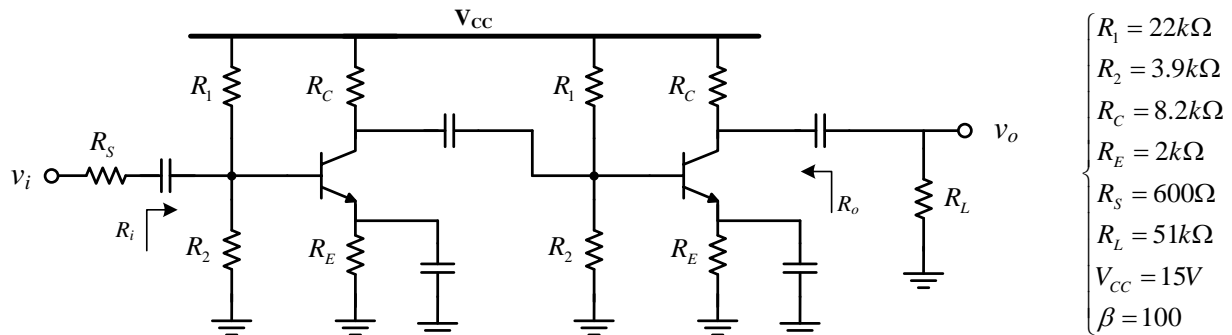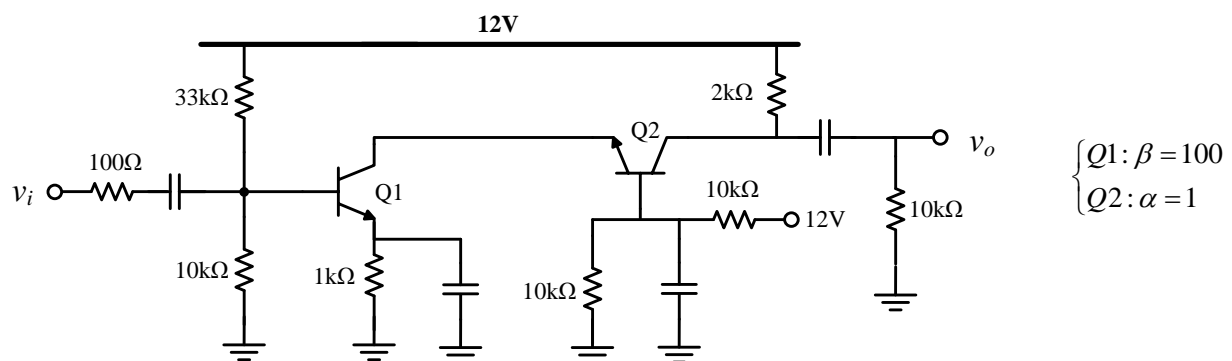**Electronics 2, Assignment #4, Multi-stage amplifiers.**
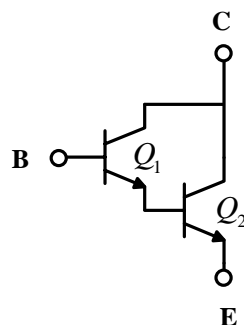
1- Calculate the voltage gain, input resistance and output resistance of the following circuit.


$$\begin{cases} R_1 = 22k\Omega \\ R_2 = 3.9k\Omega \\ R_C = 8.2k\Omega \\ R_E = 2k\Omega \\ R_S = 600\Omega \\ R_L = 51k\Omega \\ V_{CC} = 15V \\ \beta = 100 \end{cases}$$

2- In the circuit shown below, determine the voltage gain.

