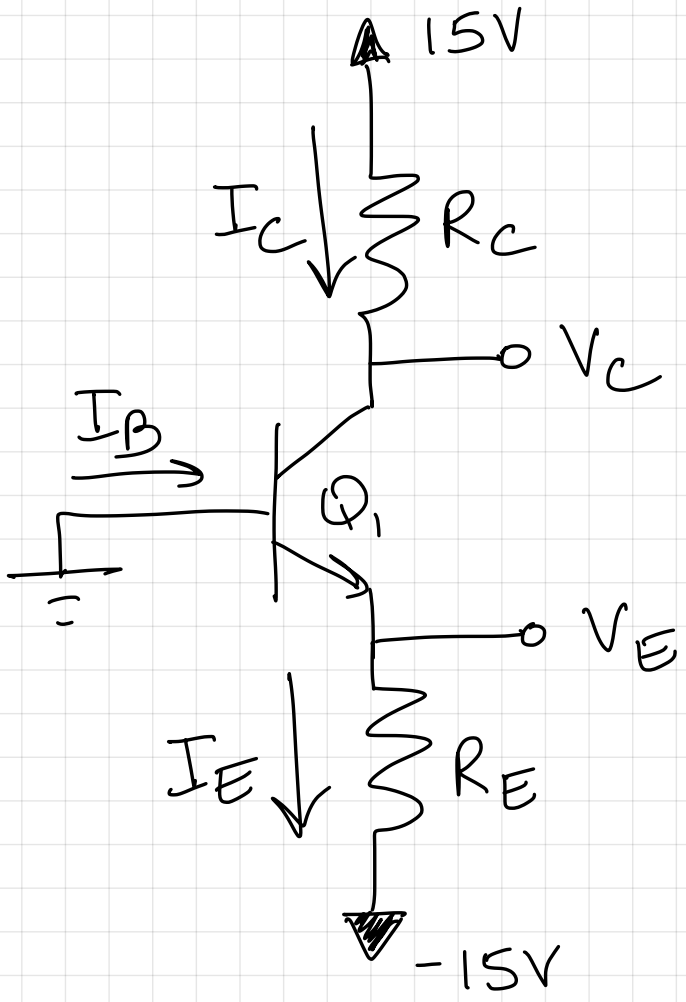
npn => Q_1, Q_2 $\qquad$ $v_C = V_C$



$\beta = 100$

$V_{BE} = 0.7V$
$I_C = 1mA$

What are R_C and R_E for

$I_C = 2mA$
$V_C = 5V$

$V_{CB} > 0$ } $5 - 0 = 5V$

$$R_C = \frac{15 - V_C}{I_C} = \frac{15-5}{2mA} = 5k\Omega$$

$$V_{BE2} - V_{BE1} = V_T \ln\left(\frac{I_{C2}}{I_{C1}}\right)$$

$$V_{BE2} - 0.7 = (.025)\ln\left(\frac{2mA}{1mA}\right)$$

$$V_{BE2} = 0.717V$$

$$V_{BE_2} = \cancel{V_B}^{0} - V_E = 0.717V$$

$$\boxed{V_E = -0.717V}$$

$$R_E = \frac{V_E - (-15)}{I_E}$$

$$I_C = \alpha I_E \qquad \alpha = \frac{\beta}{\beta+1} = \frac{100}{101}$$

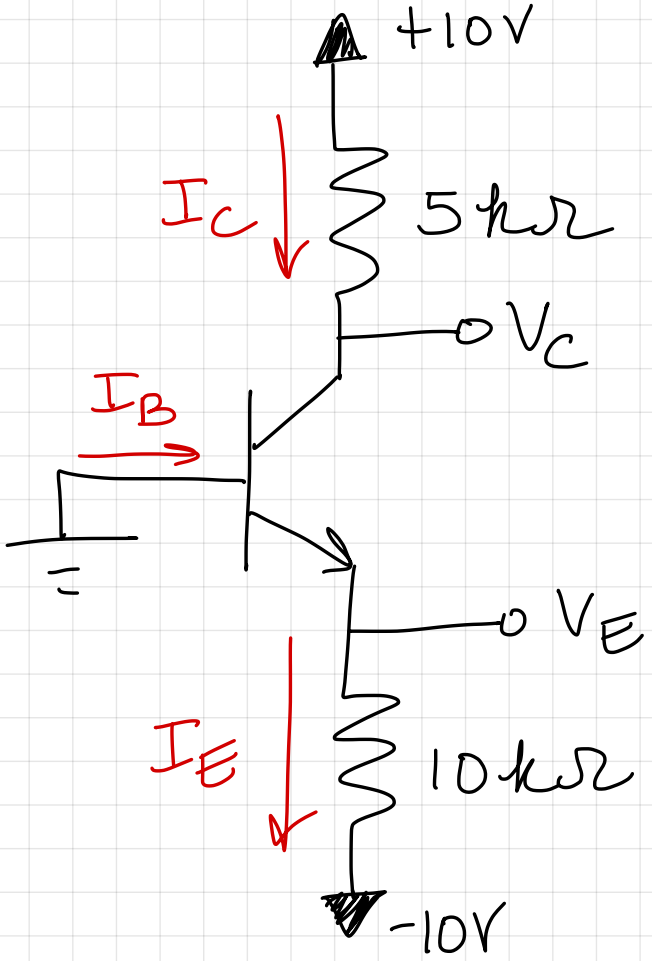
$$\alpha = 0.99$$

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

$$I_E = \frac{2 \times 10^{-3}}{0.99} = 2.02\ mA$$

$$R_E = \frac{-0.717 + 15}{2.02 \times 10^{-3}}$$

$$\boxed{R_E = 7.07\ k\Omega}$$



$\beta = 50$

$V_E = -0.7\,V$

Find I_C, I_B, I_E & V_C.

