Indraprasth Institute of Information Technology Delhi

Mid Term Examination

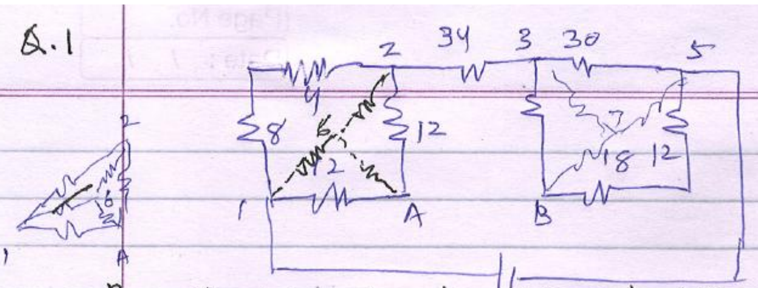
ECE 113 Basic Electronics

Maximum Marks 40

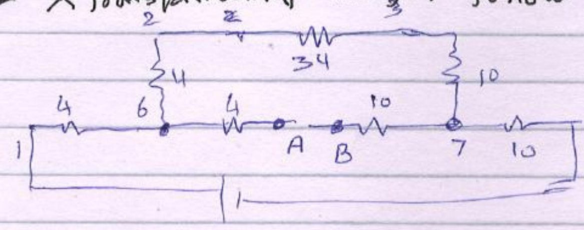
Q. 1 Find the current in the 10 Ω resistance in the circuit shown in Fig, 1.

[5 Marks]

Q.1



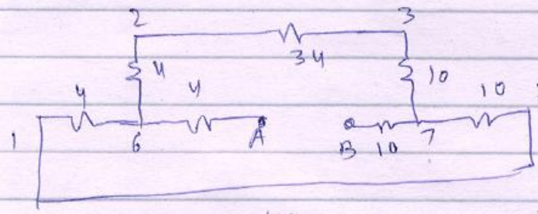
Doing Δ-λ transformation, we get following circuits:

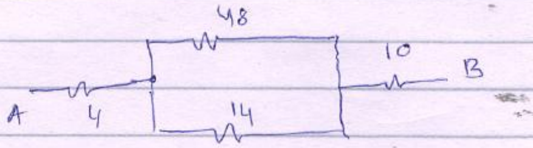


$$I = \frac{180}{4+4+34+10+10} = \frac{180}{62} \text{ Amps.}$$

$$V_{AB} = \frac{180}{62} \times (4+34+10) = \frac{180 \times 48}{62} \text{ V}$$ (2)

R_{AB}





$$R_{AB} = 4 + 10 + \frac{48 \times 14}{62} = 14 + \frac{672}{62}$$

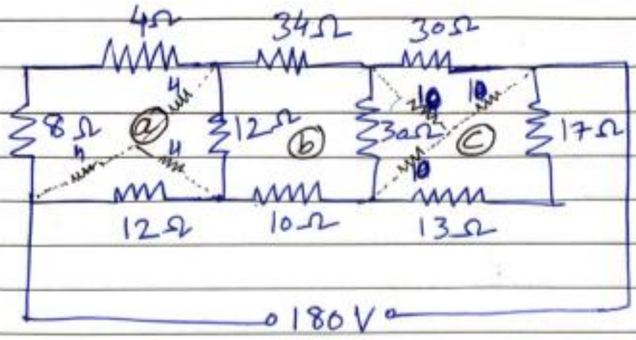
$$= \frac{868 + 672}{62} = \frac{1540}{62} \ \Omega$$ (2)

$$I_{10} = \frac{180 \times 48}{62} \cdot \frac{1}{10 + \frac{1540}{62}} = \frac{180 \times 48}{\cancel{62}} \times \frac{\cancel{62}}{620+1540}$$

$$\frac{180 \times 48}{2160} = 4A$$ (1)