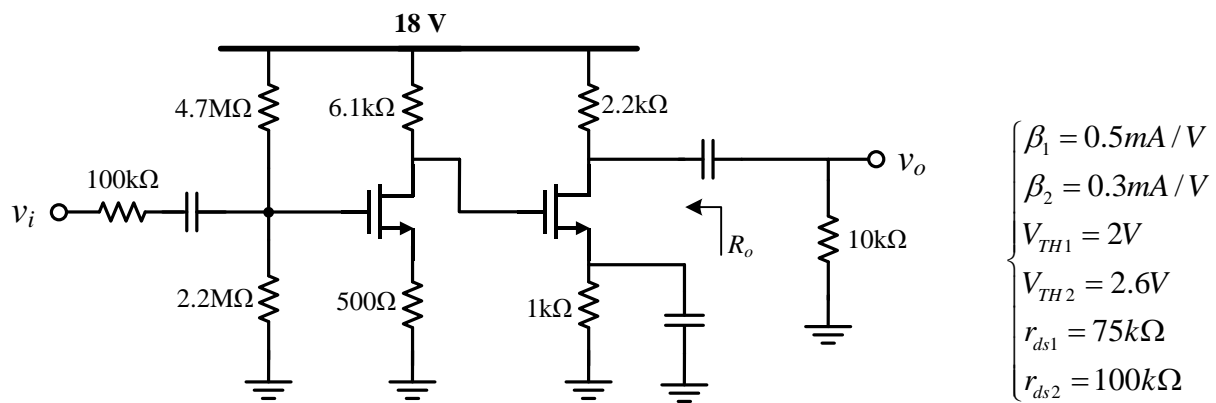$$\begin{cases} Q1: \beta = 100 \\ Q2: \alpha = 1 \end{cases}$$

3- The following structure is known to be the "Darlington pair" configuration and is used in order to increase the β of a single transistor. This configuration can be modeled as a single NPN transistor. Determine its equivalent r_π, g_m and β.

4- The following configuration is called the "Sziklai Pair" or the "Complementary Darlington pair". This configuration can be used to construct a PNP transistor with a large β. For the following circuit, determine the voltage gain and the input resistance.


$$\begin{cases} \beta_1 = 160 \\ \beta_2 = 200 \end{cases}$$
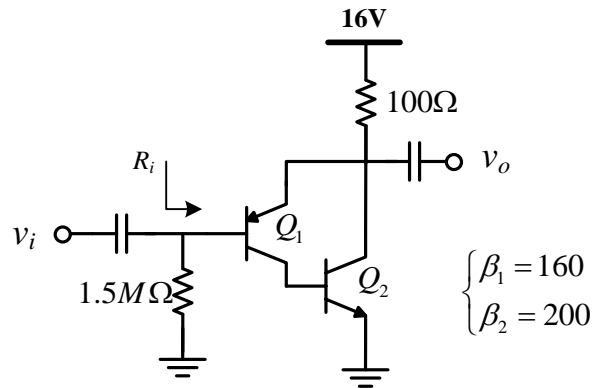
5- Determine to voltage gain and the output resistance of the following structure.

$$\begin{cases} \beta_1 = 0.5mA/V \\ \beta_2 = 0.3mA/V \\ V_{TH1} = 2V \\ V_{TH2} = 2.6V \\ r_{ds1} = 75k\Omega \\ r_{ds2} = 100k\Omega \end{cases}$$

6- a) Specify R_1 and R_2 so that the bias current of M1 will be equal to 1 mA.

   b) Calculate the voltage gain and the output resistance.

