Student ID: 202052307
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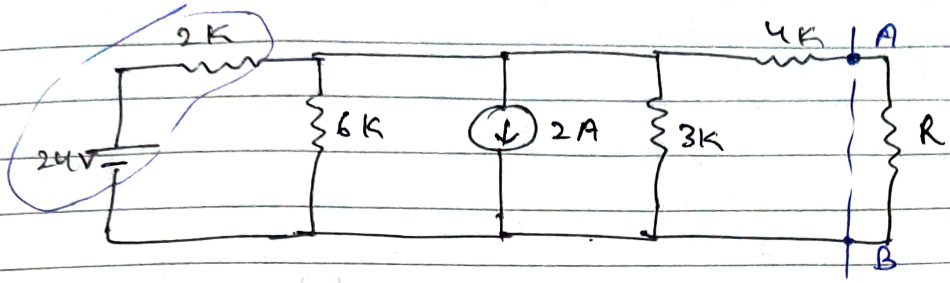
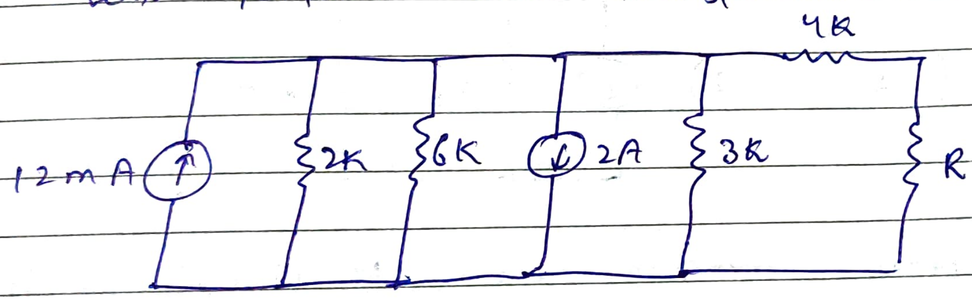
EC Remote Exam

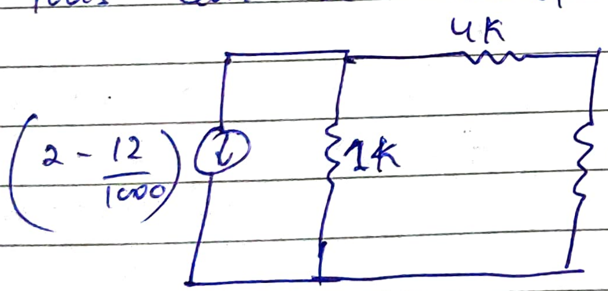


Roll Number is 202052307
$\therefore$ $R = 17\ K\Omega$

Lets perform source transformation as shown



This can be transformed to



Now we get current equivalent $I_N = \left(2 - \frac{12}{1000}\right) A$

and the R_N will be calculated by doing

voltage → ~~short~~ circuit, open circuit → current

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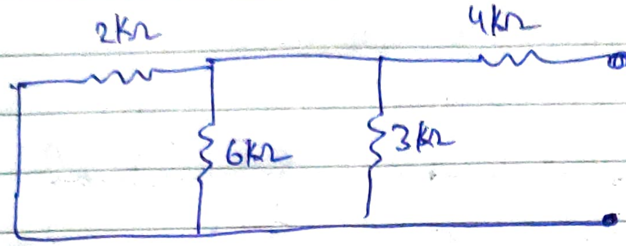
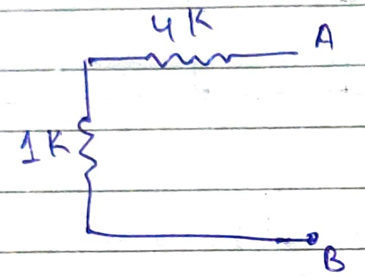
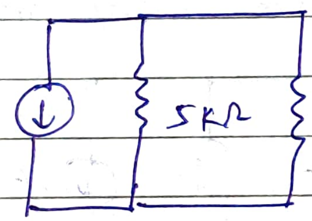




