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

a)

\[
\begin{align*}
I_C &= \\
V_{CC} &= \\
V_B &= 3.1 \text{ V} \\
V_C &= 7.4 \text{ V} \\
V_{CE} &= \\
V_E &= \\
R_C &= 3 \text{ k}\Omega \\
R_E &= 2 \text{ k}\Omega \\
\end{align*}
\]

b)

\[
\begin{align*}
R_1 &= 130 \text{ k}\Omega \\
I_C &= 4 \text{ mA} \\
V_{CC} &= \\
V_C &= \\
V_{CE} &= 6.3 \text{ V} \\
V_E &= \\
R_C &= \\
R_E &= \\
V_B &= \\
I_{R2} &= 0.12 \text{ mA} \\
R_2 &= 20 \text{ k}\Omega \\
\end{align*}
\]

c)

\[
\begin{align*}
R_1 &= \\
I_C &= 5 \text{ mA} \\
V_{CC} &= 12 \text{ V} \\
V_C &= 9 \text{ V} \\
V_{CE} &= \\
V_E &= \\
R_C &= \\
R_E &= 400 \text{ } \Omega \\
I_{R2} &= \\
R_2 &= 1.8 \text{ k}\Omega \\
\end{align*}
\]
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 $I_C \approx I_E$ assumption.
      $I_C$ 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) $V_E = 2.4 \text{ V}$,  $V_{CE} = 5 \text{ V}$,  $I_C = 1.2 \text{ mA}$,  and  $V_{CC} = 11 \text{ V}$
   b) $V_B = 2.4 \text{ V}$,  $V_{CC} = 18 \text{ V}$,  $V_E = 1.7 \text{ V}$,  $R_E = 425$,  $V_C = 8 \text{ V}$,  $R_C = 2.5 \text{ k}$
   c) $V_E = 2.0 \text{ V}$,  $V_{CE} = 7 \text{ V}$,  $R_C = 600 \text{ k}$,  and  $V_B = 2.7 \text{ V}$,  $I_{R2} = 1.5 \text{ mA}$,  $R_1 = 6.2 \text{ k}$
   d) $I_E := 11.57 \text{ mA}$  $V_C := 8.51 \text{ V}$  $V_{CE} := 5.96 \text{ V}$  $V_B := 3.246 \text{ V}$  $I_{R2} := 1.475 \text{ mA}$  $R_2 := 2.2 \text{ k}$

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