MILITARY COLLEGE OF SIGNALS
BESE 16 (A@B) COURSE
Mid Term Exam

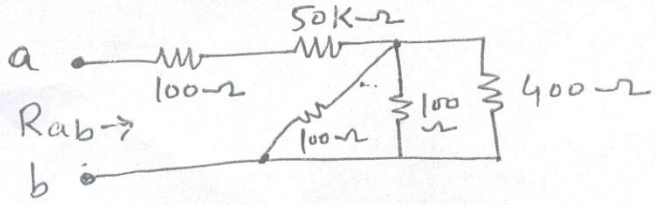
Subj: BEE **Marks: 30**
Instr: Muhammad Saleem® **Time:1-1/2Hrs**
Note:- Attempt all questions, Make neat and clean diagram where required.

Question-1

a. Find charge entering the terminal between $t = 1$ second and $t = 3$ second, if current is $(3t^2 - t)$ A. (6)

b. using source transformation Technique convert ideal 24 V DC source to equivalent current source. (2)

c. Find Rab in the circuit

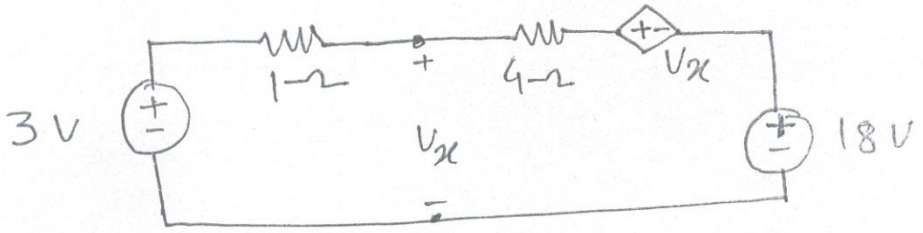


(2)

Question No-2 :-

a. Compute charge on 8 million proton and 4000 electrons. (2)

b. Compute V_x in the given circuit



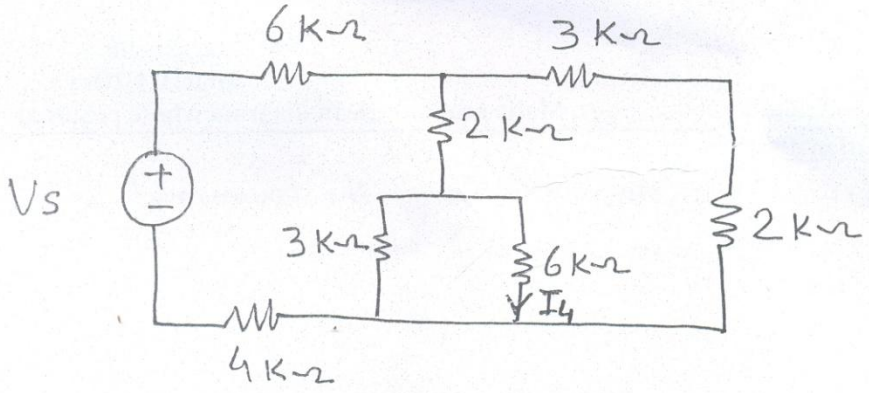
(3)

c. Total charge entering the terminal is $Q = 6t \sin 4\pi t$ mc calculate current at time $t = 0.5$ second. (3)

d. Differentiate between voltage and Emf, and Potentiometer and rheostat. (2)

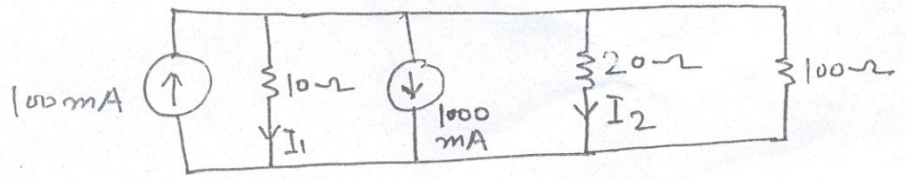
Question No - 3

a. Find Vs if $I_4 = \frac{1}{2}$ mA



(3)

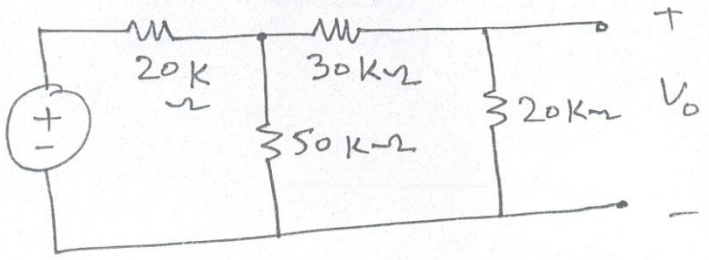
b. Find I_1 and I_2 using current DIVISION formula.



