURSE CODE: ETUA21176

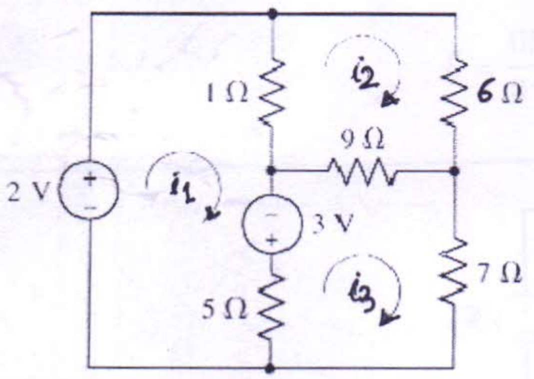
(PATTERN 2017)

Time: [**1Hour**] [Max. Marks: **30**]

(*) Instructions to candidates:

1) **Answer Q.1 OR Q.2 and Q.3 OR Q.4.**
2) **Figures to the right indicate full marks.**
3) **Use of scientific calculator is allowed**
4) **Use suitable data wherever required**

Q1 a) **Determine all mesh currents.** [6]



Solution

Three loop equations - 3M

Three currents- 3M

We need to construct three mesh equations:

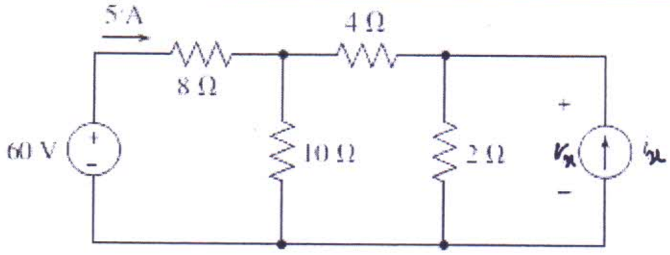
$$-2+(1)(i_1-i_2)-3+5(i_1-i_3)=0 \quad [1]$$

$$(1)(i_2-i_1)+6i_2+9(i_2-i_3)=0 \quad [2]$$

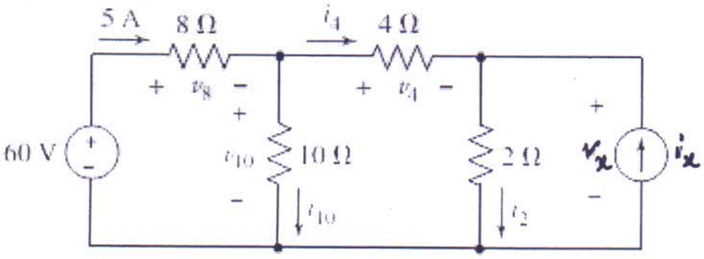
$$5(i_3-i_1)+3+9(i_3-i_2)+7i_3=0 \quad [3]$$

Solving, $i_1 = 989.2$ mA. $i_2 = 150.1$ mA and $i_3 = 157.0$ mA

b) Determine Vx using KCL and KVL equations. [6]



solution-
KVL and KCL equations -4M
Vx- 2M



$$i_2 = i_4 + i_x$$

$$-60 + v_8 + v_{10} = 0$$

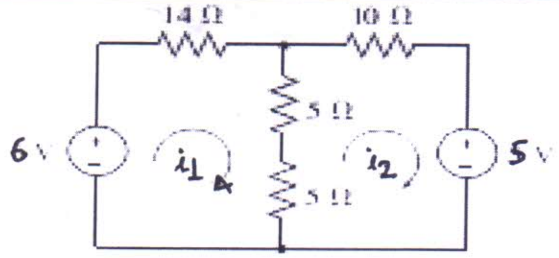
$$-v_{10} + v_4 + v_x = 0$$

$$v_x = 20 - v_4$$

$$i_4 = 5 - i_{10} = 5 - \frac{v_{10}}{10} = 5 - \frac{20}{10} = 3$$

$$v_x = 20 - 12 = 8 \text{ V.}$$

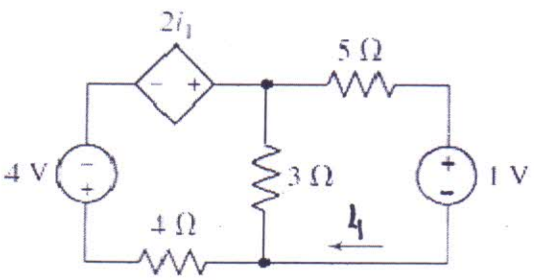
c) [4]



