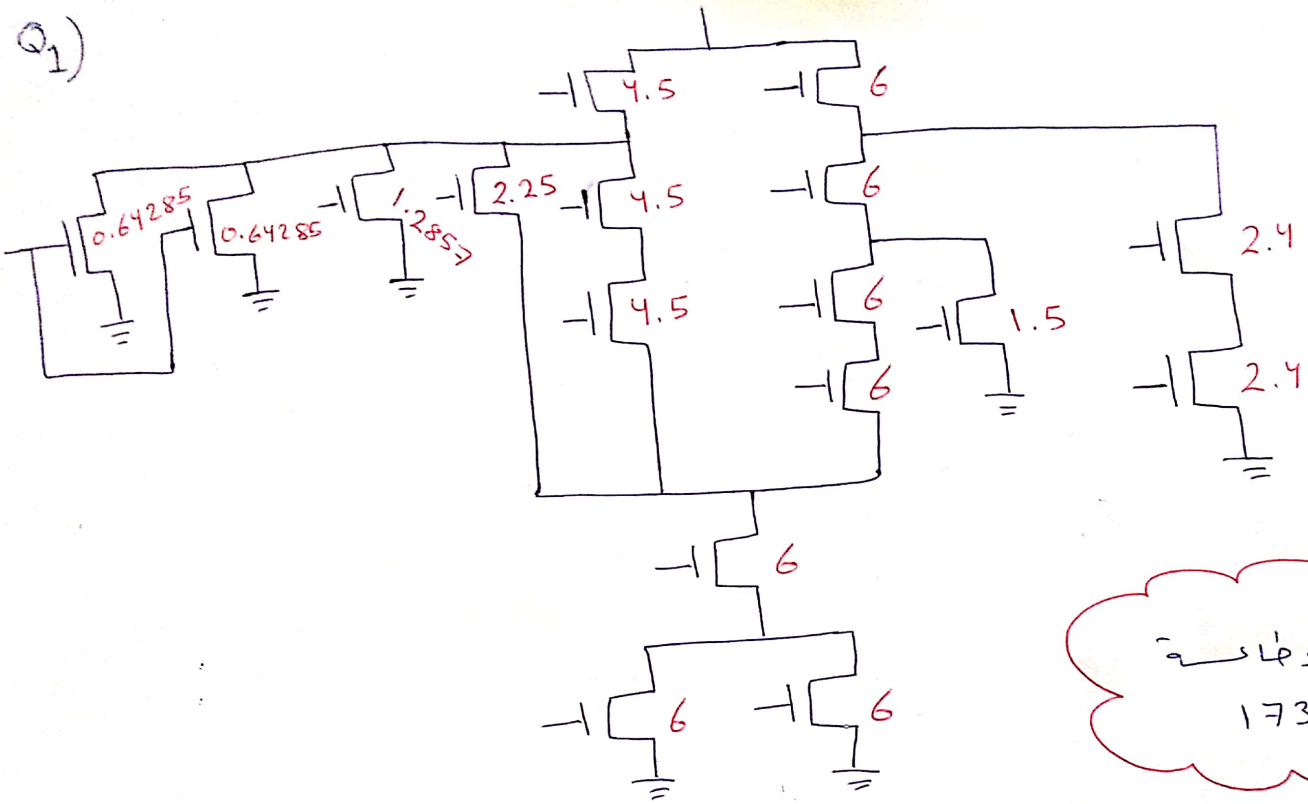
Q1)

Size $(W/L)_n = 1$



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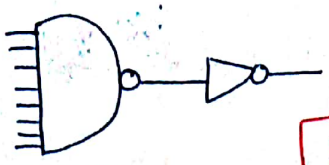
1732971

Q2)

$C_{in} = 1$, $C_L = 64$

A) Design 1 :-



$B = 1$

$P = 8 + 1 = 9$

$\Rightarrow H = \frac{C_{out}}{C_{in}} = \frac{64}{1} = 64 = H$

$N = 2$
*no of stage

$G = \frac{n+2}{3}$ ← n input

$L_D \; \frac{8+2}{3} = \frac{10}{3}$

$\Rightarrow F = BGH = 1 * \frac{10}{3} * 64 = 213.3$

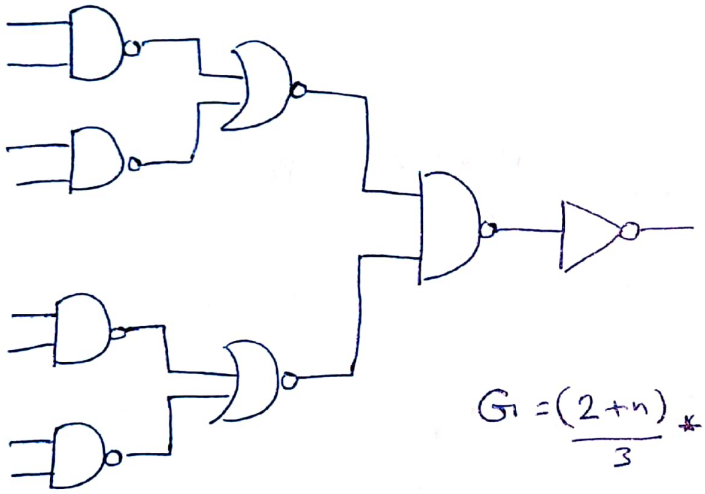
$\hat{f} = F^{\frac{1}{N}} \Rightarrow \hat{f} = (213.3)^{\frac{1}{2}} \simeq 14.61$