$R_{AB} = 5K$

so we can write norton equivalent



Now, voltage across 17 kΩ is 1.988 V

∴ current $I = \frac{V}{R}$

$= \frac{1.988}{17 \times 1000} = 0.11694$ A

$= 116.94$ mA

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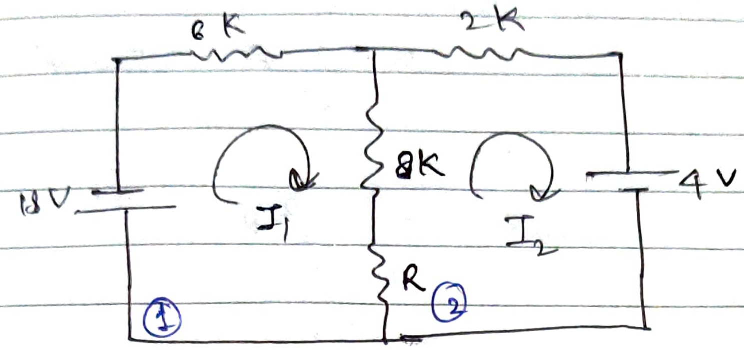
(2)



Let I_1 and I_2 be current in mesh 1 and mesh 2.

Applying KVL in mesh 1,

$$-18 - 6I_1 - (8+R)(I_1 - I_2) = 0 \quad \text{—(I)}$$

Applying KVL in mesh 2,

$$-2I_2 - 4 - (I_2 - I_1)(R+8) = 0 \quad \text{—(II)}$$

eqn (I), $(\because R = 17K)$

$$18 + 6I_1 + 25(I_1 - I_2) = 0$$

$$31I_1 - 25I_2 + 18 = 0 \quad \text{—(III)}$$

eqn (II),

$$2I_2 + 4 + (I_2 - I_1)(25) = 0$$

$$-25I_1 + 27I_2 + 4 = 0 \quad \text{—(IV)}$$

Solving (III) and (IV),

$$I_1 = \frac{-293}{106}$$

and $$I_2 = \frac{-287}{106}$$

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current through $R_1 = I_1 - I_2$

$= \frac{-6}{106} A = \frac{-3}{53} A$

$\therefore$ Power consumed $= I^2 R$

$= \frac{9}{53 \times 53} \times 17$

$= 0.0544 \text{ W}$

$= 54.4 \text{ mW}$

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(4)

$$J = x \ mA/(\mu m)^2$$
$$= 17 \ mA/(\mu m)^2$$
$$V_{ext} = 21 \ V$$

$$J = q N_D \mu_n E$$

$$N_D = \frac{J}{q \mu_n E} = \frac{17 \times 10^{-3} \ A/(\mu m)^2}{1.6 \times 10^{-19} \times 1300 \times 10^{-6} (\mu m)^2/V \cdot \times \frac{21}{25 \mu m}}$$

$$N_D = \frac{17 \times 10^{-3} \times 25}{1.6 \times 10^{-19} \times 1300 \times 10^{-6} \times 21}$$

$$N_D = 0.0097 \times 10^{22}$$
$$N_D = 9.7 \times 10^{19} \ \text{atoms}/cm^3$$

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5) X is = 5 + 2 + 3 + 0 + 7 = 17

Now, $V_o = V_T \ln\left(\frac{N_A N_D}{n_i^2}\right)$

So $V_o' = V_T \left(\frac{N_A \times 17 N_D}{n_i^2}\right)$

$$\cancel{V_o' - V_o = V_T \ln\left(\frac{N_A \cdot N_D}{n_i^2}\right) \{\ln 17 - 1\}}$$

$$\cancel{= V_T \ln\left(\frac{N_A \cdot N_D}{n_i^2}\right) (1.83)}$$

$$V_o' - V_o = V_T \ln\left(\cancel{\frac{N_A + N_D}{n_i^2}}\right) + V_T \ln(17) - V_T \ln\left(\cancel{\frac{N_A + N_D}{n_i^2}}\right)$$

$$= V_T \ln(17)$$

$$= 2.83\ V_T$$

V_T at 300 K = 0.026 V

$$\boxed{\begin{aligned} V_o' - V_o &= 0.026 \times 2.83 \\ &= 0.07358\ V \end{aligned}}$$

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(10) Given V_1, V_2, V_3, V_4, V_5 are inputs
V_0 is output

We know that for an inverting circuit we have

$$V_0 = -\left(\frac{R_f}{R_1}V_1 + \frac{R_f}{R_2}V_2 + \frac{R_f}{R_3}V_3\right)$$