$$I_E = \frac{V_E - (-10)}{10 \times 10^3}$$

$$= \frac{-0.7 + 10}{10 \times 10^3}$$

$$\boxed{I_E = 0.93\,mA}$$

$$I_C = \alpha I_E$$

$$= \left(\frac{\beta}{\beta+1}\right) I_E$$

$$= \left(\frac{50}{51}\right)(.93\,mA)$$

$$\boxed{I_C = 0.912\,mA}$$

$$I_B = \frac{I_C}{\beta} = \frac{0.912\,mA}{50} = 0.018\,mA$$

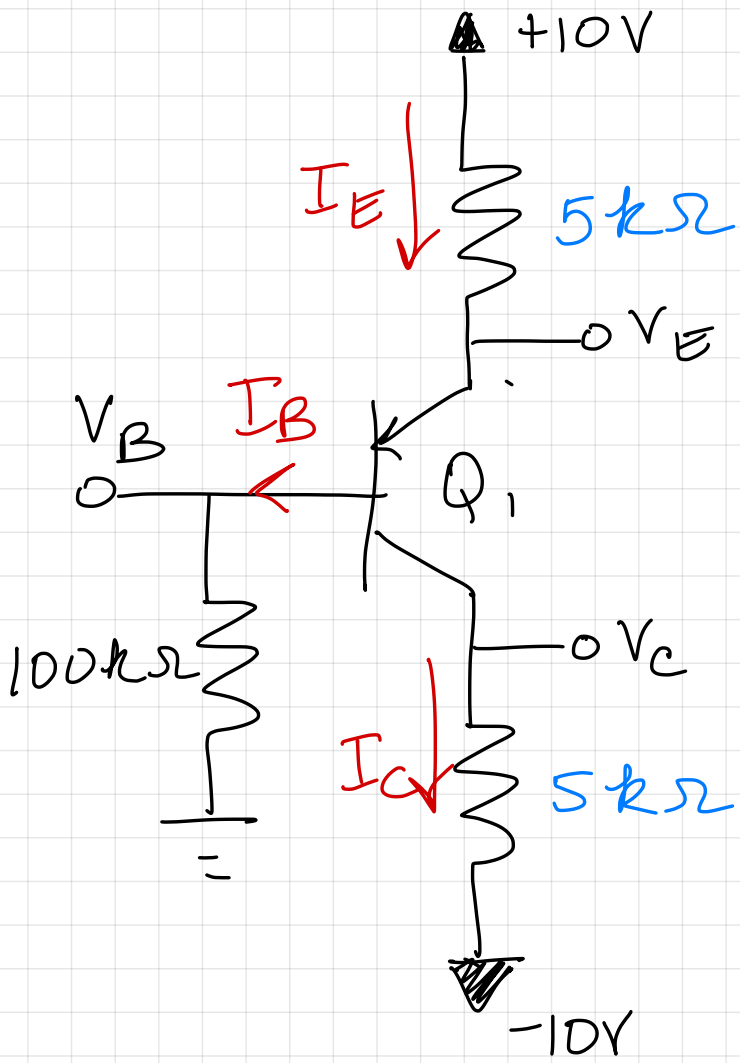
$$I_B = 0.018\,mA$$

$$V_C = 10 - 5 I_C$$

($R\Omega$, mA)

$$= 10 - 5(.912)$$

$$V_C = 5.44\,V$$



$V_B = 1V$

$V_E = 1.7V$

β , α , V_C

$$V_{EB} = 0.7\,V$$

$$I_B = \frac{V_B}{100 \times 10^3} = \frac{1}{100 \times 10^3}$$

$$I_B = 0.01\,mA$$

$$I_E = \frac{10 - V_E}{5 \times 10^3}$$

$$I_E = \frac{10 - 1.7}{5 \times 10^3} = 1.66\ mA$$

$$I_C = I_E - I_B = 1.65 mA$$

$$I_C = \alpha I_E$$

$$\alpha = \frac{I_C}{I_E} = 0.994$$

$$\beta = \frac{I_C}{I_B} = \frac{1.65}{.01} = 165$$

$$I_C = \frac{V_C + 10}{5 \times 10^3}$$

$$V_C = 5 I_C - 10$$

$$V_C = -1.75 V$$

$$V_{BC} = 1 - (-1.75)$$

$$V_{BC} = 2.75V$$

↑

active.