1- For the following circuits, the transistors are the same and $V_{BE} = 0.7V$.
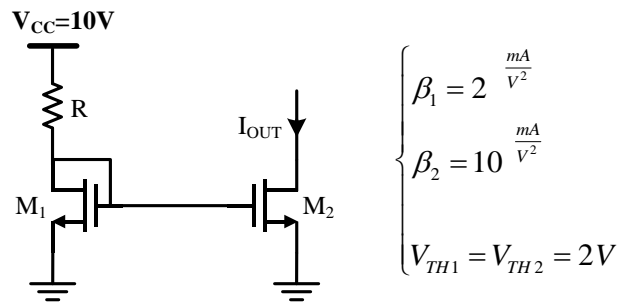
   a) Calculate I_{ref} in fig. 1.a.

   b) Determine I_o / I_{ref} in terms of β and compute its value for $\beta = 50, \beta = 200, \beta = \infty$. Discuss about the results (Fig. 1.a).

   c) In order to alleviate the undesirable effect of β in BJT current mirrors, the circuit which is depicted in fig. 1.b can be used. For this circuit, calculate I_o / I_{ref} and compare the results with those in (b). Assume $\beta = 50$.

(1.a)   (1.b)
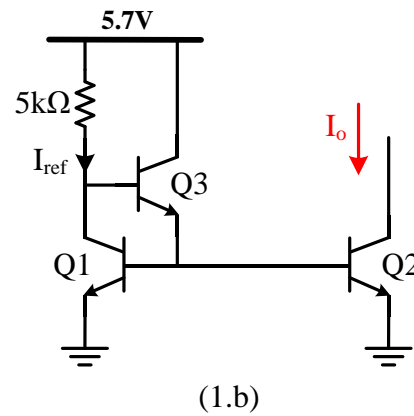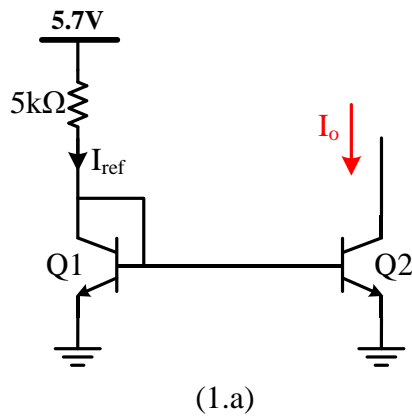
2-   The following circuit is known as the "cascade" current-mirror. Determine the output current and the output resistance (Assume $\lambda \neq 0$ and neglect β effect). What are the advantages of this configuration over the simple current-mirror scheme?
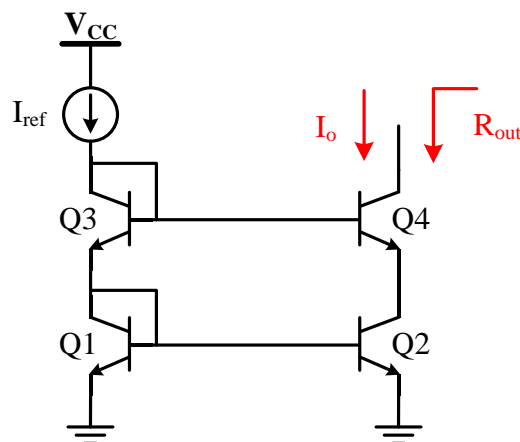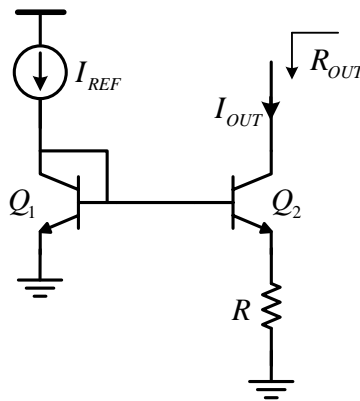
3- Specify the value of R so that $I_{OUT} = 5$ mA.

V$_{CC}$=10V

$$\begin{cases} \beta_1 = 2 \; \frac{mA}{V^2} \\ \\ \beta_2 = 10 \; \frac{mA}{V^2} \\ \\ V_{TH1} = V_{TH2} = 2V \end{cases}$$
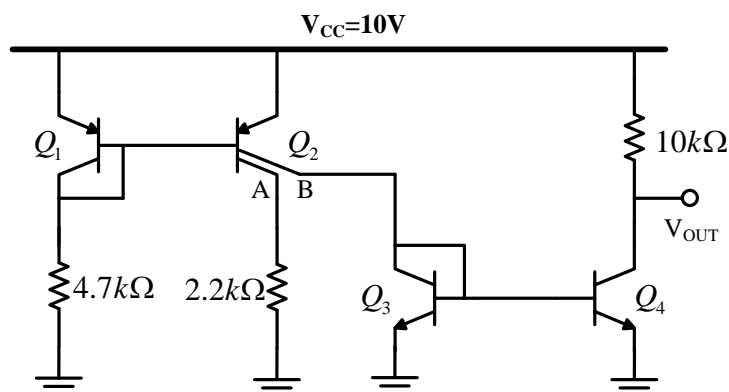
4- In the following circuit,
   a) Determine the output resistance. Assume that the current source is ideal.
   b) Specify R such a way that $I_{REF} = 2 \times I_{OUT}$. The transistors are the same and $\beta \ggg 1$.
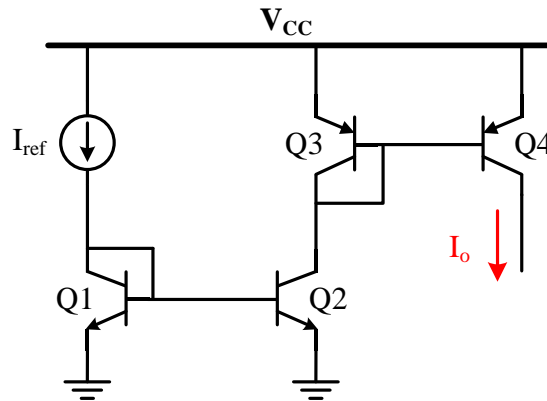
5- In the following circuit, all of the transistors are the same. The effective area of the collector "A" of Q_2 is 3 times larger than the effective area of the collector "B" of Q_2. Calculate the output voltage.
   (Hint: Q_2 is a transistors with two collector terminals, which, their currents are proportional to their effective areas. The total effective collector area of Q_2 is the same as that of Q_1).

V$_{CC}$=10V

6- In the following circuit, specify a relation for I_o in terms of I_{ref} (neglect β and λ effects). The collector areas of Q_2 and Q_4 is 2 times larger than Q_1 and the collector area of Q_3 is 3 times larger than Q_1. larger than Q_1.

Good Luck- M.R. Ashraf