two loop equations – 2M
Answers- 2M
i1= 184.2 mA
i2=-157.9 mA

OR

Q2 a) **Determine power dissipated in 4 ohm resistor using mesh analysis** [6]



Loop equations – 3 M
Power calculations -3 M

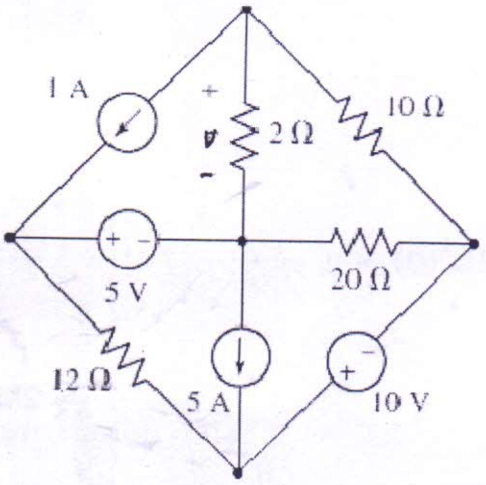
In the lefthand mesh, we define a clockwise mesh current and name it i_2. Then, our mesh equations may be written as:

$$4 - 2i_1 + (3 + 4)i_2 - 3i_1 = 0 \quad [1]$$
$$-3i_2 + (3 + 5)i_1 + 1 = 0 \quad [2]$$

(note that since the dependent source is controlled by one of our mesh currents/variables/unknowns, these two equations suffice.)

Solving, $i_2 = -902.4$ mA so $P_{4\Omega} = (i_2)^2(4) = \boxed{3.257 \text{ W}}$

b) Determine the voltage v across 2 ohm resistor using nodal analysis [6]



Nodal equations – 4M
Determination of v- 2M

We select the central node as the reference node. We name the left-most node v_1; th node v_2, the far-right node v_3 and the bottom node v_4.

By inspection, $v_1 = 5$ V

We form a supernode from nodes 3 and 4 then proceed to write appropriate KCL equations:

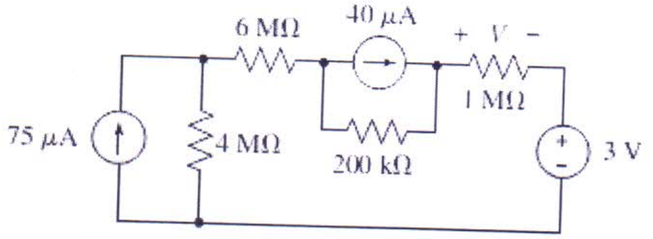
$$-1 = \frac{v_2}{2} + \frac{v_2 - v_3}{10} \quad [1]$$

$$5 = \frac{v_3 - v_2}{10} + \frac{v_3}{20} + \frac{v_4 - v_1}{12} \quad [2]$$

Also, we need the KVL equation relating nodes 3 and 4, $v_4 - v_3 = 10$

Solving, $v_2 = v = \boxed{1.731 \text{ V}}$

c) compute the voltage Vacross the 1 M ohm resistor using repeated source transformations. [4]

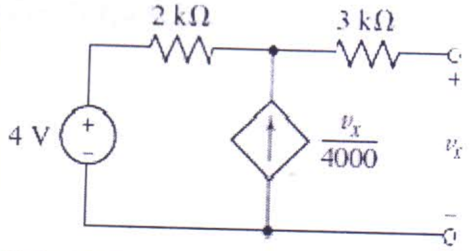


Solution-

Conversion of current sources to voltage sources- 2M

V= 27.2 V – 2M

Q3 a) Obtain Thevenin's equivalent for the following network [6]