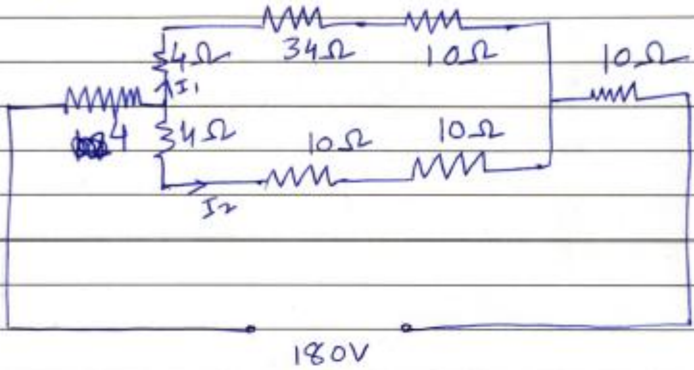
OR

Q1



Soln

Applying Delta to star conversion in a & b, we get



$$I = \frac{180}{30} = 6\,A$$

$$I_2 = \frac{48}{48+24} \times 6 = \frac{\cancel{48}^{4}}{\cancel{72}_{12}} \times \cancel{6} = 4\,A$$

$\therefore$ I in 10Ω is 4A

Q. 2 Use the Principles of Superposition to find the current in 2 Ω resistance connected between A and B in circuit shown in Fig, 2.

[5 Marks]

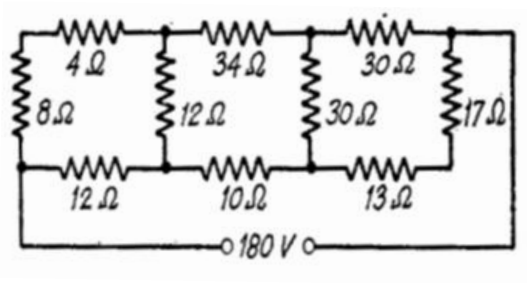


Figure 1

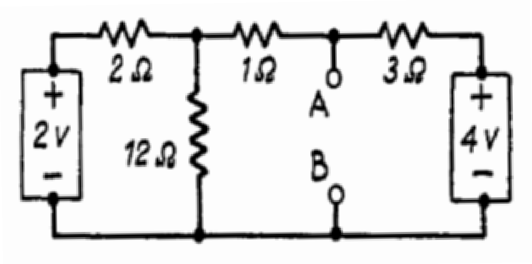


Figure 2

Q.2

Superposition

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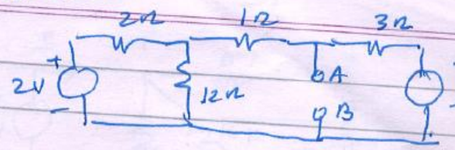
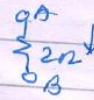
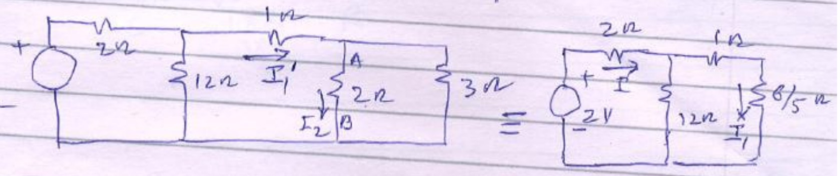
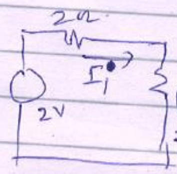




Taking left source into account only, the ckt reduced to





$(12\|2.2)\Omega = \frac{12\times 11/5}{12+11/5} = \frac{132}{71}$ ~~Amp~~

$I = \frac{2}{2+\frac{26.4}{14.2}}$ Amp $= \frac{14.2\times 2}{\cancel{28.4}\ 54.8} =$ ~~1 Amp~~ 0.518 Amp

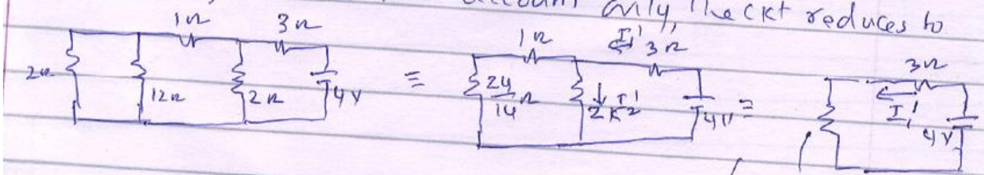
$I_1'' = \frac{12\times I}{12+2.2} = \frac{12}{14.2}\times$ ~~1 Amp~~ $0.518A$

