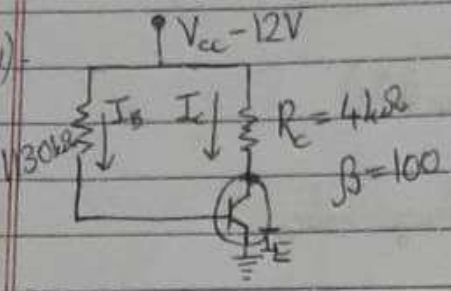
Tutorial-2

(Q-1)



i) $12 - I_B(1130) - 0.7 = 0$

$\Rightarrow \frac{1130}{11300} = I_B$

$\Rightarrow 0.01mA = I_B$

ii) $I_C = \beta I_B = 1mA$

iii) $V_C = 12 - 4 = 8V$

$V_B = 12 - 11.30 = 0.7$

$V_{CB} = 8 - 0.7 = \underline{7.3V}$

iv) $V_{cc} - I_C R_C = V_{CE}$

$\Rightarrow V_{CE} = 12 - 1 \times 4 = 8V$

Q-point $\equiv (8V, 1mA)$

$S = (\beta + 1)$ [Basic Resistor method]

$\underline{S = 101}$

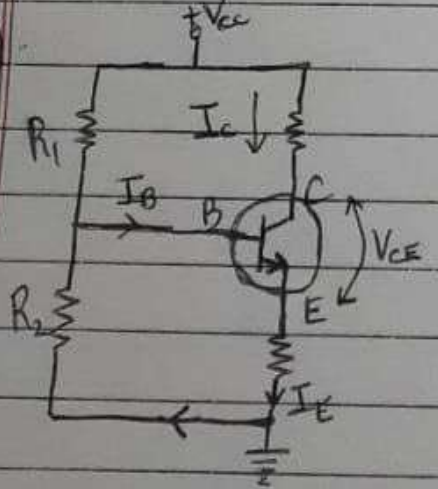
2) $\alpha = 0.97$, $\Delta I_C = 1.6mA$

$\Delta I = 30 \Rightarrow \Delta I_{CBO} = 1.7 \times 30 = 57\mu A$

$S = \frac{\Delta I_C}{\Delta I_{CBO}} = \frac{1.6 \times 10^{-3} A}{51 \times 10^{-6} A}$

$\Rightarrow \underline{S = 31.4}$

3)



$V_{cc} = 16V$, $R_2 = 30k\Omega$, $R_E = 1k\Omega$

$V_{BE} = 0.2V$, $I_E = 2mA$, $\alpha_0 = 0.985$

$V_{CE} = 6V$

$\beta = \frac{\alpha}{1-\alpha} = \frac{0.985}{0.015} = \underline{65.67}$

$I_C = (\beta + 1) I_B$, $I_B = \frac{2}{66.67} = 30\mu A$

$$\Rightarrow I_c = \beta I_B = \underline{1.97mA}$$

$$V_{cc} - I_{BR_1} - V_{BE} - I_E R_E = 0$$

$$R_1 = \frac{V_{cc} - V_{BE} - I_E R_E}{I_B}$$

$$\Rightarrow R_1 = \frac{16 - 0.2 - 2\times 1}{0.03} = \underline{460k\Omega}$$

$$V_{cc} - I_c R_c - V_{CE} - I_E R_E = 0$$

$$R_c = \frac{13.8}{1.97}\ k\Omega = \underline{7k\Omega}$$

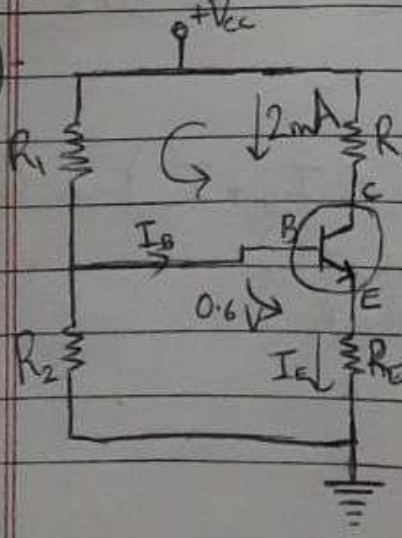
$$S = \frac{1+\beta}{1-\beta\left(\frac{\partial I_B}{\partial I_c}\right)}$$