Solution-

$$-4 + 2 \times 10^3 \left(-\frac{v_x}{4000}\right) + 3 \times 10^3(0) + v_x = 0$$

$$v_x = 8 \text{ V} = V_{oc}$$

----------- 2M

Determination of Isc ------ 2M

$$R_{TH} = \frac{V_{oc}}{I_{sc}} = \frac{8}{0.8 \times 10^{-3}} = 10 \text{ k}\Omega$$

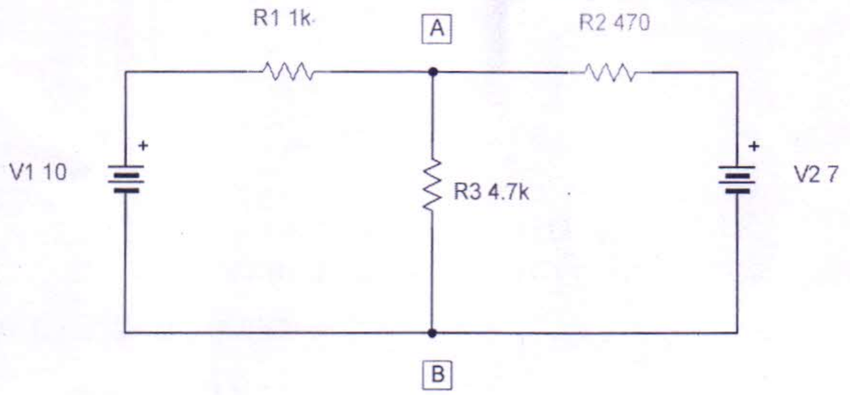
-------------- 2M

b) State and prove maximum power transfer theorem for network with reactive components. [4]

Statement – 1M

Proof- 3M

c) Apply superposition theorem to the following network and find the current through 4.7 K resistor that is I_{AB} [4]

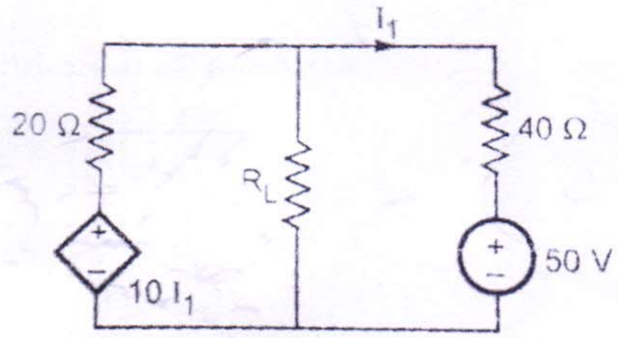


I_{AB} with only 10 V =0.64mA
I_{AB} with only 7 V =0.94mA ------ 3M

Total I_{AB} with both sources= 0.64+0.94= 1.54 mA ---- 1M

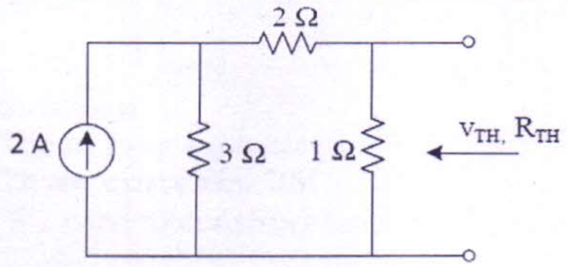
OR

Q4 a) Determine the value R_L to happen maximum power transfer [6]



Solution-

b) [4]



Solution -

Current through 1Ω resistor (using current division) $= \frac{2\times3}{3+3} = 1amp$

$V_{th} = 1\ volt$

------ 2M

$R_{th} = 1||5 = \frac{1\times5}{6} = \frac{5}{6}\Omega$ ------- **2M**

c) Statement- 2M
Explanation- 2M [4]