$I_2'' = \frac{3}{3+2}\times I_1 = \frac{12}{14.2}\times\frac{3}{5}\times 0.518A$

$= \frac{36}{71}$ ~~Amp~~ $=$ ~~0.507 Amp~~ $= 0.2535$ A

(2)

Taking right source into account only, the ckt reduces to



$I_1' = \frac{4}{3+\frac{76}{66}} = \frac{4\times 66}{198+76} = \frac{264}{274}$

$(2\|\frac{38}{14})\Omega = \frac{38\times 2/14}{(2+38/14)} = \frac{76}{66}\Omega$

$I_2' = I_1'\times\frac{38/14}{\frac{38}{14}+2} = \frac{I_1'\times 38}{66} = \frac{4\times 66}{274}\times\frac{38}{66} = 0.554$ Amp

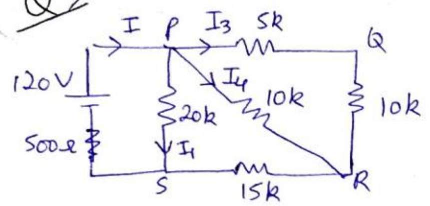
(2)

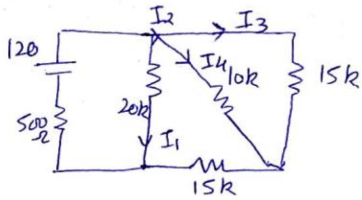
Q. 3 Determine the (a) current given by 120 V battery (b) potential difference across RS and (c) magnitude and direction of current in PR for the circuit shown in Fig. 3.

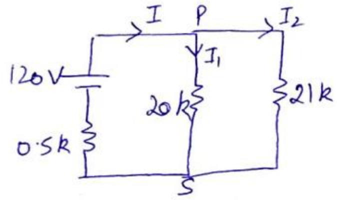
[5 Marks]

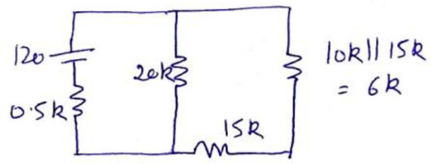
ANS:

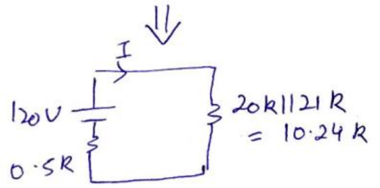
Q3.











All correct circuits (2 marks)

$$I = \frac{120V}{0.5k + 10.24k} = \frac{120V}{10.74k} = 11.17\ mA \quad (1\ mark)$$

$$I_1 = \frac{21}{20+21} \cdot I = \frac{21}{41} \times 11.17 = 5.72\ mA$$

$$I_2 = \frac{20}{20+21} \cdot I = \frac{20}{41} \times 11.17 = 5.44\ mA$$

$$I_3 = \frac{10}{10+15} \cdot I_2 = \frac{10}{10+15} \times 5.44 = 2.176\ mA$$

It will flow from P to R (1 mark)

