

Problem 1:

$$V_{TRIP} = \frac{(V_{Tn}) + (V_{DD} + V_{Tp}) * \sqrt{\left(\frac{u_p}{u_n}\right) \left(\frac{W_2}{W_1}\right) \left(\frac{L_1}{L_2}\right)}}{1 + \sqrt{\left(\frac{u_p}{u_n}\right) \left(\frac{W_2}{W_1}\right) \left(\frac{L_1}{L_2}\right)}} = \frac{(0.5) + (2.05 - 0.5) * \sqrt{\left(\frac{70}{350}\right) \left(\frac{1}{1}\right) \left(\frac{1}{1}\right)}}{1 + \sqrt{\left(\frac{70}{350}\right) \left(\frac{1}{1}\right) \left(\frac{1}{1}\right)}} \\ = \mathbf{0.824\text{ V}}$$

Problem 2:

$$V_{Tn} = 0.4\text{ V and } V_{Tp} = -0.6\text{ V}$$

$$V_{TRIP} = \frac{(0.4) + (2.05 - 0.6) * \sqrt{\left(\frac{70}{350}\right) \left(\frac{1}{1}\right) \left(\frac{1}{1}\right)}}{1 + \sqrt{\left(\frac{70}{350}\right) \left(\frac{1}{1}\right) \left(\frac{1}{1}\right)}} = 0.724\text{ V}$$

$$\text{Percent Deviation} = \frac{0.824 - 0.724}{0.824} = \mathbf{12.1\%}$$

Problem 3:

TRUTH TABLE

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

$$Y = 0$$

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

$$Y = A + \bar{B}$$

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

$$Y = A \oplus B$$

$$XOR$$

AB	Y
00	0
01	0
10	0
11	1

$$Y = A \cdot B$$

AB	Y
00	1
01	1
10	1
11	0

$$Y = A + \bar{B}$$

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	0

$$Y = \bar{B}$$

$$NOT$$

AB	Y
00	0
01	0
10	0
11	1

$$Y = A$$

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	0

$$Y = \bar{A}$$

AB	Y
00	0
01	0
10	0
11	1

$$Y = A \cdot B$$

$$AND$$

AB	Y
00	0
01	1
10	1
11	1

$$Y = B$$

AB	Y
00	1
01	1
10	1
11	1

$$Y = 1$$

AB	Y
00	0
01	0
10	0
11	1

AB	Y
00	0
01	0
10	0
11	1

$$Y = A \oplus B$$

$$XOR$$

$$Y = A \cdot B$$

$$AND$$

AB	Y
00	0
01	1
10	1
11	1

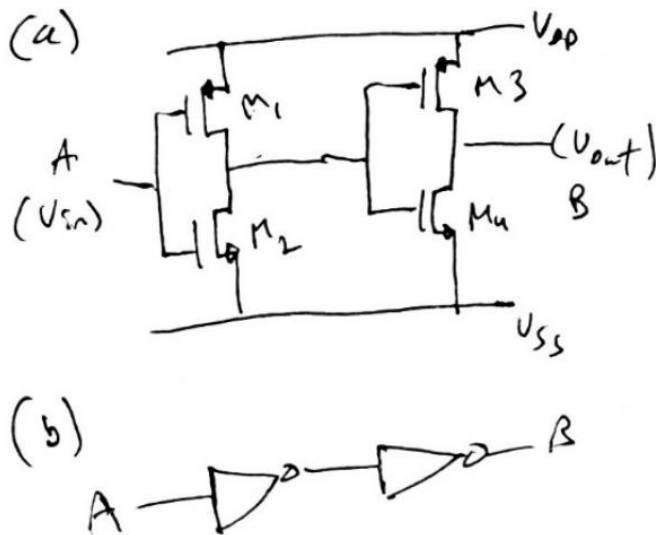
$$Y = A + B$$

$$AND$$

$$Y = A + B$$

$$XOR$$

Problem 4:



