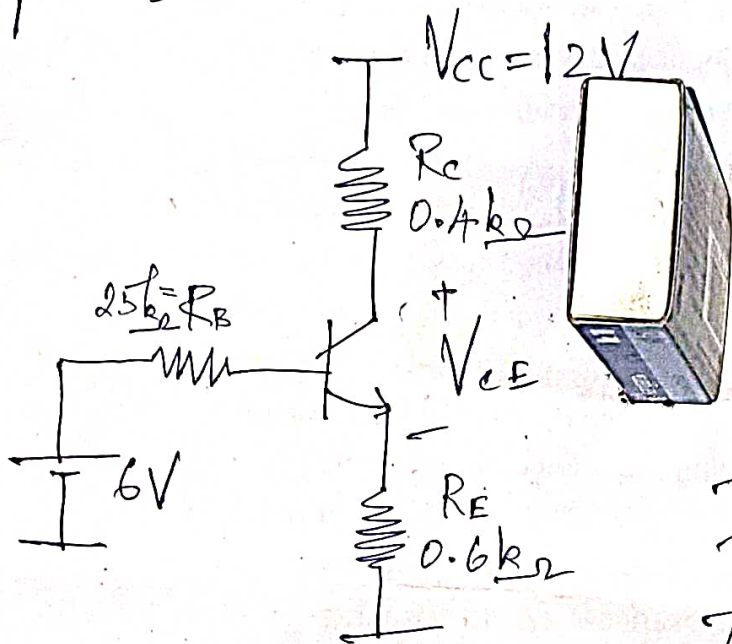


Calculate the characteristics of the a circuit containing an emitter resistor.  $V_{BE(on)} = 0.7V$  and  $\beta = 75$ .



KVL on BE loop

$$I_B = \frac{V_{BB} - V_{BE(on)}}{R_B + (1 + \beta) R_E}$$

$$= \frac{6 - 0.7}{25 + 76(0.6)} = 75 \mu A$$

$$I_C = \beta I_B = 5.63 \text{ mA}$$

$$I_E = (1 + \beta) I_B = 5.71 \text{ mA}$$

$$V_{CE} = V_{CC} - I_C R_C - I_E R_E$$

$$= 12 - 5.63 \times 0.4 - 5.71 \times 0.6 = 6.32 \text{ V}$$

\* Find  $I_B$ ,  $I_C$ ,  $I_E$  and  $V_{CE}$ . Take  $V_{BE(on)} = 0.65V$  and

Assuming FAM  $\beta = 100$

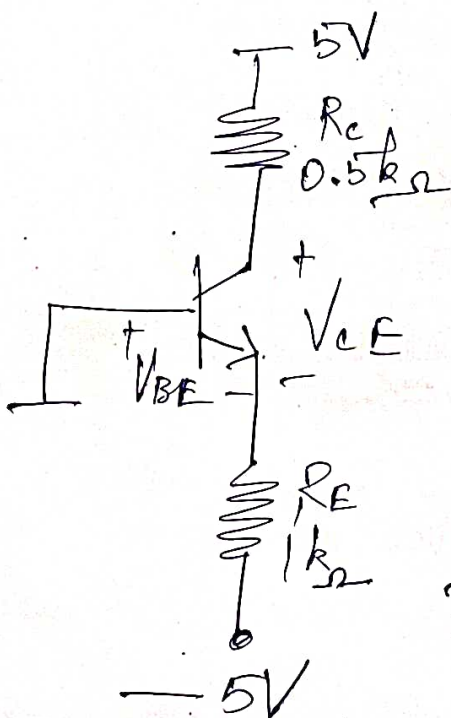
$$0 = V_{BE(on)} + I_E R_E + V_{CE}$$

$$I_E = \frac{-V - V_{BE(on)}}{R_E}$$

$$= \frac{5 - 0.65}{1} = 4.35 \text{ mA}$$

The base current is

$$I_B = \frac{I_E}{1 + \beta} = 43.1 \mu A$$

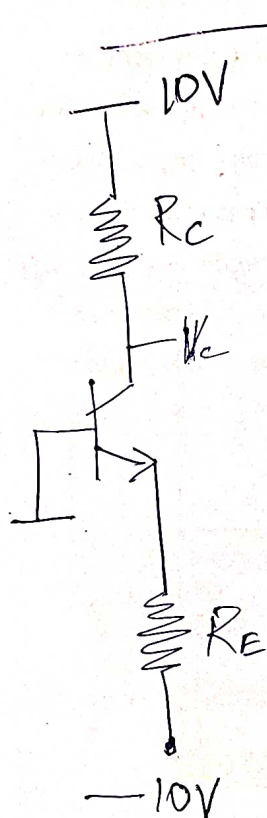
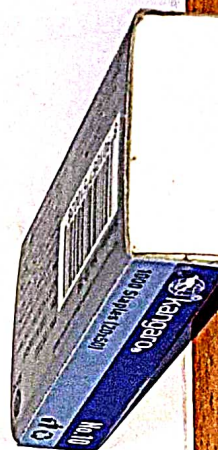


$$I_C = \frac{\beta}{1+\beta} I_E = 4.31 \text{ mA}$$

$$V_{CE} = V^+ - I_C R_C - I_E R_E - V^-$$

$$V_{CE} = 3.5 \text{ V} > V_{CE(\text{sat})}$$

Hence in FAM as assumed.