(2)

C. Define electric shock, linear Resistance, branch, Node and Dependent source. (2.5)

d. 24V



Compute V_o using any technique. (2.5)

(Good Luck)

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Question-1

a- $i = (3t^2 - t)$ A

$$q = \int_{t=1}^{t=3} i\,dt \qquad q = \int_1^3 3t^2 - t$$

$$q = \int_1^3 \frac{3t^3}{3} - \frac{t^2}{2} = t^3 - \frac{t^2}{2}\Big|_1^3$$

$$= \left[(3)^3 - \frac{(3)^2}{2}\right] - \left[(1)^3 - \frac{(1)^2}{2}\right]$$

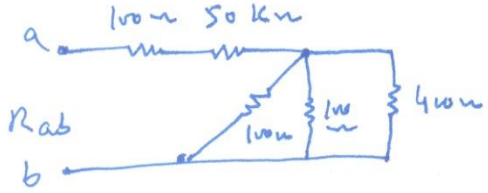
$$\left[27 - 4.5\right] - \left[1 - \tfrac{1}{2}\right]$$

$$(22.5) - \tfrac{1}{2} = 22\,C$$

$\boxed{q = 22\,C}$

b. In ideal voltage source $R = 0$, with $R = 0$ source transformation is not possible.

c.



$100 \| 100 = \frac{100 \times 100}{200} = 50\,\Omega$

$50 \| 400 = \frac{400 \times 50}{450} = 44.45\,\Omega$

Now $100\,\Omega + 50\,K\Omega + 44.45\,\Omega =$

$144.45 + 50{,}000 = 50144.45\,\Omega \cong \boxed{50.1445\,K\Omega}$

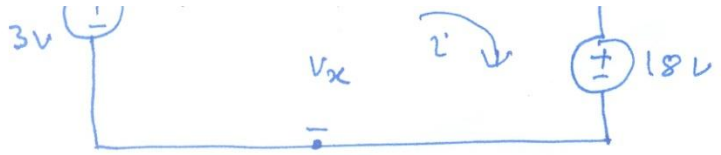
Question NO-2

a. Each e has charge $= -1.602 \times 10^{-19}$ C so 4000 e will have charge

$-1.602 \times 10^{-19} \times 4000 = \boxed{-6.408 \times 10^{-16}\ C}$

Each P has charge $= 1.602 \times 10^{-19}$ C so 80,00000 will have charge

$1.602 \times 10^{-19} \times 80.00000 = \boxed{1.2816 \times 10^{-12}\ C}$



KVL on Loop = $-3V + 5i + V_x + 18 = 0$ — (1)

KVL on 3V, in & V_x

$= -3 + i + V_x = 0$ — (2)

Subtract (2) from (1)

$4i = -18$

$i = -4.5A$

Put up value of i in eqn 2 or 1

$-3 + i + V_x = 0$

$-3 + (-4.5) + V_x = 0$

$-3 - 4.5 + V_x = 0$

$V_x = 7.5V$

$\boxed{V_x = 7.5V}$

$q = 6t \sin 4\pi t$ mc i at .5s.

$i = \frac{dq}{dt}$

$i = 6\sin 4\pi t + 24\pi t \cdot \cos 4\pi t$

$u\frac{du}{dt} + u\cdot\frac{dv}{dt}$

$6\sin 4\pi(.5) + 24\pi(.5)\cdot\cos 4\pi(.5)$

$\sin 4\pi t \cdot 6 + 6t \cdot \cos 4\pi t \cdot 4\pi$ (fn of a fn)

$6\sin 2\pi + 12\pi \cdot \cos 2\pi$

$6\sin 4\pi t + 24\pi t \cdot \cos 4\pi t$

$0 + 12\pi \cdot \cos 2\pi = \boxed{37.714\,mA / 37.699\,mA}$

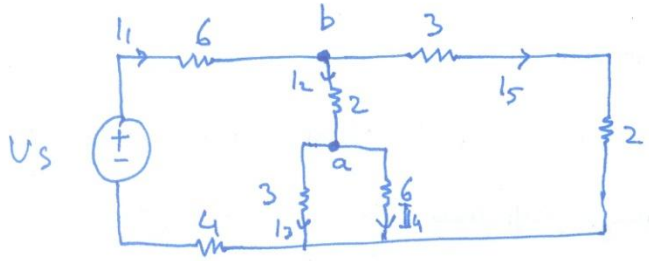
$\cos 2\pi = 1$

$\sin 2\pi = 0$

- voltage is the measure of Emf. V is the pot diff b/w 2 pts.

