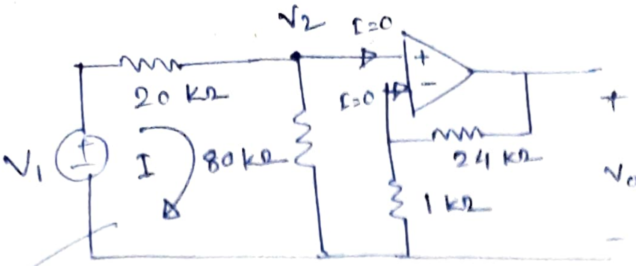
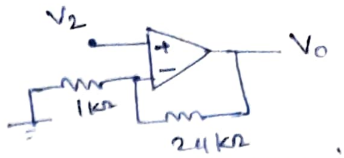
Test - 3

(1)





Non-inverting Amp.

→ KVL, $V_1 = I \times 20\,k\Omega + I \times 80\,k\Omega$, $V_2 = I \times 80\,k\Omega$

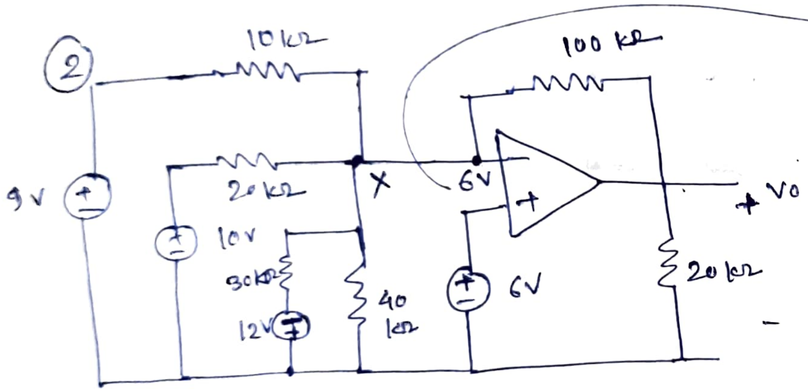
Ratio $\frac{V_2}{V_1} = \frac{80}{20+80} = 0.8$ or, Simply $V_2 = \frac{80}{20+80} V_1 = 0.8\,V_1$

→ Non-inverting amplifier.

$$\text{gain}\left(\frac{V_o}{V_2}\right) = 1 + \frac{24}{1} = 25$$

So, $\frac{V_o}{V_1} = \frac{V_o}{V_2} \times \frac{V_2}{V_1} = 25 \times 0.8 = \boxed{20.}$

(2)



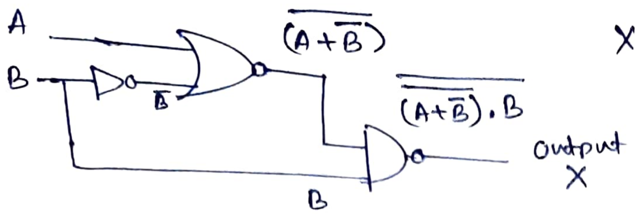
Due to virtual short.

KCL at node X,

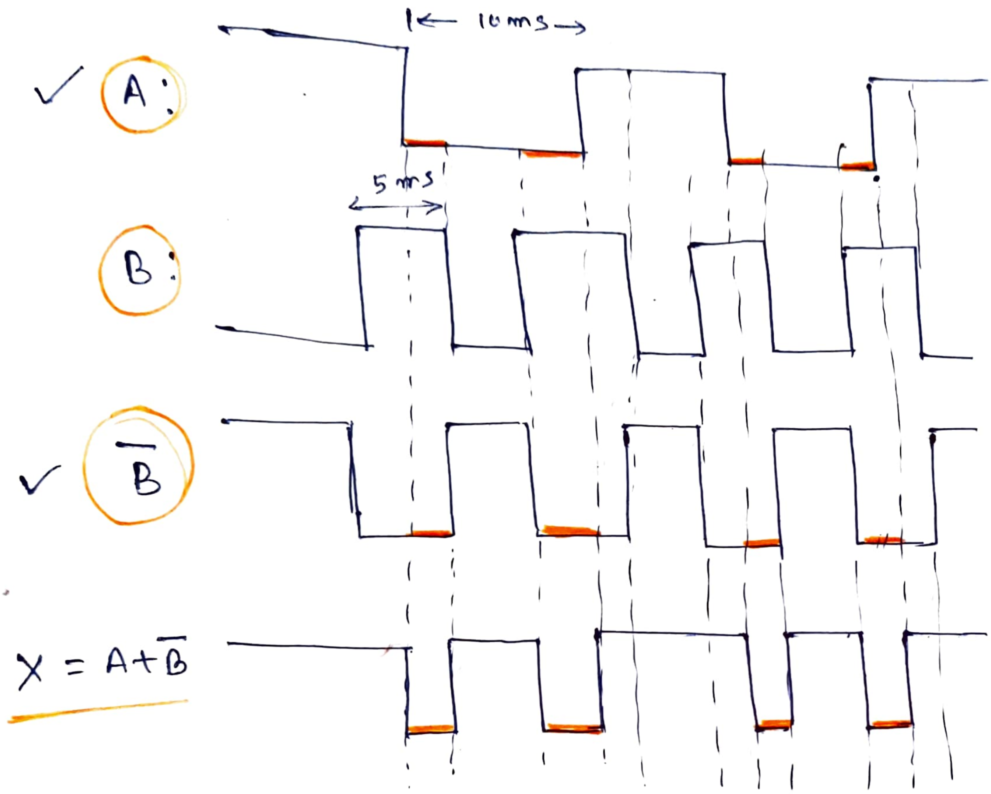
$$\frac{9-6}{10\times10^3} + \frac{10-6}{20\times10^3} + \frac{-12-6}{30\times10^3} = \frac{6}{40\times10^3} + \frac{6-V_o}{100\times10^3}$$

