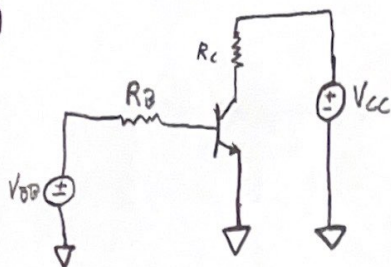


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1)



$$V_{CC} = 5V, V_{BE(on)} = 0.7V, V_{CE(sat)} = 0.2V$$

$$R_B = 10k\Omega, R_C = 1k\Omega, \beta = 100$$

Find operating region for each voltage.

a) $V_{BB} = 0V$ $V_{BB} < V_{BE(on)} \Rightarrow 0 < .7$

\therefore BJT in cutoff region a

b) $V_{BB} = 1V$, assume forward active as $V_{BB} > V_{BE(on)}$

$$\Rightarrow i_B = \frac{V_{BB} - V_{BE(on)}}{R_B} = \frac{1 - .7}{10k} = .03mA \Rightarrow i_C = \beta i_B = (100)(.03mA) = 3mA$$

$$V_{CE} = V_{CC} - R_C i_C = 5V - (1k\Omega)(3mA) = 5 - 3 = 2V > V_{CE(sat)}$$

$$V_{CE} > V_{CE(sat)} \quad 2V > .2V \quad \therefore \text{forward active} \quad b$$

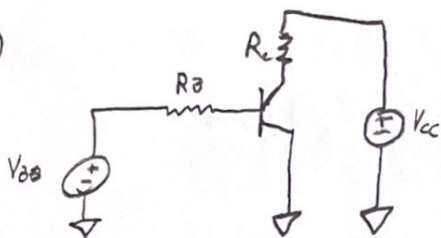
c) $V_{BB} = 4V$, assume forward active as $V_{BB} > V_{BE(on)}$

$$\Rightarrow i_B = \frac{V_{BB} - V_{BE(on)}}{R_B} = \frac{4 - .7}{10k} = .33mA \Rightarrow i_C = \beta i_B = (100)(.33mA) = 33mA$$

$$V_{CE} = V_{CC} - R_C i_C = 5V - (1k\Omega)(33mA) = 5 - 33 = -28 < V_{CE(sat)}$$

$$V_{CE} < V_{CE(sat)} \quad -28V < .2V \quad \therefore \text{saturated} \quad c$$

2)



$$V_{BB} = 1.2V, V_{CC} = 10V, V_{BE(on)} = 0.7V, V_{CE(sat)} = 0.2V$$

$$R_B = 10k\Omega, \beta = 100$$

Find operating region for each R_C value

a) $R_C = 1.4k\Omega$

$$\Rightarrow i_B = \frac{V_{BB} - V_{BE(on)}}{R_B} = \frac{1.2 - 0.7}{10 \times 10^3} = 0.05 \text{ mA} \Rightarrow i_C = \beta i_B = (100)(0.05 \text{ mA}) = 5 \text{ mA}$$

$$V_{CE} = V_{CC} - i_C R_C = 10V - (5 \text{ mA})(1.4k\Omega) = 3V$$

$$V_{CE} = 3V > V_{CE(sat)} = 0.2V \quad \therefore \text{active} \quad a$$

b) $R_C = 0.5k\Omega$

$$\Rightarrow V_{CE} = V_{CC} - i_C R_C = 10V - (5 \text{ mA})(0.5k\Omega) = 7.5V$$

$$V_{CE} = 7.5V > V_{CE(sat)} = 0.2V \quad \therefore \text{active} \quad b$$