Practice Problems #5

1. $v_{BE_1} = 0.74\,V$ $\quad v_{BE_2} = 0.714\,V$

$i_{C_1} = 9.5\,mA$ $\quad i_{C_2} =$ ____

$$\frac{i_{C_2}}{i_{C_1}} = \exp\left(\frac{v_{BE_2} - v_{BE_1}}{V_T}\right)$$

$$i_{C_2} = (9.5)\left(\exp\left(\frac{.714 - .74}{.025}\right)\right)$$

$$\boxed{i_{C_2} = 3.36\,mA}$$

2. $I_B = 0.01\,mA$

$I_C = 0.6\,mA$

$I_E = I_C + I_B$

$\boxed{I_E = 0.61\,mA}$

$I_C = \alpha I_E$

$\alpha = \frac{I_C}{I_E} = 0.984$

$\boxed{\alpha = 0.984}$

$I_B = \frac{I_C}{\beta}$

$\beta = \frac{I_C}{I_B}$

$\boxed{\beta = 60}$

3. $I_C = I_S \exp\left(\frac{V_{BE}}{V_T}\right)$

$= 5 \times 10^{-15} \exp\left(\frac{.64}{.025}\right)$

$\boxed{I_C = 0.656\,mA}$

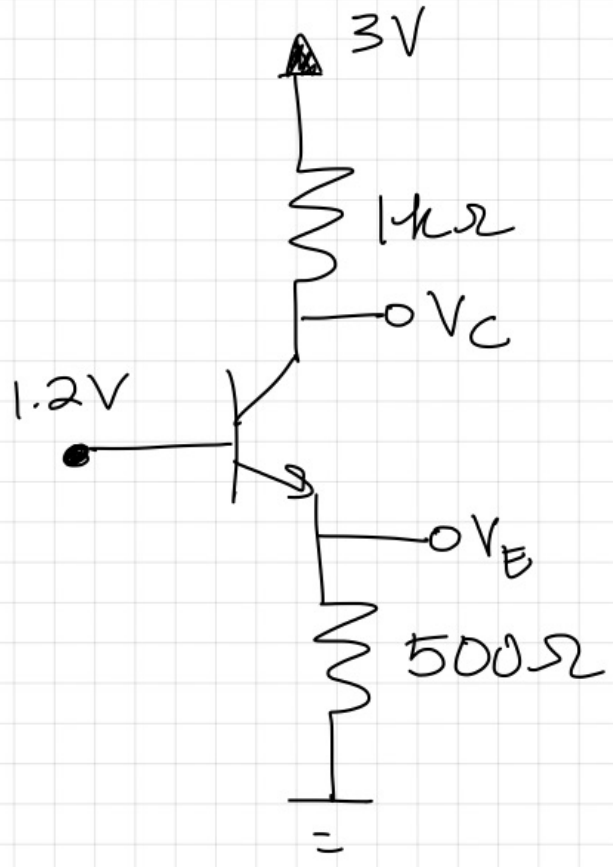
$I_B = \frac{I_C}{\beta} \Rightarrow \frac{.656 \times 10^{-3}}{50}$ to $\frac{.656 \times 10^{-3}}{500}$

