1. For the following circuit, \( V_{BE\text{ON}} = 0.4V \), \( V_{CESAT} = 0.2V \), \( R_B = 20k\Omega \), \( R_C = 2k\Omega \) and \( \beta = 100 \). Find \( V_{CE} \) for the following input voltages.
   a. \( V_B = 0.3V \)
   b. \( V_B = 1.0V \)
   c. \( V_B = 1.4V \)
   d. Repeat a-c if there is now a diode with \( V_{on} = 0.7V \) placed between \( R_B \) and the BJT.

2. For the following circuit: \( V_{CC} = 8V \), \( R_C = 2k\Omega \), and \( V_{CESAT} = 0.2V \)
   a. Label the three regions of the \( i_C \) vs. \( V_{CE} \) curves. Hint: what are the regions of operation for a BJT?
   b. What is \( \beta \) of the transistor?
   c. Which of the values of \( i_B \) (20, 40, 60, 80 \( \mu \)A) force the transistor into saturation?

3. For the following circuit, \( V_{CC} = 5.2V \), \( V_{BE\text{ON}} = 0.7V \), \( V_{CESAT} = 0.2V \) \( R_B = 20k\Omega \), \( R_C = 1k\Omega \) and \( \beta = 100 \).
   a. Determine the values of \( V_{CE}, V_{CC}, V_{BE} \), and \( V_{BE\text{ON}} \).
   b. What is the maximum value of \( A \) that keeps the BJT in the active region when:
      i. \( V_I = 1.2 + Asin(\omega t) \)
      ii. \( V_I = 0.9 + Asin(\omega t) \)
      iii. \( V_I = 1.4 + Asin(\omega t) \)
   c. What is the voltage gain in the active region?
4. For the following circuit, \( V_{DD} = 6 \text{V}, R_D = 100 \Omega \) and \( I_I = 5 \text{mA} \).
   a. List the equations for \( I_D \) in the Ohmic and Active regions.
   b. Using the equations from part (a), determine the value of \( k \).
   c. Find the values of \( I_D \) and \( V_{DS} \) when:
      i. \( V_{GS} = 4 \text{V} \) and \( V_{TH} = 2 \text{V} \)
      ii. \( V_{GS} = 5 \text{V} \) and \( V_{TH} = 1 \text{V} \)

\[
C) V_{OC} = V_{DD} = 6 \text{V} \\
I_S = \frac{V_{DD}}{R_D} = \frac{6}{100} = 60 \mu\text{A}
\]
\[
I_{SC} = 60 \mu\text{A} = 1\text{mA}
\]
\[
D) I_D = 16I_1 \\
9I_1 \\
4I_1 \\
I_1 \\
V_{GS} - V_{TH} \\
10 \text{V}
\]
\[
V_{DS} = 1 \text{V}
\]
\[
V_{TH} = 2 \text{V}
\]
\[
I_{DS} = k(V_{GS} - V_{TH})^2 = \left(\frac{5 \text{mA}}{\text{V}^2}\right)^2 = 2.5 \text{mA}
\]
\[
V_{DS} = V_{DD} - I_D R_D = 6 - \left(\frac{2.5 \text{mA}}{100 \Omega}\right) = 6 - 0.025 \times 10^3 \Omega = 5.975 \text{V}
\]

5. Fill in the truth table for the following CMOS circuit where A, B and C are inputs and Z is the output.