1. (a) Write the bias equation and solve for $I_C$ and $V_{CB}$ for the values $V^+ = 18 \text{ V}$, $R_E = 1 \text{ k}\Omega$, $R_1 = 130 \text{ k}\Omega$, $R_2 = 36 \text{ k}\Omega$, $R_C = 2.4 \text{ k}\Omega$, $V_{BE} = 0.7 \text{ V}$, and $\beta = 99$. (b) Is the BJT biased in the active mode? $[I_C = 2.474 \text{ mA}, V_{CB} = 8.863 \text{ V}]$

![Circuit Diagram]

2. Add a second npn transistor to the circuit of problem 1 as shown below. (a) Show that $I_{C1}$ does not change. (b) Show that $V_{BB2} = V^+ - I_{C1}R_C$ and $R_{BB2} = R_C$. (c) For $R_3 = 1 \text{ k}\Omega$, and the same $V_{BE}$ and $\beta$ as in problem 1, write the bias equation for the second transistor and solve for $I_{E2}$. (c) Solve for $V_{CB}$ for both transistors and verify they are in the active mode. $[I_{E2} = 11.10 \text{ mA}, V_{CB2} = 6.204 \text{ V}, V_{CB1} = 8.597 \text{ V}]$

![Circuit Diagram]

3. (a) Show that

$$V_{BB} = V^+ \frac{R_2}{R_1 + R_2 + R_C} - I_C \frac{R_C}{R_C + R_1 + R_2} \times R_2 \quad R_{BB} = (R_1 + R_C) \parallel R_2$$

$$V_{CC} = V^+ \frac{R_1 + R_2}{R_C + R_1 + R_2} - I_B \frac{R_2}{R_C + R_1 + R_2} \times R_C \quad R_{CC} = R_C \parallel (R_1 + R_2)$$

(b) For $\beta = 99$ and $\beta = \infty$ and $R_1 = 10 \text{ k}\Omega$, $R_2 = 47 \text{ k}\Omega$, $R_C = 1.5 \text{ k}\Omega$, $R_E = 2 \text{ k}\Omega$, $V_{BE} = 0.7 \text{ V}$, and $V^+ = 9 \text{ V}$, write the bias equation and solve for $I_C$ and $V_{CB}$. Verify that the BJT is biased in the active mode. $[\beta = 99: I_C = 1.968 \text{ mA} \text{ and } V_{CB} = 1.194 \text{ V}, \beta = \infty: I_C = 2.025 \text{ mA}, V_{CB} = 1.019 \text{ V}]$