$$I_4 = I_2 - I_3 = 5.44 - 2.176 = 3.264\ mA$$

$$V_{RS} = 15k \times 5.44\ mA = 81.6\ V \quad (1\ mark)$$

Q. 4 What is the difference in potential between the points X and Y, in the circuit shown in Fig, 4.

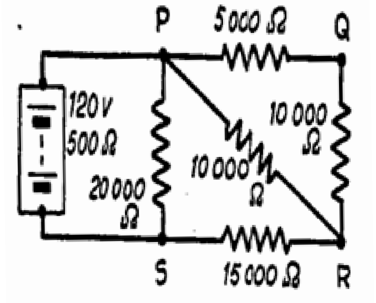


Figure 3

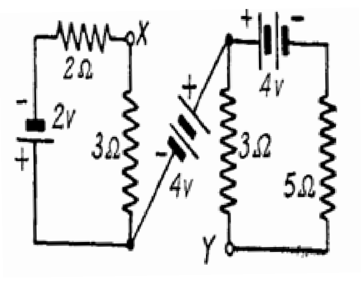
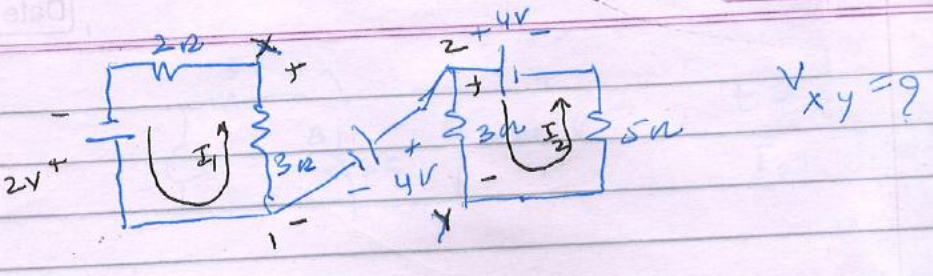


Figure 4

[5 Marks]

Q 4



$V_{xy} = ?$

$I_1 = \frac{2}{2+3} = \frac{2}{5} = 0.4\,\text{Amp}$ (1)

$I_2 = \frac{4}{3+5} = \frac{4}{8} = 0.5\,\text{Amp}$ (1)

$V_{xy} = V_{x1} + V_{12} + V_{2y}$ (2)

$= -3I_1 - 4V + 3I_2$

$= -3\times0.4 - 4 + 3\times1.5$

$= -3.7\,V$

Point Y is 3.7 V more positive than point (1)

(5)

Q. 5 State whether the following statements are TRUE or FALSE. Give appropriate justification for your answer in brief.

I. In Fig. 3(a), the switch has been in position A for a long time. If the switch is moved suddenly from A to B at t = 0, the current flowing through the resistance 2 K ohm at time t = 20 ms will be equal to 10 mA.

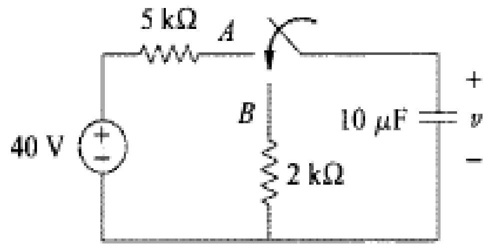


Figure 3(a)

ANS:

Since switch has been in position A for long time, the capacitor will be charged to source voltage i.e. v = 40 V.

So $v(0_-) = 40$ V.

After switch is moved to position B, the capacitor will discharge through 2 k resistance. And the capacitor voltage v(t) is given as

$$v(t) = v(0_-)\, e^{-\frac{t}{2k\,8\,10\,\mu}}$$

$$= 40\, e^{-t/20\,mS}$$

At t = 20 mS, v (20 mS) = v_1**= 40** $e^{-20\,ms/20\,mS}$**= 40** e^{-1}**V**

Current = v_1**/2K = 7.35 mA**

FALSE

II. A DC voltage of 200 V is suddenly applied across a series circuit consisting of resistance 10 ohm in series with an inductance of 0.1 H. The voltage across the inductance just after the application of voltage is equal to 0 V and current at 0.01 s is also 0 A.

ANS:

At the instant of switching on I = 0, so I R = 0, hence all applied voltage drop across inductance only**. Voltage drop across inductance = 200 V not 0 V as given.**

At t= 0.01 s, current grows exponentially and the applied voltage is partly drops across resistance and partly across the coil.

The time period of the circuit = L/R = 0.1/10 = 0.01 s and given time is equal to time constant. Thus current is not 0 A.

FALSE

III. Transient disturbance is produced in a circuit only when its applied voltage or applied current are suddenly changed.

ANS:

TRUE

When a switched is either made on or off, there is sudden change in applied voltage or current through the circuit containing energy storage elements i.e. L and C.

The other reasons are shorting of the circuit of sudden change in supply voltage or current..

Thus there will be transient disturbances.

IV. There are no transients in a circuit consisting of only resistance because the circuit obeys Ohm's law

ANS:

FALSE

The circuit obeys ohms law, but there are no energy storage element in purely resistive circuits.

So for transient we must have L or C connected in purely resistive elements.