$V_o = 31\ V.$

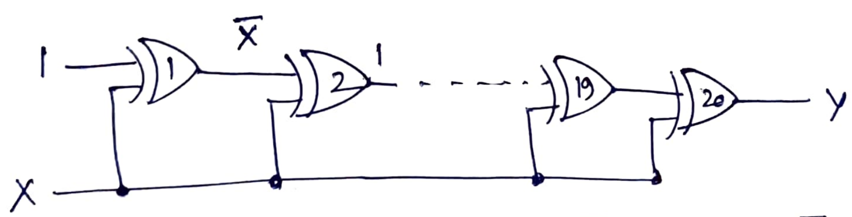
(3)



$$X = \overline{\overline{(A+\overline{B})} \cdot B}$$
$$= \overline{\overline{A+\overline{B}}} + \overline{B}$$
$$= (A+\overline{B}) + \overline{B}$$
$$X = A+\overline{B}$$



(4)



output of 1'st XOR gate $= X.\overline{1} + \overline{X}.1 = \overline{X}$

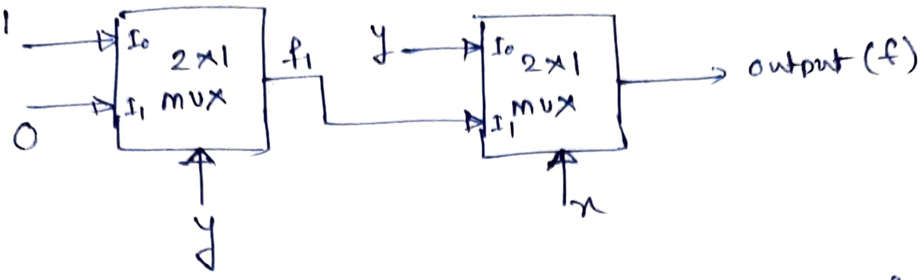
" " 2'nd " " $= X \oplus \overline{X} = \overline{X}\overline{X} + X.\overline{\overline{X}} = \overline{X}+X = 1$

" " 3'rd " " $= 1 \oplus X = \overline{X}$ and so on.

" 4'th " " $= X \oplus \overline{X} = 1$

Hence, after 2nd, 4th, 6th, ..., 20th XOR gate the output will be $= 1$

(5)



when, $y = 0,\ f_1 = 1$

$y = 1,\ f_1 = 0$

when, $x = 0,\ f = y$

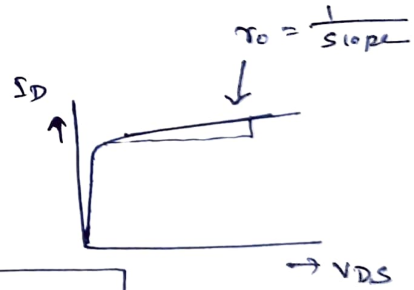
$x = 1,\ f = f_1$

x	y	f
0	0	0
0	1	1
1	0	1
1	1	0

XOR operation ~~gate~~

so, $f = x \oplus y$

(6) V_{GS} is constant.



$I_D = 2\ mA$ when $V_{DS} = 4V$

$I_D = 2.2\ mA$ " $V_{DS} = 8\ V$.

$$r_o = \frac{\Delta V_{DS}}{\Delta I_D} = \frac{8-4}{(2.2-2)\times 10^{-3}} = \boxed{20\,k\Omega = r_o}$$

ratio,

$$\frac{I_{D1}}{I_{D2}} = \frac{\cancel{\frac{1}{2}k_n' \frac{W}{L}(V_{GS}-V_{Th})^2}(1+\lambda V_{DS1})}{\cancel{\frac{1}{2}k_n' \frac{W}{L}(V_{GS}-V_{Th})^2}(1+\lambda V_{DS2})}$$

$$\frac{I_{D1}}{I_{D2}} = \frac{1+\lambda V_{DS1}}{1+\lambda V_{DS2}} \rightarrow \lambda = \frac{I_{D2}-I_{D1}}{V_{DS2}\times I_{D1} - V_{DS1}\times I_{D2}}$$

$$\boxed{\lambda = 0.0278\ V^{-1}}$$