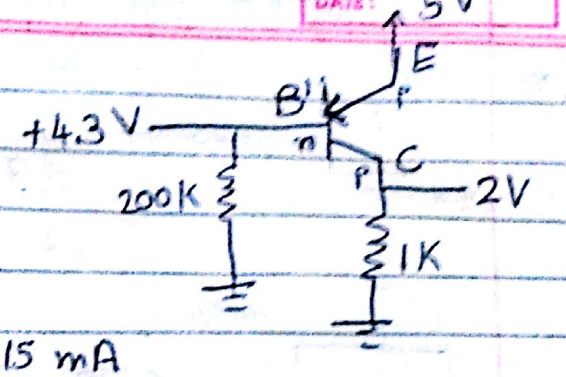
6.29 (a) $V_{EB} = 0.7\,V$ (FB), $V_{BC} = 2.3\,V$ (RB) } FA

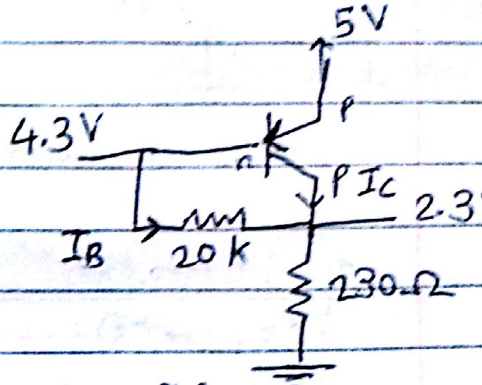


$I_C = \frac{2}{1K} = 2\,mA, \quad I_B = \frac{4.3}{200K}$

$= 0.0215\,mA$

$\beta = \frac{I_C}{I_B} = \frac{2}{0.0215} = \underline{93}$

(b) based upon the biasing: FA



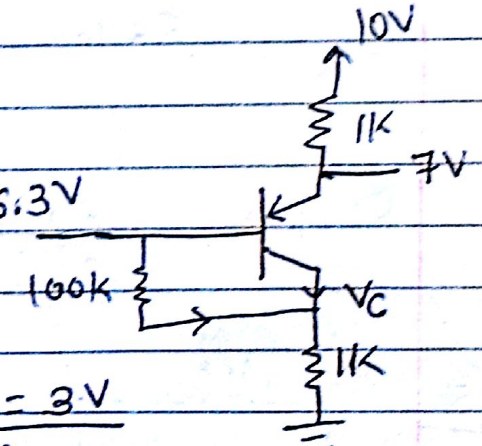
$I_E = I_B + I_C = \frac{2.3}{230}$

$= 10\,mA$

$I_B = \frac{4.3 - 2.3}{20K} = \frac{2}{20K} = 0.1\,mA, \quad I_C = 9.9\,mA$

$\beta = \frac{I_C}{I_B} = \frac{9.9}{0.1} = \underline{99}$

(c) $I_E = \frac{10 - 7}{1K} = \underline{3\,mA}$



~~assuming FA,~~ $\frac{6.3 - V_C}{100K} = I_B$

$\frac{V_C}{1K} = I_B + I_C = I_E = 3\,mA \Rightarrow \underline{V_C = 3\,V}$

$I_B = \frac{3.3}{100K} = 0.033\,mA$

$I_C = 2.967\,mA$

$\beta = \frac{I_C}{I_B} = \frac{2.967}{0.033} = \underline{89.9}$

6.3 $I_C = I_S e^{V_{BE}/V_T}, \quad 100\,\mu A = I_S e^{28}$

$\Rightarrow \underline{I_S = 6.9 \times 10^{-17}\,A}$ (sat^n current)

with E Junction 32 times larger, $I_S = 32 * 6.9 * 10^{-17}$.

Since $I_S \propto A_E$

$I_C = I_S e^{V_{BE}/V_T} = 220.8 \times 10^{-17} e^{28} = \underline{3200\,\mu A}$

$1\,mA = 220.8 \times 10^{-17} e^{V_{BE}/V_T} \Rightarrow 4.5 * 10^{11} = e^{V_{BE}/V_T}$