$= 13.1\,\mu A$ to $1.31\,\mu A$

$I_E = I_C + I_B$

$I_E \Rightarrow 0.669\,mA$ to $0.657\,mA$

(4) $\beta = 50$ $\quad |V_{BE}| = 0.8V$



$V_B = 1.2V$

$V_E = 0.4V$

$I_E = \frac{V_E}{500}$

$\boxed{I_E = 0.8mA}$

$\alpha = \frac{\beta}{\beta+1} = \frac{50}{51} = 0.98$

$I_C = \alpha I_E$

$\boxed{I_C = 0.78mA}$

$I_C = \frac{3 - V_C}{1k\Omega}$

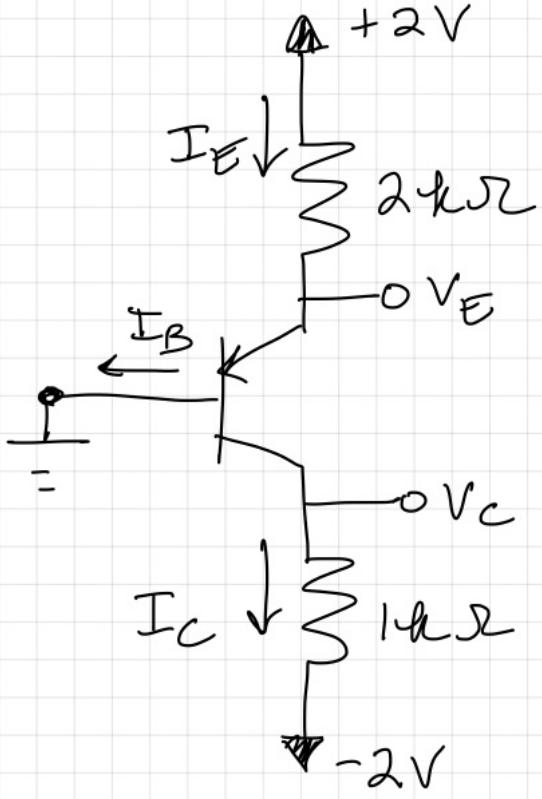
$V_C = 2.22V$

$I_B = I_E - I_C$

$\boxed{I_B = 0.02mA}$

$V_C > V_B > V_E \Rightarrow$ active

(4) cont



$|V_{BE}| = 0.8V$

$\beta = 50$

$V_B = 0$

$V_E - V_B = 0.8V$

$V_E = 0.8V$

$I_E = \frac{2 - V_E}{2000}$

$I_E = 0.6mA$

$\frac{V_C + 2}{1000} = I_C$

$I_C = \alpha I_E = (.98)(.6)$

$V_C = -1.41$

$I_C = 0.59mA$

$V_C < V_B < V_E$

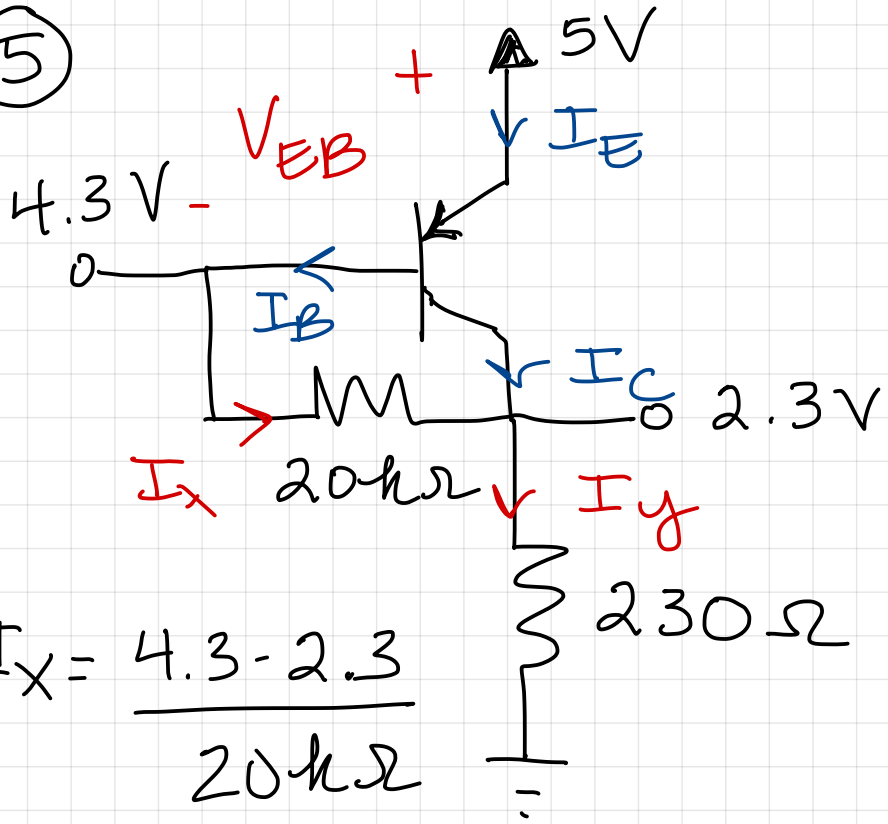
$\Downarrow$

active

$I_B = I_E - I_C$

$I_B = 0.01mA$

(5)



