CSE251 ASSIGNMENT 1

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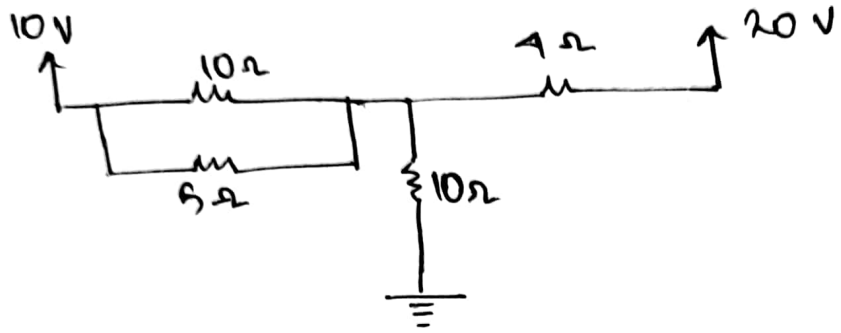
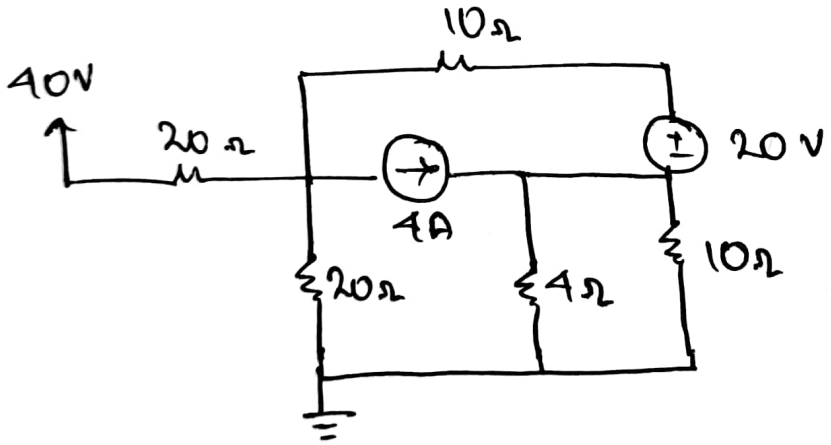
SECTION: 12

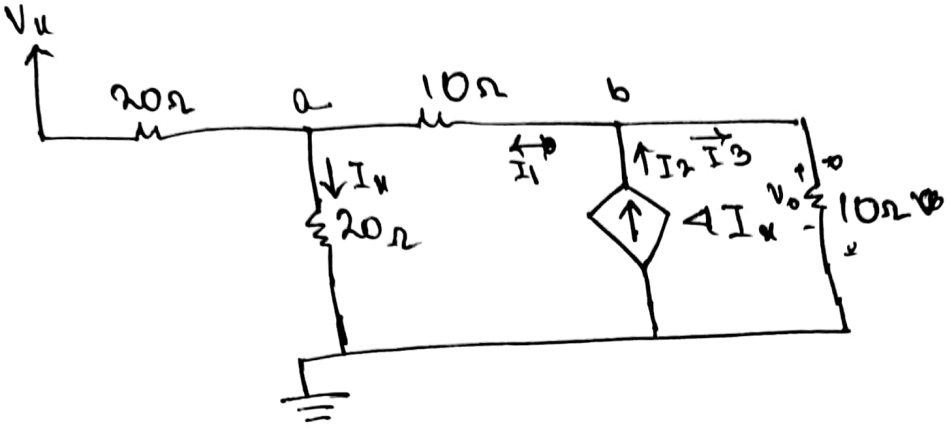
(1) (a)



(b)



(2)



$V_x = 40 + 8 = 48\Omega$

KCL at a,

$$\frac{V_a - V_x}{20} + \frac{V_a - 0}{20} + \frac{V_a - V_b}{10} = 0$$

$$\frac{V_a - 48}{20} + \frac{V_a - 0}{20} + \frac{V_a - V_b}{10} = 0$$

$$\frac{1}{5} V_a - \frac{1}{10} V_b = \frac{48}{20} \quad \text{—— (i)}$$

KCL at b,

$$\frac{V_a - V_b}{10} + 4I_x + \frac{0 - V_b}{10} = 0 \qquad \left[I_x = \frac{V_a - 0}{20}\right]$$

