GIVEN: 20 MILLION GATES $P_{DISS} = 20\,W$

FIND: $P_{AVE,\,GATE}$ IF $V = 1.8\,V$ THEN HOW MUCH CURRENT PER GATE

SOLN:

$$P_{AVE,\,GATE} = \frac{20\ W}{20\,M\,(1/3)} = 3\,\mu W/GATE$$

$$I_{GATE} = \frac{3\ \mu W}{1.8\ V} = 1.67\,\mu A/GATE$$

GIVEN: FIG. 6.12 $V_L = 0.5V$

FIND: R W/L NM_L NM_H

SOLN: FOR FIG 6.12 ... I_D WAS $80\mu A$ (p. 295)

SO, $$R = \frac{V_D - V_L}{I_D} = \frac{2.5 - 0.5}{80\mu} = \underline{\underline{25\,K\Omega}}$$

AND $$80\mu A = \left(100\,\frac{\mu A}{V^2}\right)\left(\frac{W}{L}\right)\left(2.5 - 0.6 - \frac{0.5}{2}\right)(0.5)$$

$$\frac{W}{L} = \frac{1}{1.03}$$

$$NM_L = 0.6 + \frac{1}{KR} - \sqrt{\frac{2V_D}{2KR}} = 0.183\,V$$

$$NM_H = 2.5 - 0.6 + \frac{1}{2KR} - 1.63\sqrt{\frac{V_D}{KR}} = 0.453\,V$$

GIVEN: FIG. 6.29 c) w/ $K = 100\mu A/V^2$

FIND: V_H V_L P IF $K = 70\mu A/V^2$, $K = 130\mu A/V^2$

SOLN: V_H & V_L DO NOT DEPEND UPON K

SO THEY REMAIN $V_H = 2.5V$

$V_L = 0.2V$

BUT I_D WILL CHANGE

SO $I_D = 80\mu A \cdot \left(\frac{70}{100}\right) = 56\mu A$

$I_D = 80\mu A \left(\frac{130}{100}\right) = 104\mu A$

THUS $P = 2.5(56\mu A) = 140\mu W$

AND $P = 2.5(104\mu A) = 260\mu W$

GIVEN: $V_D = 1.8\,V$ $V_L = 0.2\,V$ $P = 100\mu W$

$V_{TN} = 0.5V$ $V_{TP} = -0.5V$

FIND: DESIGN NMOS INVERTER

NM_L NM_H

SOLN: $I_D = \frac{100\mu W}{1.8V} = 55.6\,\mu A$

FOR NMOS $55.6\mu A = 100\mu W\left(\frac{W}{L}\right)\left(1.8 - 0.5 - \frac{0.2}{2}\right)0.2$

$$\frac{W}{L} = \frac{2.32}{1}$$

FOR PMOS $\frac{W}{L} = \frac{1.66}{1}$

$$V_{OH} = 1.8 - (1.8 - 0.5)\left(1 - \sqrt{\frac{3.52}{3.52+1}}\right) = 1.65V$$

$$V_{OL} = \frac{1.8 - 0.5}{\sqrt{3(3.52}} = 0.4V$$

$NM_H = 0.3V$

$NM_L = 0.426V$

$$V_{IH} = 0.5 + 2(0.4) = 1.3V$$

$$V_{IL} = 0.5 + \frac{1.8 - 0.5}{\sqrt{3.52+1}} = 1.65V$$

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