  Potmeter is voltage dividing device, having 3 terminal, variable R.

  rheostat is current controlled device, having 2 terminal,



All R in KΩ

$I_4 = \frac{1}{2}$ mA

Voltage at pt a = 3V ohm law.

i in 3 KΩ R = 1A i.e I_3

KCL at a = 1 + .5 = 1.5 mA thru 2 KΩ R i.e I_2 = 1.5 mA

V develop at b = (1.5) 2 = 3V + 3V (at a) so = 6V

6 V dev across 3 & 2 KΩ same V in parallel.

i thru 3 & 2 KΩ i.e I_5 = 6 ÷ 5 = 1.2 mA, ohm law

KCL at b = 1.5 + 1.2 = 2.7 mA i.e I_1

V drop at 6KΩ R = 6 × 2.7 = 16.2 V

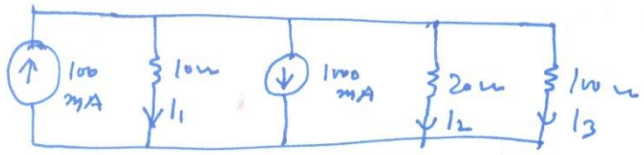
i thru 4 KΩ R = 2.7 so V dev = (2.7) 4 = 10.8 V

KVL at left loop =

$-V_s + 16.2V + 3V + 3V + 10.8V = 0$

V_s = 33 V

33 V



Total i of the ckt 1000 mA − 100 mA = 900 mA in downward direction

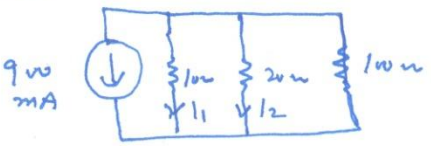
900 i will divide in 3 × br 10Ω, 20Ω & 100Ω

$20 \| 100 = \frac{100 \times 20}{120} = 16.67\ \Omega$

$I_1 = \left(\frac{16.67}{26.67}\right) 900 =$ **562.5 mA**

$10 \| 100 = \frac{100 \times 10}{110} = 9.091\ \Omega$

$I_2 = \left(\frac{9.091}{29.09}\right) 900 =$ **281.25 mA**



C. (1) **Electric shock**: Involuntary contraction of muscles with feeling of pain is electric shock.

2.5

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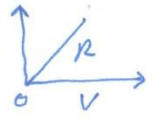
(2) **Linear Resistance**: LR is that which obey ohm law i.e V & I are in proportion while varying, proportionality constant R is a straight line passing through origin or R having constant value of R. R does not change with applied V.



(3) **Branch**: single element of the circuit having two terminal e.g V-source or Resistance. e.g.

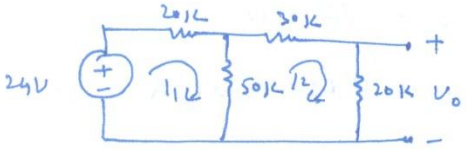
(4) **Node**: where two or more than two element connects connect. or pt connecting 2 or more element. represented with a dot.

(5) **Dependent source**.

Generate the voltage or current, that is determined by a voltage or current at a specified location in the ckt. symbols is used to model the electric devices.

d.

2.5



Find V_o

use mesh

mesh 1 KVL: $-24V + 20I_1 + 50(I_1 - I_2) = 0$

$$70I_1 - 50I_2 = 24 \quad \text{---} (1)$$

mesh 2 KVL: $50(I_2 - I_1) + 30I_2 + 20I_2 = 0$

$$-50I_1 + 100I_2 = 0 \quad \text{---} (2)$$

Solve 1 & 2 substitution:

$$I_1 = 2I_2 \quad \text{---} (3)$$

put (3) in (1)

$$I_2 = 0.266 \text{ mA}$$

$V_o = (20K)(0.266mA)$ ohm Law

$V_o = \boxed{5.333 \text{ V}}$

Solve two simultaneous eqn.

$I_2 = 0.266 \text{ mA}$

$V_o = (20)(0.266) = 5.333V$