$$R_{th} = \frac{R_1 R_2}{R_1+R_2} = \frac{460\times 30}{490} = \underline{28.16k\Omega}, \quad S = \frac{\beta+1}{1+\beta\left(\frac{R_E}{R_E+R_{th}}\right)}$$

$$\Rightarrow S = \frac{65.67+1}{1+65.67\left(\frac{1}{1+28.16}\right)}$$

$$\Rightarrow S = \frac{66.67}{3.25} = \underline{20.513}$$

4)-



$V_{cc} = 8V$, $I_c = 2mA$

$\beta = 50$

$$I_c = \beta I_B \Rightarrow I_B = \frac{2}{50} = \underline{0.04mA}$$

$$I_E = (\beta+1) I_B = \underline{2.04mA}$$

$$20 - 9.4 - 8 - 2.04\,mA \times R_E = 0$$

$$R_E = 102.7\,k\Omega$$

$$\Rightarrow 20 - 0.04R_1 - 0.6 - 2.6 = 0$$

$$\Rightarrow R_1 = 420\,k\Omega$$

$$S \leq 5 \quad \Rightarrow \quad \frac{\beta+1}{1+\beta\left(\frac{R_E}{R_E+R_{th}}\right)} \leq 5$$

$$\Rightarrow \frac{51}{1+50\left(\frac{1.27}{R_{th}+1.27}\right)} \leq 5$$

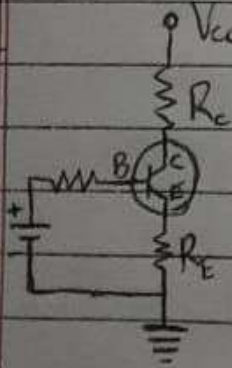
$$\Rightarrow 51 \leq 5 \Rightarrow \frac{63.5}{R_{th}+1.27} = 10.1$$

$$\Rightarrow R_{th} = 5.63\,k\Omega$$

$$\frac{R_1 R_2}{R_1+R_2} = 5.63$$

$$\Rightarrow R_2 = \frac{2364.6}{414.37} = 5.7\,k\Omega$$

5)



$$R_{th} = \frac{10 \times 90}{100} = 9\,k\Omega$$

$$V_{th} = \frac{90 \times 22.5}{90+10} = 20.25\,V$$

By KVL,

$$20.25 - 9I_B - (I_B + I_C) = 0$$

Let $I_B = x$

$$\Rightarrow 20.25 - 65x = 0$$

$$\Rightarrow x = 0.311\,mA$$

$$I_C = \beta I_B$$

$\Rightarrow I_C = 55x = 17.1\,mA$

$$S = \frac{\beta+1}{1+\beta\left(\frac{R_E}{R_E+R_{th}}\right)} = \frac{56}{1+55\left(\frac{1}{1+R_{th}}\right)}$$

$$\Rightarrow R_{th} = \frac{R_1 R_2}{R_1+R_2} = \frac{90\times 10}{90+10} = 9k\Omega$$

$$\Rightarrow S = \frac{56}{6.5} = \underline{8.6}$$

$$I_E = (\beta+1) I_B = 56 \times 0.311\,mA = 17.416\,mA$$

KVL on outer loop,

$\Rightarrow I_C R_C = V_{cc}$

$\Rightarrow V_{cc} = I_C R_C + V_{CE} + I_E R_E$

$\Rightarrow V_{EE} = 22.5 - (17.1)(5.6) - (17.416)$

$= \underline{-90.676\,mA}$

$\Rightarrow Q_{point} \equiv (-90.676, 17.1)$