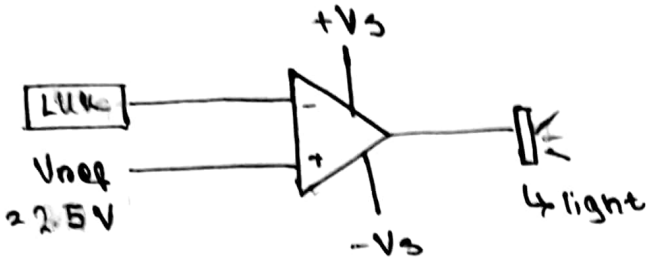
$$\frac{V_a - V_b}{10} + 4\left(\frac{V_a}{20}\right) - \frac{V_b}{10} = 0$$

$$\frac{3}{10} V_a - \frac{V_b}{5} = 0 \quad \text{—— (ii)}$$

$V_a = 48V, V_b = 72V$

$V_o = V_b = 72V$

3(a)



0 LUX = 1 V
20 LUX = 2V
80 LUX = 3V

ON → $V_{in} < V_{ref}$
(1V, 2V)

Off → $V_{in} > V_{ref}$
(3V)

(b) $V_{o1} = -\frac{R_f}{R_{in}} V_1$, $V_{o2} = -\frac{R_f}{R_{in}} V_2$, $V_{o3} = -\frac{R_f}{R_{in}} V_3$

$V_{out} = V_{o1} + V_{o2} + V_{o3}$

$= -\frac{R_f}{R_{in}} V_1 + -\frac{R_f}{R_{in}} V_2 + -\frac{R_f}{R_{in}} V_3$

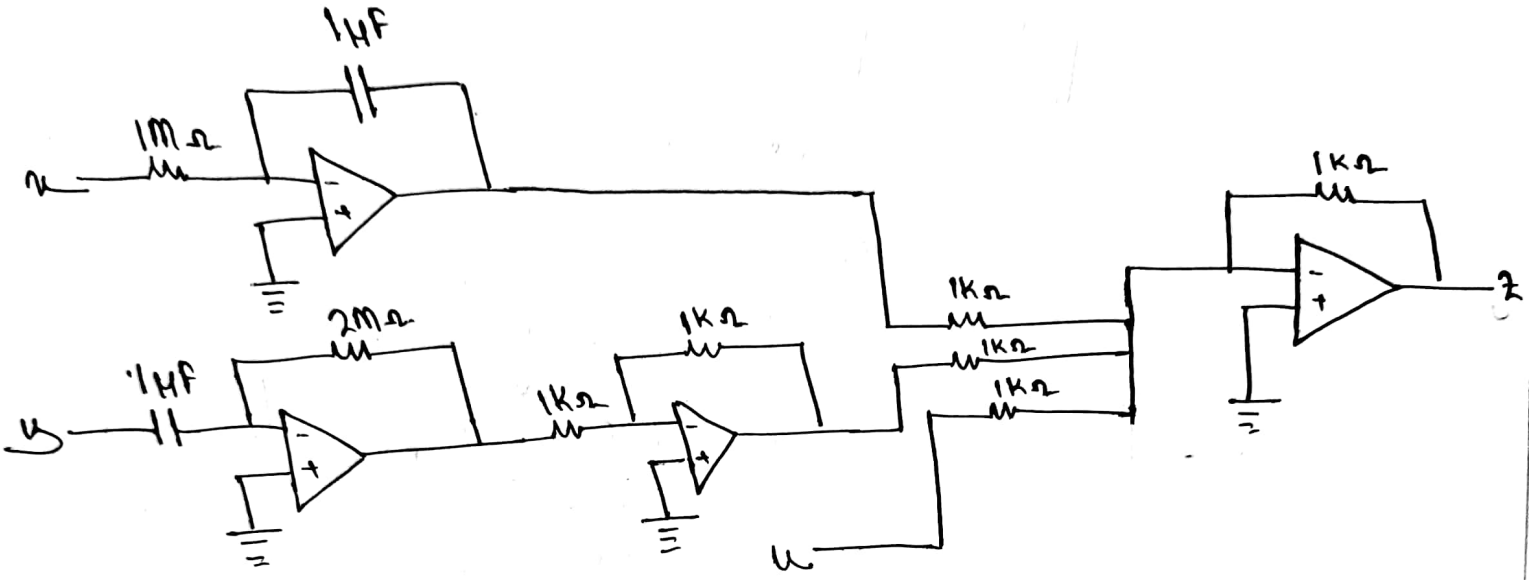
$V_{out} = -\frac{R_f}{R_{in}} (V_1 + V_2 + V_3)$

