Question #1: BJT Memory Cell
$V_{BE(on)} = 0.7\, V$, $V_{CE(sat)} = 0.2\, V$, $\beta_N = 100$, $\beta_R = 0$, $\beta_L = 0$, $V_E = 3\, V$

a. Find $V_D'$
b. Find $V_D$

Question #2: ECL Memory Cell
$V_{BE(on)} = 0.7\, V$, $\beta = 10$

a. Find $V_E$
b. Find $I_{E2}$
c. Find $I_{B2}$

d. Find $I_{C2}$

e. Find $V_{O1}$

f. Find $V_{O2}$

**Question #3: NMOS Static RAM cell**

$V_T = 1\text{V}, \quad k_1 = k_2 = 2\text{mA/V}^2, \quad k_3 = k_4 = 0.2\text{mA/V}^2$

a. Find the value of $V_{O1}$

b. Find the value of $V_{O2}$

**Question #4: BJT Bistable Multivibrator:** Plot the waveforms of the listed nodes showing voltage levels, times and time constants for the applied input pulse to the circuit shown. Assume $Q_1$ = ON to start.

Questions on next page. Note $Q_1$ is on the left & is ON, $Q_2$ is on the right & off.
a. $V_k$

b. $V_{be1}$

c. $V_{ce1}$

d. $V_{be2}$

e. $V_{ce2}$

Question #5: Set/Clear Bistable Multivibrator

a. Build a clocked S/C flip-flop out of NAND gates. Show the circuit.


c. For the circuit shown below, plot $V_{o1}$ and $V_{o2}$ for the applied clock pulses. Assume that initially $Q_1 = Q_2 = 0$.

![Bistable Multivibrator Circuit](image)

Question #6: The simple BJT bistable circuit shown in the diagram is called an emitter-coupled flip-flop. Assume that $V_{CE(sat)} = 0V$, $V_{BE(sat)} = 0.8V$, $Q = 1$ initially. Determine all the voltages and currents in the circuit below. Assume $I_{B1} = 0$

Drawing on the next page!
Question #7: Flip Flop
Fill in the chart assuming the proper pulses are applied. Where Qp is the present state of Q and Qn is the next state of Q upon ck = 1.

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<th>Qp</th>
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Drawing:
Question #8
Start with all flip-flops cleared, Q's = 0. Then show the count sequence (output of each flip flop) for 16 input pulses. Q* = Q bar.

Question #9: CMOS Flip-Flop
Q1 & Q3: Kp = 1mA/V^2, Q2 & Q4: Kn = 1mA/V^2
Q5 & Q6: Kn = 8mA/V^2. V_T(all) = 1V, V_DD = 5

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a. Find V_{OH} if Reset = 0
b. What is the status of Q_1 thru Q_4 when V_o = V_{OH}
c. If Ck=5V, Reset = 5V and V_o starts at V_{OH}, find V_o just before the state changes. Assume OHMNIC for all on Q's.