5.3 \( I_C = I_s e^{V_{BE}/V_T} \implies I_s = \frac{I_C}{e^{V_{BE}/V_T}} \)

For device 1: \( I_s = \frac{0.2\text{mA}}{e^{0.72V/0.025V}} = 6.21 \times 10^{-17} \text{A} \)

For device 2: \( I_s = \frac{12\text{mA}}{e^{0.72V/0.025V}} = 3.73 \times 10^{-15} \text{A} \)

As \( I_s \) is directly proportional to junction area, the scale currents of the two transistors will have the same ratio as their area.

\[
\frac{\text{Area of Transistor 2}}{\text{Area of Transistor 1}} = \frac{3.73 \times 10^{-15} \text{A}}{6.21 \times 10^{-17} \text{A}} = 60.
\]

5.10 \( I_C = \beta I_B \). As \( \beta \) ranges from 60 to 300, \( I_C \) ranges from \( 60 \times 50\mu\text{A} \) to \( 300 \times 50\mu\text{A} \) = 3 mA to 15 mA.

\( I_E = I_C + I_B \). Therefore, \( I_E \) ranges from 3.05 mA to 15.05 mA.

Maximum power = Max V × Max I = 9 V × 15.05 mA = 135 mW.

5.20 (a) \( I_1 = \frac{10.7V - 0.7V}{10K\Omega} = 1\text{mA} \).

(b) \( I_C = \frac{4V - (-10V)}{2.4K\Omega} = 2.5mA \)

\[ V_2 = 12V - 2.5mA \times 5.6K\Omega = -2V. \]

(c) Because \( \beta \) is very large, we can assume that \( I_B \) is zero, and that \( I_C = I_E \).

\[ I_3 = I_E = I_C = \frac{0V - (-10V)}{10K\Omega} = 1\text{mA}. \]

\[ V_4 = 1V, \text{ as } I_B \text{ is zero.} \]

(d) Because \( \beta \) is very large, we can assume that \( I_B \) is zero, and that \( I_C = I_E \).

Therefore, \( V_{CE} = V_{BE} = 0.7V \).

\[ I_5 = \frac{10V - 0.7V - (-10V)}{15K\Omega + 8K\Omega} = 0.965\text{mA} \]

\[ V_6 = 10V - 0.965mA \times 15K\Omega = -4.475V \]