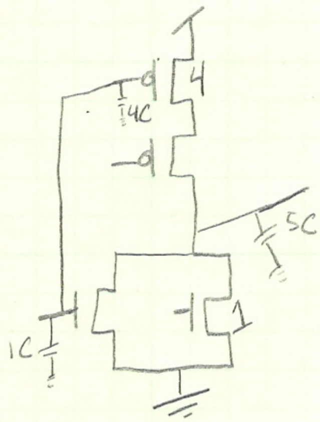
Problem 1

$d = gh + p$

$p = N = 2$

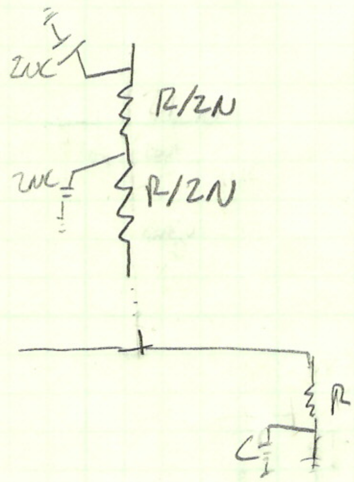
$g = \frac{4+2N}{3} = 8/3$

$d = 8/3\, h + 2$



$5hC\ 5hR = 25h^2$ delay

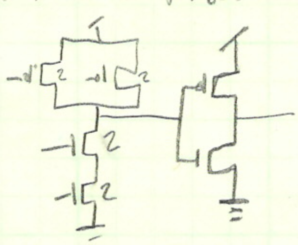
Problem 2



$$R(C + N2NC) + \sum_{n=0}^{N-1} R/_{2n}(n2NC)$$

Problem 3

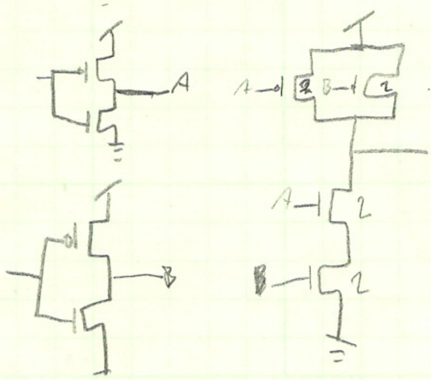
(a) will be faster because it will have less capacitance than (b)



$d = gh + p \quad g = \frac{2+N}{3} = 4/3,\ p = N = 2,\ h = \frac{C_{inv}}{C_{inv}} = 1$

$d = 4/3 + 2 = 10/3$ for NAND

$d = 1$ for Inverter



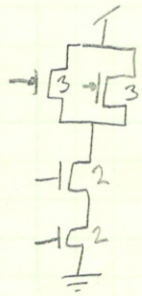
$d = \frac{3+4}{3}(1) + 2 = 7/3 + 2 = 13/3$ for NAND

delay (a) $= 10/3$

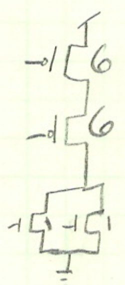
delay (b) $= 13/3$

Problem 4

logical effort $= g = \dfrac{\cancel{R_t} C_t}{\cancel{R_{inv}} C_{inv}} = \dfrac{C_t}{C_{inv}}$ because equally sized



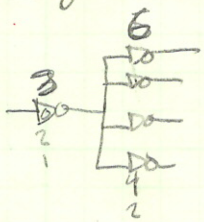
$C_t = 3+2$
$C_{inv} = 4$ $= \underline{\underline{\dfrac{5}{4} \text{ NAND}}}$



$C_t = 7$
$C_{inv} = 4$ $= \underline{\underline{\dfrac{7}{4} \text{ NOR}}}$

Problem 5

Theres not alot of detail of what is going on. What we know: successivly larger (how much larger?) FO4 (fanout of 4)



$d = gh + p$ $\quad d_0 = (1)\left(\frac{4 \cdot 6}{3}\right) + \frac{3}{3} = 8+1 = 9$

$d_1 = \left(\frac{6}{3}\right) h + \frac{6}{3} = 2h+2$ $\quad$ load $= \frac{1pF}{2fF} = 500$

$= 1002$

Use as few inverters as possible, assuming FO4 use 5 inverters for a delay of 1011