$\Rightarrow \underline{V_{BE} = 0.67\,V}$

6.17 $\beta = 100$, $I_S = 10^{-15}$ A

assuming FA. $V_E = -0.7$ V

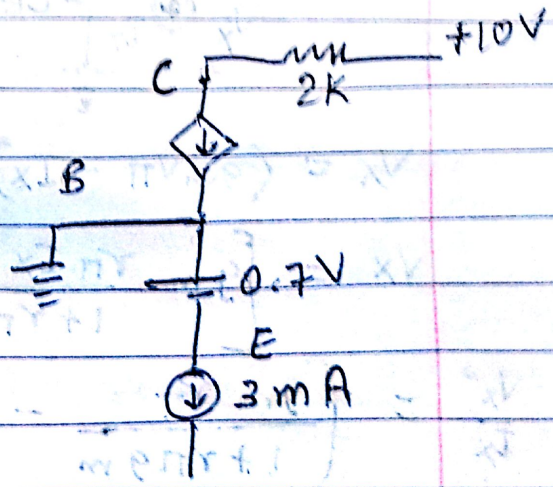
$I_E = 3$ mA

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

$$= \frac{100}{101}(3) = 2.97 \text{ mA}$$

$V_C = 10 - 2\text{K}(2.97\text{ mA}) = 4.06$ V

$I_B = I_E - I_C = 3 - 2.97 = 0.03$ mA



$V_{CE} = 4.76\text{V} > 0.2\text{V}$

confirm: FA

6.28 (a) $V_{EB} = 0.7$ EBJ : FB

assume FA $\quad I_1 = \frac{10.7 - 0.7}{10K} = 1\ mA$

$\beta \to$ large $\quad I_C \approx I_E = 1\ mA$

$$\frac{V_2 - (-10.7)}{10K} = 1\ mA$$

$$V_2 + 10.7 = 10 \Rightarrow V_2 = -0.7\ V$$

$V_{CE} = V_2 - 0.7 = -0.7 - 0.7 = -1.4 < -0.2\ V$

confirmed : FA

(b) $V_{CB} = -4 - (-2.7) = -4 + 2.7 = -1.3$ (RB)

assume FA

$$I_C = \frac{-4 - (-10)}{2.4\ k} = \frac{6}{2.4K} = 2.5\ mA$$

$I_E \approx I_C = 2.5\ mA \qquad \frac{12 - V_3}{5.6\ k} = 2.5$

$\Rightarrow V_3 = -2\ V$

$V_{EB} = -2 - (-2.7) = 0.7\ V$ (FB)

$V_{CE} = -4 - (-2) = -2\ V < -0.2\ V$

confirmed : FA

(c) β large, assume $I_B \approx 0 \Rightarrow V_4 = 1\ V$

assume FA

$$I_C = \frac{0 - (-10)}{10K} = 1\ mA$$

$I_S = I_E \approx I_C = 1\ mA$

$V_{CB} = -1\ V$ (RB)

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(cd) $I_B \approx 0$ ~~$V_7 = 0.7V$~~ $V_7 \approx V_B$

$V_{BE} = 0.7\,V$ (given) (FB)

$\frac{10 - V_7}{15K} = I_E$ and $\frac{V_E - (-10)}{5K} = I_E = I_6$

$\frac{10 - V_7}{15\ 3} = \frac{V_E + 10}{5} \Rightarrow 10 - V_7 = 3V_E + 30$

$V_{BE} = 0.7 \Rightarrow V_7 - V_E = 0.7$

$10 - [V_E + 0.7] = 3V_E + 30$

$\Rightarrow 9.3 = 4V_E + 30 \Rightarrow V_E = -5.175\,V$

$V_7 = V_B = -4.475V$ $\quad I_6 = \frac{10 - 5.175}{5K}$

$= 0.965\ mA$

6.35 (a) $V_B = 0V$, $V_{BE} = 0.8V \Rightarrow V_E = -0.8V$

$$I_E = \frac{-0.8 - (-1.5)}{2.2K} = 0.318\ mA$$

$$\alpha = \frac{\beta}{\beta+1} = \frac{50}{51} \qquad I_C = \alpha I_E = \frac{50}{51}(0.318) = 0.312\ mA$$

$$\frac{1.5 - V_C}{2.2K} = I_C \Rightarrow V_C = 1.5 - 0.69 = 0.81\ V$$

$$I_B = \frac{I_C}{\beta} = \frac{0.312}{50} = 6.24 \times 10^{-3}\ mA$$

(b) $V_B = 0V$, $V_{EB} = 0.8V$, $V_E = 0.8V$

$$\frac{1.5 - 0.8}{1K} = 0.7\ mA = I_E \qquad I_C = \alpha I_E = \frac{0.69}{mA}$$

$$\frac{V_C + 1.5}{1} = 0.69 \Rightarrow V_C = -0.81\ V \qquad I_B = \frac{I_C}{\beta} = \frac{13.8 \times 10^{-3}}{mA}$$

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c) $V_B = 1V$ $\quad V_{EB} = 0.8 \Rightarrow V_E = 1.8V$

$I_E = \frac{3 - 1.8}{1.1K} = 1.2\ mA$ $\quad I_C = \alpha I_E = 1.18\ mA$

$V_C = I_C (0.56) = 0.66\ V$

$I_B = \frac{I_C}{\beta} = 23.6 \times 10^{-3}\ mA$

d) $V_B = 1.5V$ $\quad V_{BE} = 0.8 \Rightarrow V_E = 0.8V$

$I_E = \frac{V_E}{0.47} = 1.7\ mA$ $\quad I_C = \alpha I_E = 1.67\ mA$

$\frac{3 - V_C}{1} = 1.67 \Rightarrow V_C = 1.33V$

$I_B = \frac{I_C}{\beta} = 33.4 \times 10^{-3}\ mA$