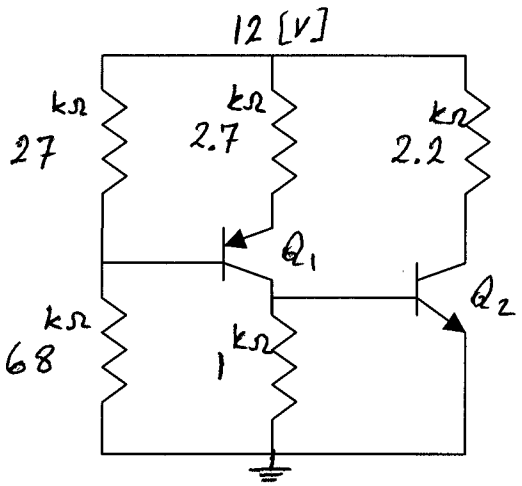
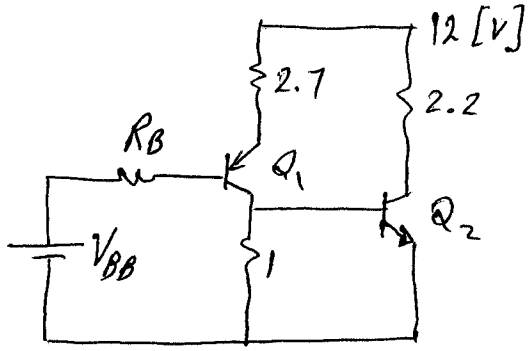
(ECE3455,Q5, SP03) In the circuit shown, both BJTs have beta=100 when are in active region.

a) Calculate I_{C1} and V_{CE1}.
b) Calculate I_{C2} and V_{CE2}.



Solution:

(a)
$$\begin{cases} R_B = \dfrac{27\times 68}{27+68} = 19.32\ [k\Omega] \\ V_{BB} = \dfrac{68}{68+27}\times 12 = 8.59\ [V] \end{cases}$$



$$I_{E1} \cong I_{C1} = \frac{12-8.59-0.7}{\frac{19.32}{100}+2.7} = 0.93\ [mA]$$

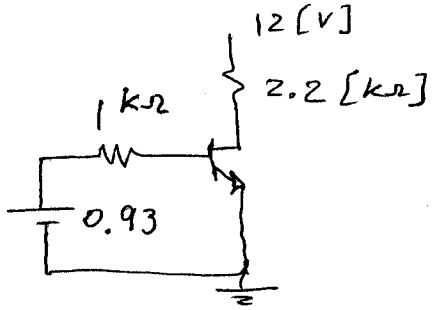
$$V_{E1} = 12 - 2.7\times 0.93 = 9.5\ [V]$$

$$V_{C1} = V_{B2} = 0.7\ [V]$$

$$V_{EC1} = 9.5 - 0.7 = 8.8\ [V]$$

$$Q_1 \begin{cases} I_{C1} = 0.93\ [mA] \\ V_{EC1} = 8.8\ [V] \end{cases}$$

(b) The effect of Q_1 on Q_2 is shown $\Rightarrow$



$$I_{B2} = \frac{0.93-0.7}{1\ k\Omega} = 0.23\ [mA]$$

If assuming Q_2 in active region $\Rightarrow$ $I_{C2} = 100\times 0.23 = 23\ [mA]$

$$V_{CE2} = V_{CC} - 2.2\times I_{C2} = 12 - 2.2\times 23 = -38.6\ [V]$$

Thus Q_2 is in Saturation and $V_{CE2} = 0.2\ [V]$

$$12 - 0.2 = I_{C2}\times 2.2$$
$$I_{C2} = 5.36\ [mA]$$

$$Q_2 \begin{cases} I_{C2} = 5.36\ [mA] \\ V_{CE2} = 0.2\ [V] \end{cases}$$