Again applying the inverting circuit :-

$$V_0 = \frac{R_f}{R_1}\left(\frac{R_c}{R_b}\right) + V_2\frac{R_c}{R_b}\frac{R_f}{R_2} - V_3\frac{R_c}{R_3} - V_4\frac{R_c}{R_4}$$

Given that $R_f = R_2 = 10\ k\Omega$

Given,

$$V_0 = \frac{V_1}{X} - 3V_2 + 10V_3 - \frac{V_4}{X} + 6V_5$$

$$V_0 = \frac{V_1}{X} + 10V_3 + 6V_5 - 3V_2 - \frac{V_3}{X}$$

where,

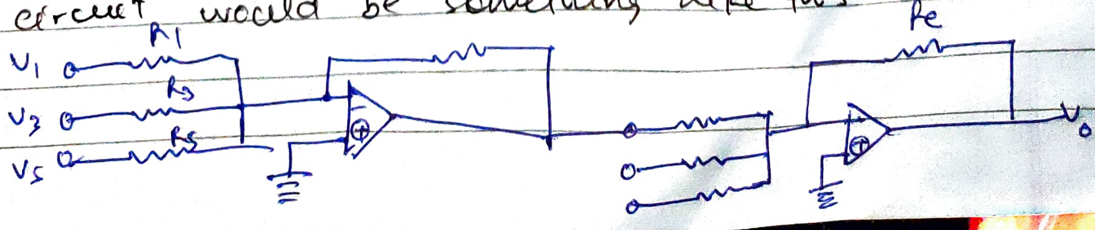
$$\frac{R_c}{R_b} = 3, \quad \frac{R_c}{R_b} = \frac{1}{x} \text{ (or) } \frac{1}{15}$$

$$\frac{R_c}{R_a} \times \frac{\cancel{10\,k\Omega}}{R_1} = \frac{1}{X} \text{ (or) } \frac{1}{15}$$

$$\frac{R_c}{R_a} \times \frac{10\ k\Omega}{R_3} = 10$$

$$\frac{R_c}{R_a} \times \frac{10\ k\Omega}{R_5} = 6$$

circuit would be something like this



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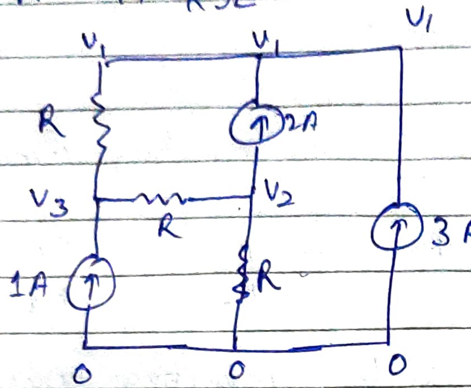
(3) $R = 17\ k\Omega$



$$\frac{V_2 - V_3}{R} - \frac{V_2}{R} = 2A \quad \text{—(I)}$$

$$\frac{V_1 - V_3}{R} + \frac{V_2 - V_3}{R} = 1A \quad \text{—(II)}$$

$$\frac{V_2}{R} = 1 + 3 = 4A$$

$$\Rightarrow \quad V_2 = 4 \times 18$$
$$= 72\ KV$$

$$\Rightarrow \quad 72 - V_3 - 72 = 2 \times 18$$
$$-V_3 = 36\ KV$$
$$V_3 = -36\ KV$$

$$\Rightarrow \quad V_1 - 36 + 72 - 36 = 18KV$$

$$V_1 = 18\ KV$$

$$\boxed{\begin{aligned} P_{3A} &= 17\ KV \times 3A \\ &= 51\ KW \end{aligned}}$$

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(6).

Roll No. is 202052307

$\therefore$ $X = 17$

So reverse saturation = 17 nA

forward voltage = 0.72 V

Diffusion capacitance = $\frac{\tau I}{\eta V_T}$

$\tau = 5\ \mu sec$

$T = 360\ K$

$V_T = \frac{360}{11600} = 0.031$

Now, $I_D = I_0 \left(e^{\frac{V}{\eta T}} - 1\right)$

$\eta = 2$ for Si

$I_0 = 17 \times 10^{-9}$ A

$I_D = 17 \times 10^{-9} \left(e^{\frac{0.72}{2 \times 0.031}} - 1\right)$

$\therefore C_D = \frac{(5 \times 10^{-6}) \times (17 \times 10^{-9}) \left(e^{\frac{0.72}{2 \times 0.031}} - 1\right)}{2 \times (0.031)}$