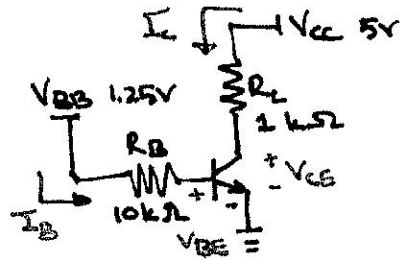
DEC 2 Refresher



First, check if the BJT is in cutoff:

* $V_{BE} \geq 0.7$ V, $I_B \geq 0$ A
  assumption

$\therefore \frac{V_{BB} - V_{BE}}{R_B} = I_B = \frac{1.25 - 0.7}{10\,k} = 55\mu A$

$\therefore$ not in cutoff.

* $\beta \approx 100$ → $I_C = \beta I_B = 5.5$ mA.
  assumption

To be in forward active mode, $V_{CE} \geq 0.2$ V.

$\therefore V_{CC} - I_C R_C - V_{CE} = 0 \rightarrow V_{CC} - I_C R_C = V_{CE} \rightarrow 5 - 5.5 = V_{CE} = -0.5$V.

$\therefore$ not in forward active mode; we are in saturation mode.

To push into forward active, let $V_{CE} = 0.3$ V, backsolve for V_{BB}.

$\therefore \frac{V_{CC} - V_{CE}}{R_C} = I_C \rightarrow \frac{4.7}{1000} = 4.7\,mA \rightarrow I_B = \frac{I_C}{\beta} = 47\mu A.$

$\therefore V_{BB} = I_B R_B + V_{BE} = 47 \times 10^{-6} \times 10 \times 10^{3} + 0.7 = 1.17$ V.

$\therefore V_{BB}$ can be within the range, $0.71 < V_{BB} < 1.17$ [V] to keep in forward active mode.