Ex:

Using superposition, derive an expression for \( v_2 \) that contains no circuit quantities other than \( i_s, v_s, R_1, R_2, \) and \( \beta \) where \( \beta > 0 \).

SOL’N:

\[
\begin{align*}
\text{Using } V_s=\text{on and } i_s=\text{off (open):} \\
\text{The remaining circuit is a voltage divider because the current through } R_1 \text{ is the same as that through } R_2. \\
V_2 &= \frac{-V_s R_2}{R_1 + R_2} \\
\text{(solution #1)}
\end{align*}
\]

\[
\begin{align*}
\text{Using } V_s=\text{off (wire) and } i_s=\text{on:} \\
\text{The resulting circuit is a current divider where } \beta i_s \\
\text{Divides between } R_1 \text{ and } R_2. \\
V_2 &= \frac{\beta i_s R_1}{R_1 + R_2} R_2 \\
\text{(solution #2)}
\end{align*}
\]

Total is the summation of both solutions:

\[
V_2 = \frac{-V_s R_2}{R_1 + R_2} + \frac{\beta i_s R_1}{R_1 + R_2} R_2
\]

or \( v_2 = \frac{-v_s R_2 + \beta i_s R_1 R_2}{R_1 + R_2} \) since \( i_x = i_s \)