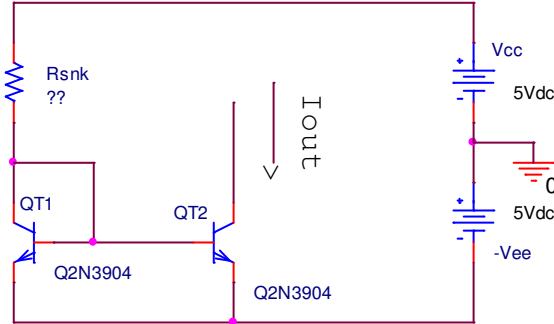


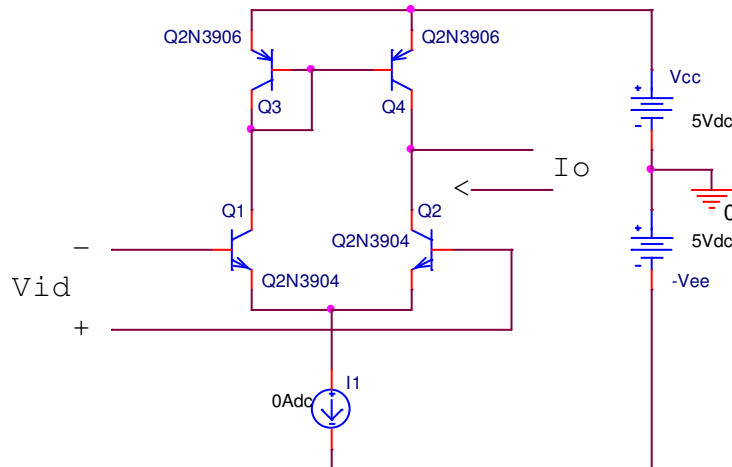
1. For the following circuit find the resistance to give an output current of 3mA.



2. a) Following Figure 8.37, p. 645, redrawn below, design a differential pair using 2n2904 BJTs for the main pair (Q1 & Q2), the above current source for Itail, and 2n2906 pnp BJTs for the current mirror (Q3 & Q4) to give

$$I_o \cong \alpha \cdot I_{tail} \cdot \tanh[V_{id}/(2V_T)].$$

To measure the output current, I_{out} , you can use an F component (a current controlled current source) with input I_{out} & ground and output into a resistor and ground. Set this up in PSpice.



- b) Set up in the same PSpice schematic a Gvalue component to give the theoretical nonlinear function. In the same Spice run obtain the I_o vs V_{id} for the transistor circuit and the Gvalue component and compare. Submit the simultaneous curves.
 c) Replace the pnp current mirror by a PMOS, mpmosis, one and compare the results.
 3. Find, and sketch in the s-plane, the zeros and poles of the following transfer functions:

a) $\frac{v_o}{v_i}(s) = \frac{(s-5)(s^2-2s+6)}{(s+5)(s^2+2s+6)}$ b) $\frac{v_o}{v_i}(s) = \frac{(s^2+6)(s^3+3s^2+2s)}{(s+3)^2(s+2)}$