All resistors have same resistance, $R_f = R_{in}$

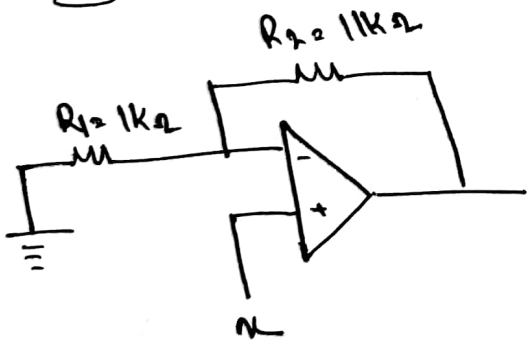
$V_{out} = -\frac{R_{in}}{R_{in}} (V_1 + V_2 + V_3)$

$V_{out} = -(V_1 + V_2 + V_3) \Rightarrow V_{out} = -(1 + 2 + 1.5) \Rightarrow V_{out} = -4.5V$

(c)(i) $z = \int x\,dt - 2\frac{dy}{dt} - v$



(ii) $y = 12x$



$y = 12x$

$V_o = A V_{in}$

$\left(1 + \frac{R_2}{R_1}\right)$ → 11, → 1

(d) $V_{I_1} = -(1\times10^{-6})(10\times10^{3})\frac{d}{dt}(y)$

$$V_{I_1} = -\frac{dy}{dt}$$

$$V_{I_2} = -\frac{5\times10^{3}}{5\times10^{3}} V_{I_1}$$

$$= -(1)\left(-\frac{dy}{dt}\right)$$

$$V_{I_2} = \frac{dy}{dt}$$

$$V_{I_3} = \frac{-1}{(1\times10^{6})(1\times10^{-6})}\int x\,dt$$

$$V_{I_3} = -\int x\,dt$$

$$f = -\left[\frac{5\times10^{3}}{5\times10^{3}} V_{I_3} + \frac{5\times10^{3}}{5\times10^{3}} V_{I_2}\right]$$