$V_{EB} = 0.7V$

Active

$$I_x = \frac{4.3 - 2.3}{20k\Omega}$$

$I_x = 0.1mA = I_B$

$$I_y = \frac{2.3}{230} = 10mA$$

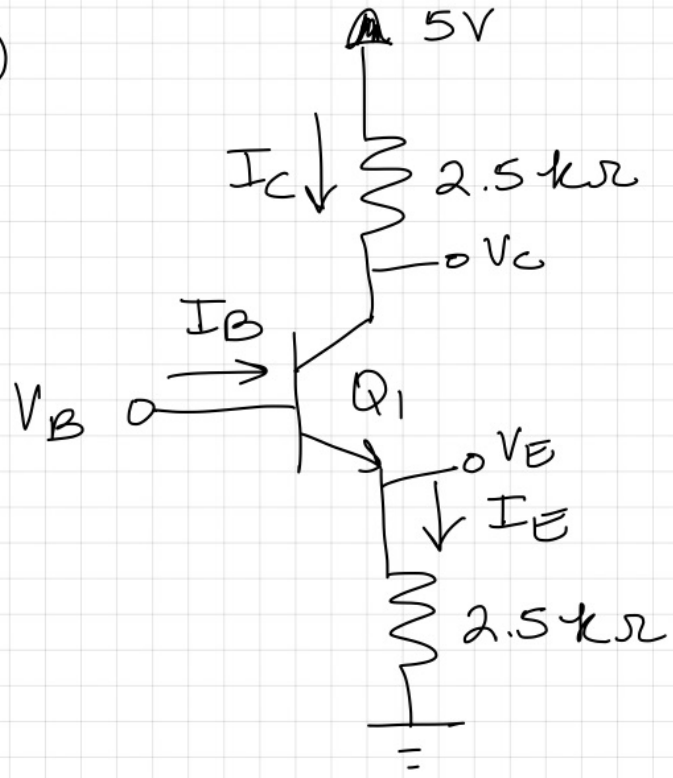
$$\beta = \frac{I_C}{I_B}$$

$\beta = 99$

$I_C = I_y - I_x$

$= 9.9mA$

(6)



$V_{BE} = 0.7V$

$V_E = V_B - V_{BE}$

note: very $\beta \equiv$ large

$I_B = \frac{I_C}{\beta}$

$I_B \to 0$

$I_E \cong I_C$

$\beta = 100$ $(\alpha = 0.99)$

$V_B = 0$

$V_E = -0.7$

$Q_1 \equiv$ cutoff

$V_B = 1V$

$V_E = 0.3V$

$I_E = \frac{.3}{2.5 \times 10^3} = 0.12mA$

$I_C = \alpha I_E = 0.119mA$

$\beta \equiv$ very large

$V_B = 0$

$V_E = -0.7V$

$Q \equiv$ cutoff

$V_B = 1V$

$V_E = 0.3V$

$I_E = 0.12mA$

$I_C \cong 0.12mA$

$I_B \cong 0$

$I_B = I_E - I_C = 0.001\,mA$

$V_B = 2V$

$V_E = 1.3V$

$I_E = \frac{1.3}{2.5 \times 10^3} = 0.52\,mA$

$I_C = \alpha I_E = 0.515\,mA$

$I_B = 0.005\,mA$

$V_B = 2V$

$V_E = 1.3V$

$I_E = 0.52\,mA$

$I_C \cong 0.52\,mA$

$I_B \cong 0$