

## 7.5

Active:  $v_{EB} = 0.7\text{V}$ .

a.)  $i_E = \frac{5\text{V}-0.7\text{V}}{2\text{k}\Omega} = 2.15\text{mA}$ ,  $v_{CB} = 0\text{V}$ ,  $v_{EC} = 0.7\text{V}$ .

b.)  $i_E = \frac{5\text{V}-0.7\text{V}}{2\text{k}\Omega} = 2.15\text{mA}$ ,  $v_{CB} = -5\text{V}$ ,  $v_{EC} = v_{EB} - v_{CB} = 5.7\text{V}$ .

c.)  $i_C = \alpha i_E = i_E$ .  $i_E = \frac{5\text{V}-0.7\text{V}}{2\text{k}\Omega} = 2.15\text{mA}$ ,  $v_{CB} = 2\text{k}\Omega i_E - 5\text{V} = -0.7\text{V}$ ,  
 $v_{EC} = -2\text{k}\Omega i_E + 5\text{V} + 5\text{V} - 2\text{k}\Omega i_E = 1.4\text{V}$ .

## 7.11

Active:  $v_{BE} = 0.7\text{V}$ ,  $i_C = \beta i_B$ .

KVL:  $v_B = \frac{30}{30+60}6\text{V} = 2\text{V}$ .

Parallel resistors:  $\frac{1}{60} + \frac{1}{30} = \frac{3}{60} = \frac{1}{20}$

a.)  $2\text{V} = 20\text{k}\Omega i_B + v_{BE} + 100\Omega(i_B + i_C) \Rightarrow i_B = 43.2\mu\text{A}$ .

b.)  $i_C = 4.32\text{mA} > 0 !!!$

c.)  $v_{CE} = 6\text{V} - 1\text{k}\Omega i_C - 100\Omega(i_B + i_C) = 1.2\text{V}$

i.e.  $v_{CE} > 0.2\text{V}$

## 7.19

Active:  $v_{BE} = 0.7\text{V}$ ,  $i_C = \beta i_B$ .

a.) KVL:  $22\text{k}\Omega i_B + v_{BE} + 2\text{k}\Omega(i_B + i_C) - 5\text{V} = 0 \Rightarrow i_B = 19.2\mu\text{A}$

b.)  $\Rightarrow i_C = 1.92\text{mA}$

c.) KVL:  $v_{CE} + 2\text{k}\Omega(i_B + i_C) - 5\text{V} = 0 \Rightarrow v_{CE} = 1.12\text{V}$

## 7.25

Active:  $v_{BE} = 0.7\text{V}$ ,  $i_C = \beta i_B$ .

Ohm's law:  $i_{B1} = \frac{3\text{V}-0.7\text{V}}{230\text{k}\Omega} = 10\mu\text{A} \Rightarrow i_{C1} = 1\text{mA}$

KVL:  $6\text{V} = 1\text{k}\Omega(i_{C1} + i_{B2}) + 0.7\text{V} + 2\text{k}\Omega(i_{B2} + i_{C2})$

$$\Rightarrow i_{B2} = 21.2\mu\text{A} \Rightarrow i_{C2} = 2.12\text{mA}.$$

$$v_{CE1} = v_{BE1} + 2\text{k}\Omega(i_{B2} + i_{C2}) = 4.98\text{V}$$

$$6\text{V} = v_{CE2} + 2\text{k}\Omega(i_{B2} + i_{C2}) \Rightarrow v_{CE2} = 1.72\text{V}$$

**7.35**

Saturation:  $v_{BE} = 0.8\text{V}$ ,  $v_{CE} = 0.2\text{V}$ .

$$v_{B1} = v_{BE1} + v_{BE2} = 1.6\text{V}$$

$$v_{C1} = v_{CE1} + v_{BE2} = 1.0\text{V}$$

$$i_{B1} = \frac{V_{CC} - v_{B1}}{68\text{k}\Omega} = 50\mu\text{A}$$

$$i_{C1} = \frac{V_{CC} - v_{C1}}{1\text{k}\Omega} = 4\text{mA}$$

$$\beta_1 \geq i_{C1}/i_{B1} = 80$$

$$i_{B2} = i_{B1} + i_{C1} - \frac{v_{BE2}}{210\Omega} = 0.24\text{mA}$$

$$i_{C2} = \frac{V_{CC} - v_{CE2}}{500\Omega} = 9.6\text{mA}$$

$$\beta_2 \geq i_{C2}/i_{B2} = 40$$