V. The time constant associated with the circuit in Fig. 3(b) is 4 s.

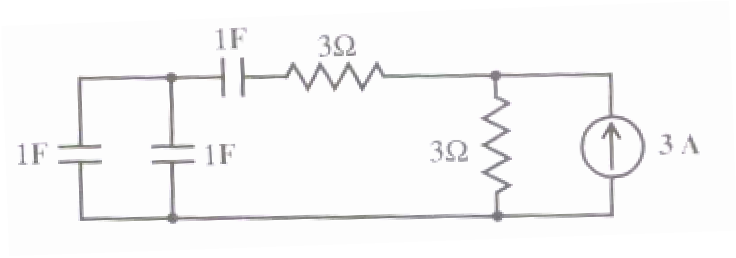


Figure 3(b)

Figure 3

ANS:

Total resistance will be 6 ohms.

Total capacitance is 1 F capacitance in series with two 1 F capacitance in parallel.

Total capacitance = 1X2/(1+2) = 2/3 F

Time constant = 6 ohm x 2/3 F = 4 s

TRUE

[5 X (1+3) = 20 Marks]

Q. 6 A student is given an unknown resistive network as illustrated in Figure 4(a). She/he wishes to determine whether the network is linear, and if it is, what its Thévenin equivalent circuit is.

The only equipment available to the student is a voltmeter (assumed ideal), 100-k Ω and 1-M Ω test resistors that can be placed across the terminals during a measurement as in Figure 4(b).

The following data were recorded:

Test Resistor	Voltmeter Reading
Absent	1.5 V
100 k Ω	0.25 V
1 M Ω	1.0 V

What should the student conclude about the network from these results? Support your conclusion with plots of the network *v i* characteristics.

ANS:

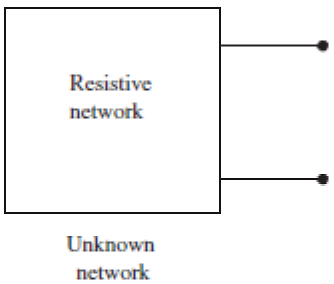


Figure 4(a)

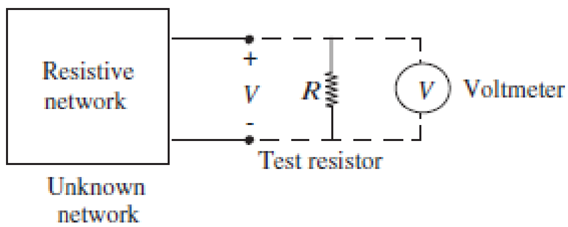
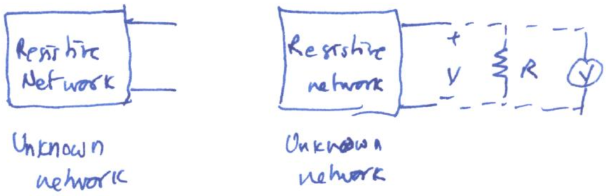
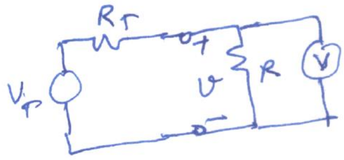


Figure 4(b)

[5 Marks]



(a) $R = \infty$ $\quad V_{oc} = 1.5\,V$



$R_1 = 100k$ $\quad v_1 = 0.25\,V$

$R_2 = 1\,M\Omega$ $\quad V_2 = 1\,V$

Since open ckt voltage $= 1.5\,V$; $V_T = 1.5\,V$

$$V_1 = \frac{V_T}{R_T + R_1} \times R_1 = \frac{1.5 \times R}{R_T + R} = \frac{1.5 \times 100K}{R_T + 100K} = 0.25$$

$$150 = 0.25\,R_T + 25$$

$$0.25\,R_T = 125 \Rightarrow R_T = \frac{125}{0.25} = 500\cancel{k}\,\Omega$$

$$= V_2 = \frac{V_T}{R_T + R_2} \cdot R_2 = \frac{1.5 \times 1M}{R_T + 1} = 1\,V$$

$$R_T + 1 = 1.5 \qquad R_T = 1.5 - 1 = 0.5\,M$$

Network is linear