Design the circuit such that  $I_C = 1.5 \text{ mA}$  and  $V_C = +4 \text{ V}$ . Consider  $\beta = 100$ ,  $V_{BE(\text{on})} = 0.7 \text{ V}$ . FAM operation.

$$I_E = \frac{\beta}{\beta+1} I_C = 1.485 \text{ mA}$$

$$0 = V_{BE(\text{on})} + I_E R_E + V^-$$

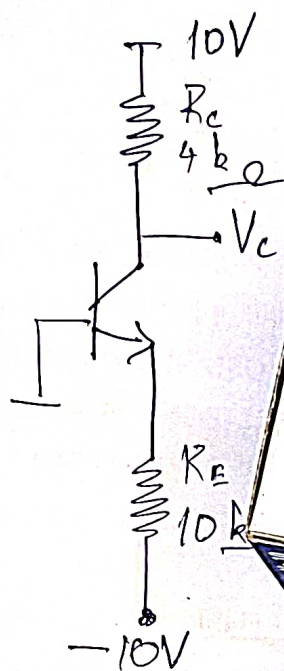
$$\frac{10 - 0.7}{I_E} = R_E = 6.262 \text{ k}\Omega$$

$$10 = I_C R_C + V_{CE} + I_E R_E + (-10)$$

$$20 - 9.3 = V_{CE} = I_C R_C$$

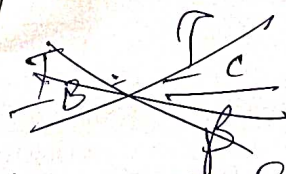
$$= 4.466 \text{ k}\Omega$$

\*



For the circuit shown, the measured value of  $V_c$  is  $V_c = 6.34V$ . Determine  $I_B$ ,  $I_E$ ,  $I_C$ ,  $V_{CE}$ ,  $\beta$  and  $\alpha$ . ( $V_{BE(on)} = 0.7V$ )

$$I_C = \frac{10 - V_c}{R_c} = \frac{10 - 6.34}{4k} = 0.915mA$$



~~$$10 = I_C R_c + V_{CE} + I_E R_E + (-10)$$~~

$$0 = 0.7 + I_E R_E + (-10)$$

$$I_E = \frac{10 - 0.7}{10k} = 0.93mA$$

$$I_B = I_E - I_C = 15\mu A$$

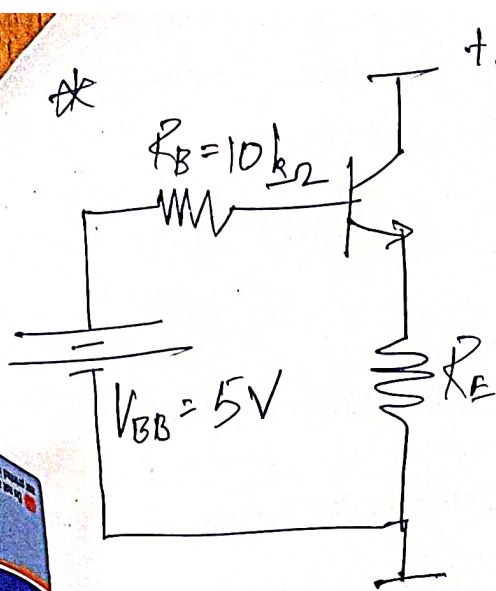
$$\alpha = \frac{I_C}{I_E} = 0.98387$$

$$\beta = \frac{\alpha}{1 - \alpha} = 61$$

~~$$10 = I_C R_c + V_{CE} + I_E R_E + (-10)$$~~

$$V_{CE} = 10 + 10 - I_C R_c - I_E R_E = 20 - 20 = 0$$

$$V_{CE} = 7.04V$$



Find  $R_E$  if  $V_{CE} = 2.5V$   
and  $\beta = 100$ ,  $V_{BE(on)} = 0.7V$ .

$$I_E R_E = 2.5V$$

$$V_{BB} = I_B R_B + V_{BE(on)} + I_E R_E$$

$$\frac{5 - 0.7 - 2.5}{R_B} = I_B$$

$$\Rightarrow I_B = 180 \mu A$$

$$R_E = \frac{2.5}{\beta + 1 I_B}$$

$$= \frac{2.5}{101 \times 180 \mu} = 137.51 \Omega$$