1) For the current source in figure 1a:
   a) Calculate the output resistance, and the “turn on” voltage at which the current source achieves this resistance, as a function of W/L and Iref.
   b) For W/L=100, and Iref=1mA, calculate the specific values from 1a for L=0.5 and 5 microns.
   c) Use SPICE to plot Iout vs. Vout for both mirrors from 1b on the same plot. At what voltage and current are they equal? Why? Draw a line indicating your predicted turn-on voltage from 1a.

2) For the circuit in figure 2, assume that W/L for all devices is 100um/1um
   a) Calculate the expected output resistance and turn-on voltage.
   b) Use SPICE to plot Iout vs. Vout, and use expression-builder in awaves to plot the output resistance as a function of output voltage.

3) For the circuit in figure 3, assume that W/L for all devices is 100um/1um
   a) Calculate the minimum value for VBN for which all transistors will be in saturation, and calculate the resulting turn-on voltage for the current source and its output resistance.
   b) Use SPICE to plot the output current vs. VBN for Vout = 2V. Make another current sink (identical copy of M1 and M2) and bias its output at Vout2=3V. Use the difference between the two output currents to plot the output resistance as a function of VBN.
   c) Make a table with the calculated and simulated values for the output resistance and turn-on voltage of each of the three current sources. Which current source gives the best performance? Why?

4) Generate VBN from part 3a using a diode-connected NMOSFET and another 1mA current. Verify that the bias voltage, turn-on voltage, and output resistance are what you expect.

5) For the circuit in figure 4, assume that the current source has a finite output resistance RL, and that the MOSFETs are identical.
   a) Write an expression for the four small signal gains: from the two inputs to the two outputs.
      Assume that the current source is 1mA, and the devices are 100um/1um:
   b) Calculate the four small-signal gains assuming that the current source is made with a PMOSFET with an output resistance equal to the NMOS devices.
   c) Calculate the four small-signal gains assuming that the current source is made with a PMOS cascode with an output resistance equal to the NMOS cascode output resistance.