1. Fill in the blanks in the circuits below and on the next page. You may neglect the base bias current ($I_b$).

a) 
\[ I_C = \quad \quad R_C := 3 \text{k}\Omega \]
\[ V_B := 3.1 \text{V} \quad \quad V_C := 7.4 \text{V} \quad \quad V_{CE} = \quad \quad V_E = \quad \quad R_E := 2 \text{k}\Omega \]

b) 
\[ R_1 := 130 \text{k}\Omega \]
\[ V_B = \quad \quad I_{R2} := 0.12 \text{mA} \quad \quad R_2 := 20 \text{k}\Omega \quad \quad R_C = \quad \quad V_C = \quad \quad V_{CE} := 6.3 \text{V} \quad \quad V_E = \quad \quad R_E = \]

c) 
\[ R_1 = \quad \quad I_C := 5 \text{mA} \quad \quad R_C = \quad \quad V_C := 9 \text{V} \quad \quad V_{CE} = \quad \quad V_E = \quad \quad R_2 := 1.8 \text{k}\Omega \quad \quad R_E := 400 \Omega \]
2. All of these questions refer to the circuit above (problem 1d).
   a) Is the transistor operating in the active region? Show your evidence.  
      Yes    No

   b) If $\beta = 150$, approximately how big is that $I_B$ that we neglected? You may use the $I_C$ found in problem 1d.

   c) Compare this value to $I_{R2}$. Was it reasonable to neglect $I_B$? (if $I_B < 10\%$ of $I_{R2}$, then yes)

   d) If we actually built this circuit, with the resistors above, what effect would the actual $I_B$ have on $I_C$? That is would $I_C$ be lower, higher or the same as you found earlier? Hint: would $V_B$ be higher or lower? Would $V_E$ be higher or lower? Would $I_E$ be higher or lower? Then stick with the $I_C = I_E$ assumption.
      IC would be: lower  higher  same  
      (circle one)

   e) If the $v_s$ signal were applied at the base, an AC signal would also appear at the collector. How much larger would it be. (What is the signal voltage gain).

   **Answers**
   1. a) $V_E = 2.4\, V$, $V_{CE} = 5\, V$, $I_C = 1.2\, mA$, and $V_{CC} = 11\, V$
      b) $V_B = 2.4\, V$, $V_{CC} = 18\, V$, $V_E = 1.7\, V$, $R_E = 425$, $V_C = 8\, V$, $R_C = 2.5\, k$
      c) $V_E = 2.0\, V$, $V_{CE} = 7\, V$, $R_C = 600$, and $V_B = 2.7\, V$, $I_{R2} = 1.5\, mA$, $R_i = 6.2\, k$
      d) $I_E := 11.57\cdot mA$ $V_C := 8.51\cdot V$ $V_{CE} := 5.96\cdot V$ $V_B := 3.246\cdot V$ $I_{R2} := 1.475\cdot mA$ $R_2 := 2.2\cdot k$

   2. a) Yes, $V_{CE} > 0.2\, V$ b) $I_B := 0.077\cdot mA$ c) OK to neglect d) lower e) 3.73