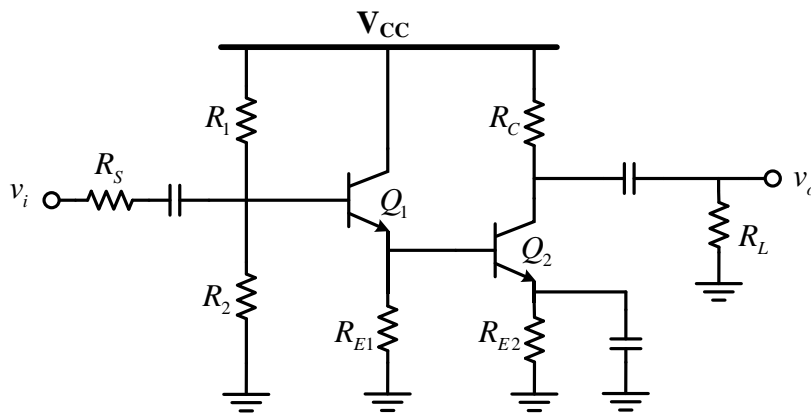$$\begin{cases} \beta = 0.25\dfrac{mA}{V^2} \\ |V_{TH}| = 0.5V \\ \lambda = 0 \end{cases}$$
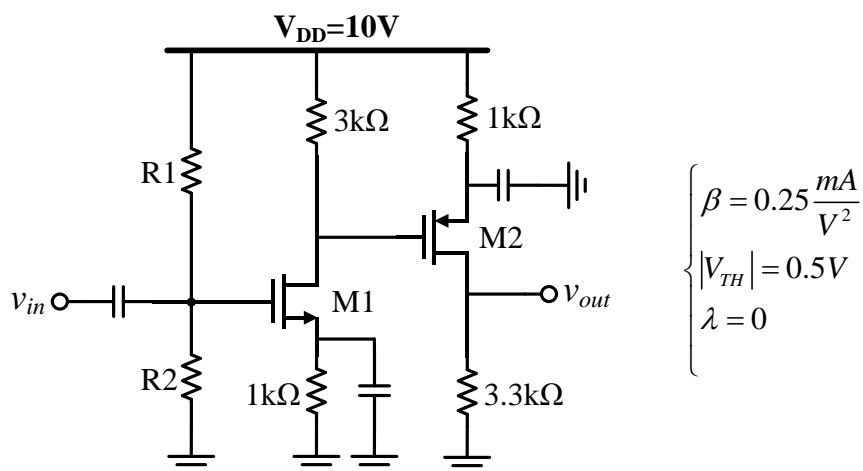
7- Calculate the voltage gain of the structure depicted in the following figure. The transistors are in the saturation region.
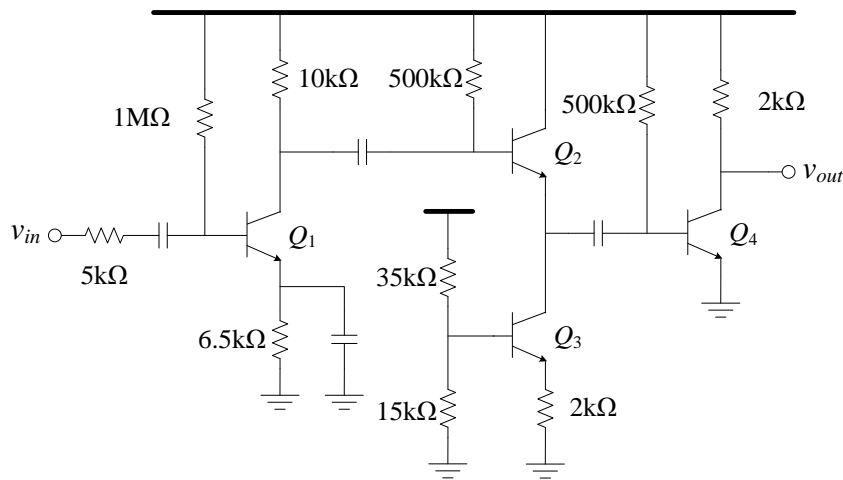
$$\begin{cases} V_A = 100V \\ V_T = 25mV \\ \beta = 100 \\ I_{C1} = I_{C4} = 1mA \\ I_{C2} = 0.5mA \end{cases}$$

8- Calculate the voltage gain in the following circuit.

$$\begin{cases} V_{CC} = 10V \\ R_C = R_S = R_L = 4k\Omega \\ R_1 = R_2 = 200k\Omega \\ R_{E1} = 3.3k\Omega \\ R_{E2} = 2.6k\Omega \\ V_{CE,sat} = 0.2V \\ V_{BE,on} = 0.7V \\ \beta_1 = \beta_2 = 100 \end{cases}$$

Good Luck- M.R. Ashraf