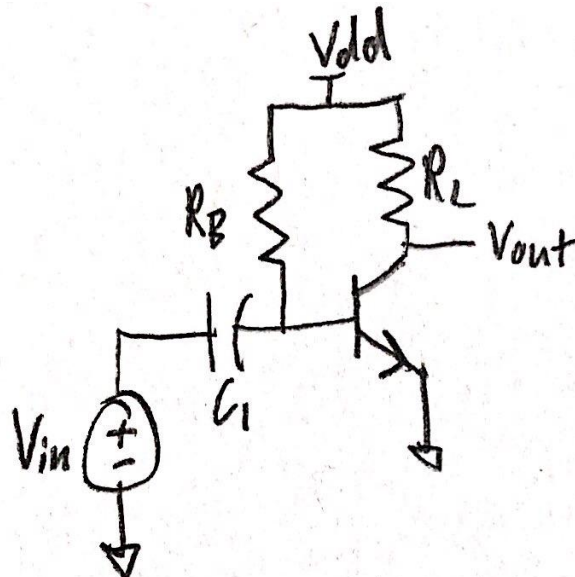
Problem 5:

Assume C_1 is large, and set $V_{DD} = 10V$

$$I_C = \frac{V_{DD} - V_{outQ}}{R_L} = \beta_n I_B = 100 * \frac{V_{DD} - 0.6V}{R_B}$$

$$\frac{10V - 5V}{2k\Omega} = 100 * \frac{10V - 0.6V}{R_B}$$

$$R_B = 376 k\Omega$$



Problem 6:

$$\frac{I_{out} + I_{BO}}{I_{in} + I_{BS}} = \frac{A_{EO1}}{A_{EO0}} = 5$$

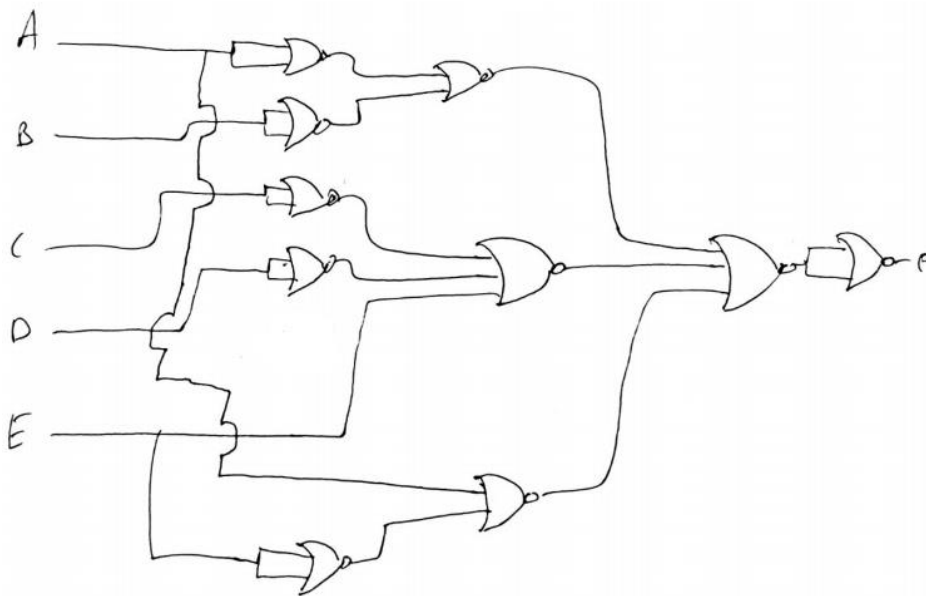
$$I_{out} + I_{BO} = 5I_{in} + 5I_{BS}$$

$$I_{out} = 5I_{in} + (5I_{BS} - I_{BO}) = 5I_{in}$$

Problem 7:

a.) $F = AB + CDE + \bar{A}E$

c.) $F = \overline{\overline{\overline{\overline{\overline{A\overline{B}}}}}} + \overline{\overline{\overline{\overline{C}}}} + \overline{\overline{\overline{\overline{D}}}} + \overline{\overline{\overline{\overline{E}}}} + \overline{\overline{\overline{\overline{A}}}} + \overline{\overline{\overline{\overline{E}}}}$



e.) Just replace all NOR gates in above schematic with transistor level NOR gate

Problem 8:

$$F = AB + \bar{C}\bar{B}$$

