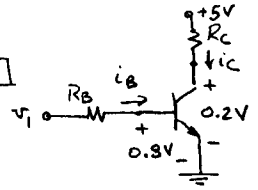
7.30




For saturation, $v_{BE} = 0.8\,V$
$v_{CE} = 0.2\,V$

(a) $i_B = \frac{v_i - v_{BE}}{R_B} = \frac{5-0.8}{50k} = \frac{4.2}{50k} = 84\,\mu A$

$i_C = \frac{V_{CC} - v_{CE}}{R_C} = \frac{5-0.2}{1k} = 4.8\,mA$

$\therefore h_{FE} \geq \frac{i_C}{i_B} = \frac{4.8m}{84\mu} = \underline{57.1}$

(b) As in part (a), $i_B = 84\,\mu A$

$i_C = \frac{V_{CC} - v_{CE}}{R_C} = \frac{5-0.2}{R_C} = \frac{4.8}{R_C}$

$h_{FE} i_B \geq i_C$

$100(84\mu) \geq \frac{4.8}{R_C} \Rightarrow R_C \geq \frac{4.8}{100(84\mu)} = \underline{571\,\Omega}$

(c) $i_B = \frac{v_i - v_{BE}}{R_B} = \frac{5-0.8}{R_B} = \frac{4.2}{R_B}$

As in part (a), $i_C = 4.8\,mA$

$h_{FE} i_B \geq i_C$

$100\left(\frac{4.2}{R_B}\right) \geq 4.8m \Rightarrow \frac{100(4.2)}{4.8m} \geq R_B \Rightarrow R_B \leq \underline{87.5\,k\Omega}$

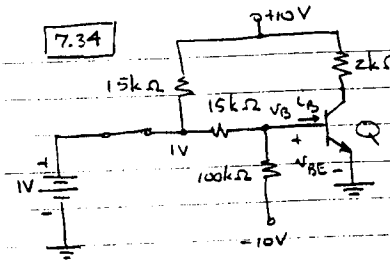
(d) $i_B = \frac{v_i - v_{BE}}{R_B} = \frac{v_i - 0.8}{50k}$ · As in Part (a), $i_C = 4.8\,mA$

$h_{FE} i_B \geq i_C$

$100\left(\frac{v_i - 0.8}{50k}\right) \geq 4.8m$

$v_i \geq \frac{4.8m}{100}(50k) + 0.8 = 2.4 + 0.8 = \underline{3.2\,V}$

7.34




(a) Assume Q is OFF.

Then, $i_B = 0$.

By KCL at node $v_B$,

$\frac{1 - v_B}{15k} = \frac{v_B - (-10)}{100k}$

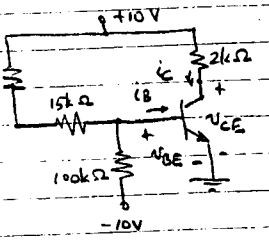
$100(1 - v_B) = 15(v_B + 10)$

$100 - 100 v_B = 15 v_B + 150$

$-115 v_B = 50$

$v_B = -\frac{50}{115} = -0.43\,V$

Since $v_{BE} = v_B = -0.43\,V < V_\gamma = 0.5\,V$, then Q is indeed OFF.




Assume Q is ON.

Then $v_{BE} = 0.8\,V$, $v_{CE} = 0.2\,V$

By KCL,

$i_B = \frac{10 - 0.8}{15k + 15k} + \frac{-10 - 0.8}{100k}$

$i_B = \frac{9.2}{30k} - \frac{10.8}{100k} = 199\,\mu A$

$i_C = \frac{10 - 0.2}{2k} = \frac{9.8}{2k} = 4.9\,mA$

For Q to be ON,

$h_{FE} \geq \frac{i_C}{i_B} = \frac{4.9m}{199\mu} = \underline{24.6}$