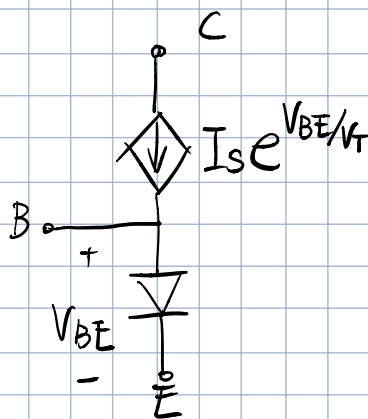


npn BJT

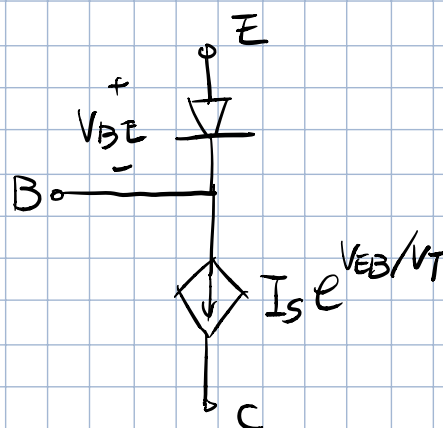
hybrid- $\pi$  model

npn BJT

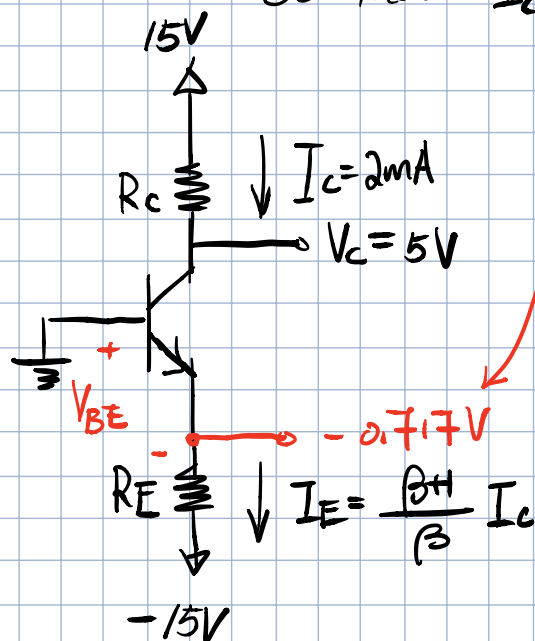


T-model

pnp BJT



Example 1 npn  $\beta=100$ ,  $V_{BE}=0.7V @ 1mA (i_C)$ , design a cet so that  $I_C=2mA$  and  $V_C=5V$



$$V_{BE} = 0.7V + V_T \ln\left(\frac{2mA}{1mA}\right) = 0.717V$$

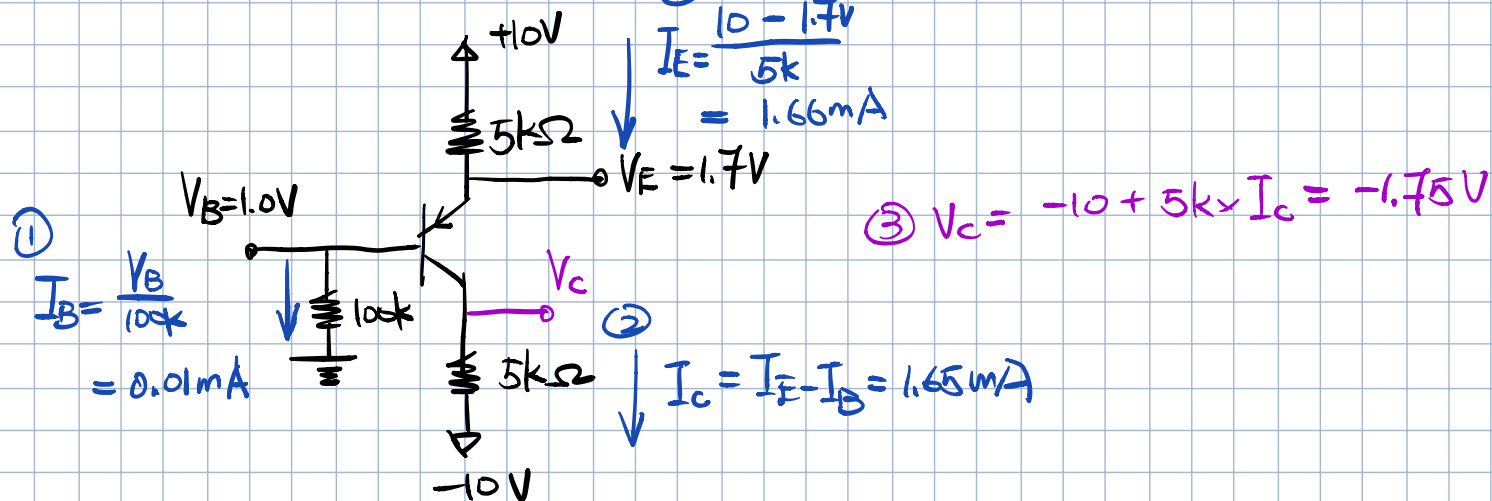
$$R_C = \frac{15 - V_C}{I_C} = \frac{15 - 5V}{2mA} = 5k\Omega$$

$$R_E = \frac{-0.717 - (-15)}{I_E} = \frac{-0.717 + 15}{\frac{100+1}{100} \times I_C} = 7.07k\Omega$$

Example 2 pnp,  $V_B=1.0V$ ,  $V_E=1.7V$ , find  $\alpha, \beta$  and  $V_C$

①

assume active mode.



check  $V_{EC} = 1.7V - (-1.75V) = 3.45V > 0.3V$  (or  $0.2V$ )

⇒ Yes, the transistor is in active mode.

$$\beta = \frac{I_C}{I_B} = \frac{1.65}{0.01} = 165, \quad \alpha = \frac{\beta}{\beta + 1} = 0.994$$