EE304 – Problem Set 4

Problem 8.11 [S&S 7/e]

8.11 Consider the basic BJT current mirror of Fig. 8.7 when Q_1 and Q_2 are matched and $I_{REF} = 1$ mA. Neglecting the effect of finite β, find the change in I_o, both as an absolute value and as a percentage, corresponding to V_o changing from 1 V to 10 V. The Early voltage is 90 V.

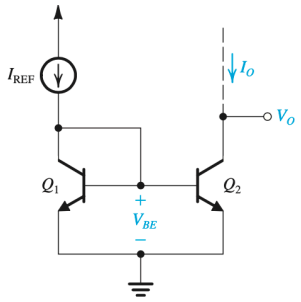

Figure 8.7 The basic BJT current mirror.

Problem 8.12 [S&S 7/e]

D 8.12 The current-source circuit of Fig. P8.12 utilizes a pair of matched *pnp* transistors having $I_S = 10^{-15}$ A, $\beta = 50$, and $|V_A| = 50$ V. It is required to design the circuit to provide an output current $I_o = 1$ mA at $V_o = 1$ V. What values of I_{REF} and R are needed? What is the maximum allowed value of V_o while the current source continues to operate properly? What change occurs in I_o corresponding to V_o changing from the

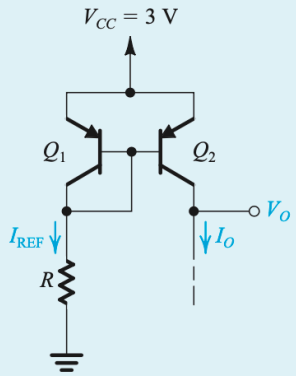

Figure P8.12

maximum positive value to –5 V? *Hint:* Adapt Eq. (8.21) for this case as:

$$I_o = I_{REF}\left[\frac{1+\dfrac{3-V_o-V_{EB}}{|V_A|}}{1+\dfrac{2}{\beta}}\right]$$

Problem 8.13 [S&S 7/e]

8.13 Find the voltages at all nodes and the currents through all branches in the circuit of Fig. P8.13. Assume $|V_{BE}| = 0.7$ V and $\beta = \infty$.

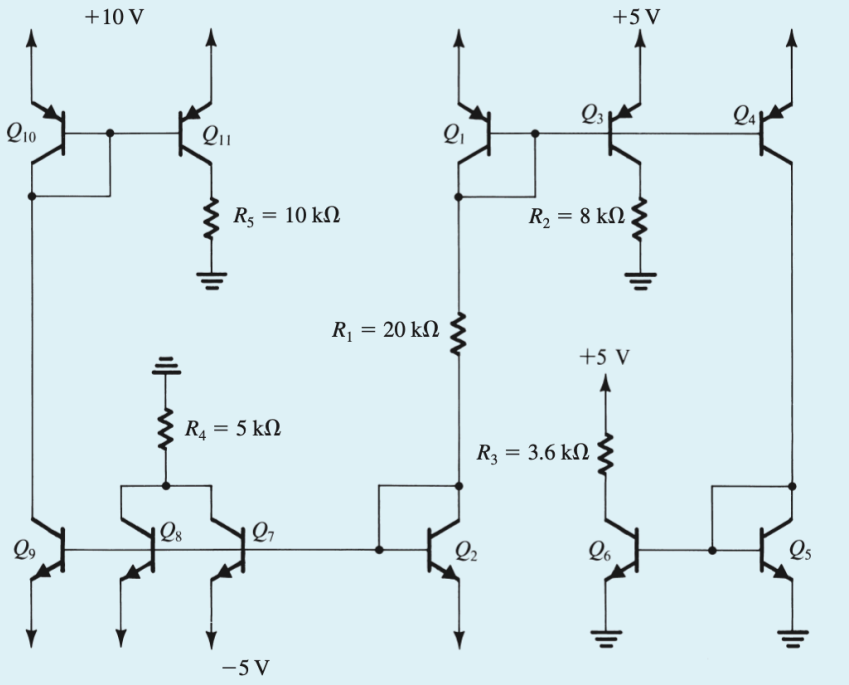

Figure P8.13

Problem 8.49 [S&S 7/e]

8.49 Transistor Q_1 in the circuit of Fig. P8.49 is operating as a CE amplifier with an active load provided by transistor Q_2, which is the output transistor in a current mirror formed by Q_2 and Q_3. (Note that the biasing arrangement for Q_1 is *not* shown.)

(a) Neglecting the finite base currents of Q_2 and Q_3 and assuming that their $V_{BE} \simeq 0.7$ V and that Q_2 has five times the area of Q_3, find the value of I.

(b) If Q_1 and Q_2 are specified to have $|V_A| = 30$ V, find r_{o1} and r_{o2} and hence the total resistance at the collector of Q_1.

(c) Find $r_{\pi 1}$ and g_{m1} assuming that $\beta_1 = 50$.

(d) Find R_{in}, A_v, and R_o.

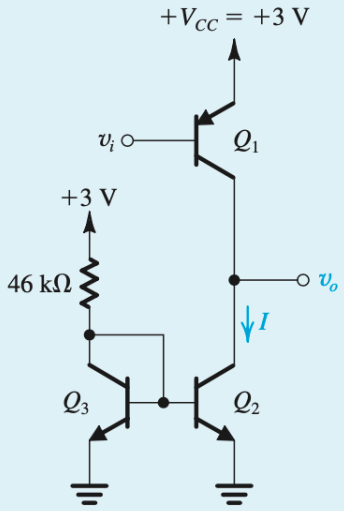

Figure P8.49