$\therefore D = N\hat{f} + P$

$= 2 * 14.61 + 9 = 38.21$ ✱

B) Design 2 :-

$N = 4$, $H = 64$, $B = 1$



$P = 2 + 2 + 2 + 1 = 7$

$G = \frac{(2+n)}{3} * \frac{(2n+1)}{3} * \frac{(n+2)}{3} * n$

$\Rightarrow = \frac{4}{3} * \frac{5}{3} * \frac{4}{3} * 1 = \frac{80}{27} = 2.96$

$\Rightarrow F = BGH = 1 * 64 * 2.96 = 189.63$

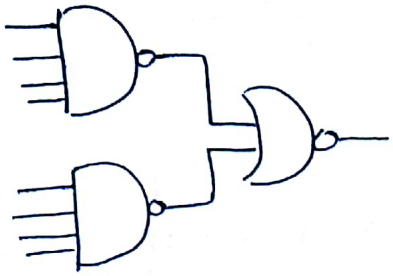
$\Rightarrow \hat{f} = F^{\frac{1}{N}} = (189.63)^{\frac{1}{4}} = 3.71$

$\therefore D = N\hat{f} + P$

$= 4 * 3.71 + 7 = 21.84$

Q2) [A] Design 3 :-

$H = 64$, $B = 1$, $N = 2$



$\Rightarrow G = \frac{(2n+1)}{3} * \frac{(n+2)}{3}$

$= \frac{26}{13} * \frac{5}{3} = \frac{10}{3} = 3.33$

$P = 4 + 2 = 6$

$\Rightarrow F = BGH$

$= 1 * 3.33 * 64 = 213.3$

$\Rightarrow \hat{f} = (f)^{\frac{1}{N}} = (213.3)^{\frac{1}{2}} = 14.61$

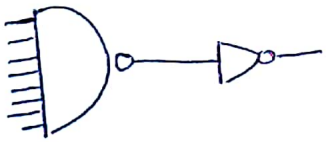
$\Rightarrow D = N\hat{f} + P$

$= 2 * 14.61 + 6 = 35.21$

Q2) [B] The Best delay is :- Design 2 ※

Q3) Given $P = 5\% = 0.05$

Design 1 :-



$\overline{P}_{AND} = P_1 * P_2 * P_3 * \cdots * P_8$

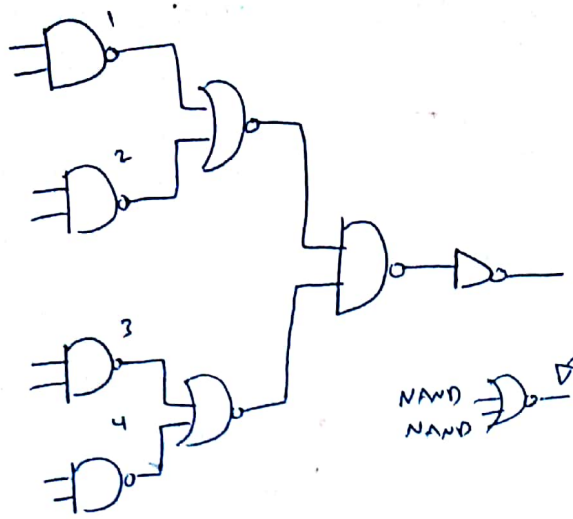
$= 0.05^{8} = 3.90625 * 10^{-11}$

$\alpha = \overline{P} * P = (1 - P) * P = (1 - 3.90625 * 10^{-11}) * 3.90625 * 10^{-11}$

$= 1 * 3.90625 * 10^{-11}$

$\alpha = 3.90925 * 10^{-11}$

Q3) (*) Design 2 :-



$P_{NAND_1} = P_{NAND_2} = 1 - P_1 * P_2$

$= 1 - 0.05^{\wedge}2$

$= 0.9975$

$\overline{P}_{NAND_{P_1,P_2}} = 1 - 0.9975 = 2.5 * 10^{-3}$

NAND NAND $\Rightarrow P_{NOR} = 2.5 * 10^{-3} * 2.5 * 10^{-3}$

$= 6.25 * 10^{-6}$

NOR NOR $\quad P_{NAND} = 1 - P_1 * P_2$

$= 1 - (6.25 * 10^{-6} * 6.25 * 10^{-6})$

$= 1 - 3.90625 * 10^{-11} \rightarrow \alpha = P(1-P)$

$\therefore P_{NAND} = 1 \Leftarrow$

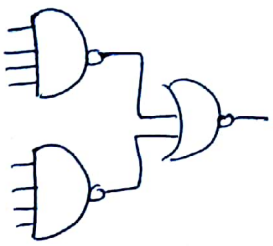
$= 3.90625 * 10^{-11} * 1$

$= 3.90625 * 10^{-11}$

$= AND = P_1 * P_2 \Rightarrow (6.25 * 10^{-6})^{\wedge}2$

$P_{AND} = 3.90625 * 10^{-11}$

(*) Design 3 :-



① $P_{NAND} = 1 - (P_1 * P_2 * P_3 * P_4)$

$= 1 - (0.05)^{\wedge}4$

$P_{NAND} = 0.9999375$

$\overline{P}_{NAND} = (1-P) = 1 - 0.9999375$

$\overline{P}_{NAND} = 6.25 * 10^{-6}$

② $P_{NOR} = \overline{P}_1 * \overline{P}_2$

NAND NAND $\quad P_{NOR} = 3.90625 * 10^{-11}$

$\alpha = P(P-1) \Rightarrow 3.90625 * 10^{-11} (1 - 3.90625 * 10^{-11}) = 3.90625 * 10^{-11}$