$$= -(V_{I_3} + V_{I_2})$$

$$= -\left[-\int x\,dt + \frac{dy}{dt}\right]$$

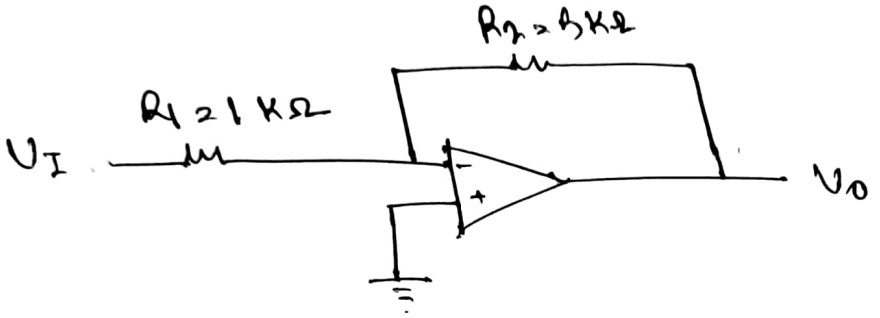
$$f = \int x\,dt - \frac{dy}{dt}$$

(4)(a) $V_O = AV_I$

$V_O = -5V_I$

$V_O = -\frac{R_2}{R_1} V_I$

$R_2 = 5\,K\Omega$, $R_1 = 1\,K\Omega$



(b) $I_{max} = 5\mu A$, $V_{in} = 0.1\,V$, $V_{out} = -5(0.1) = -0.5V$

$\frac{V_I - 0}{R_1} = 5$

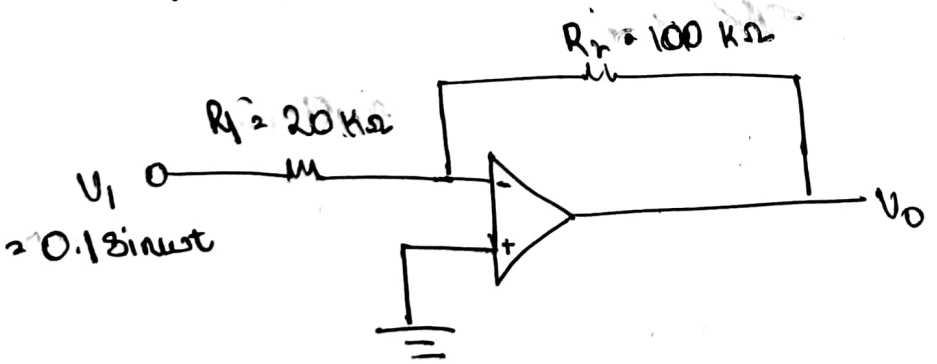
$\frac{0.1 - 0}{R_1} = 5$

$R_1 = 0.02\,M\Omega = 20\,K\Omega$

$\frac{0 - V_O}{R_2} = 5$

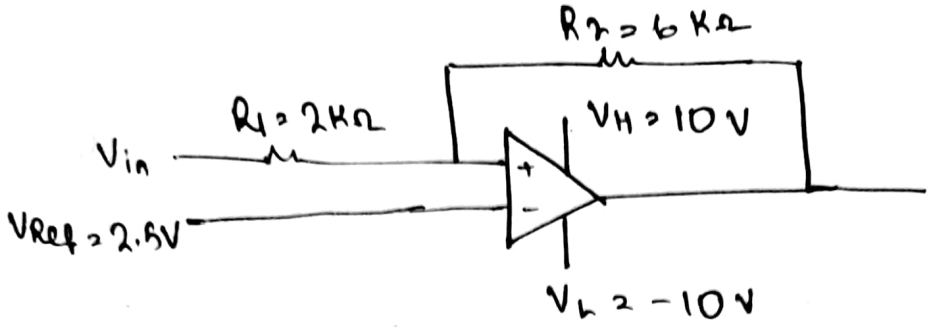
$\frac{0 - (-0.5)}{R_2} = 5$

$R_2 = 0.1\,M\Omega = 100\,K\Omega$



We need to change R_1 & R_2 to get the V_O with the same initial gain for the new V_I

(5)



$$V_{in} > -\frac{R_2}{R_2} V_L + V_{Ref} \frac{R_1+R_2}{R_2}$$

$$\Rightarrow V_{in} > -\frac{2}{6}(-10) + (2.5)\left(\frac{2+6}{6}\right)$$

$$\therefore V_{in} > \frac{20}{3}\,V \quad \text{(upper threshold)} \quad \therefore V_{TU} = \frac{20}{3}\,V$$

$$V_{in} < -\frac{R_1}{R_2} V_H + V_{Ref} \frac{R_1+R_2}{R_2}$$

$$\Rightarrow V_{in} < -\frac{2}{6}(10) + (2.5)\left(\frac{2+6}{6}\right)$$

$$\therefore V_{in} < 0\,V \quad \text{(lower threshold)} \quad \therefore V_{TL} = 0\,V$$