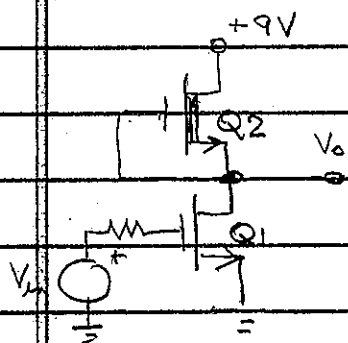
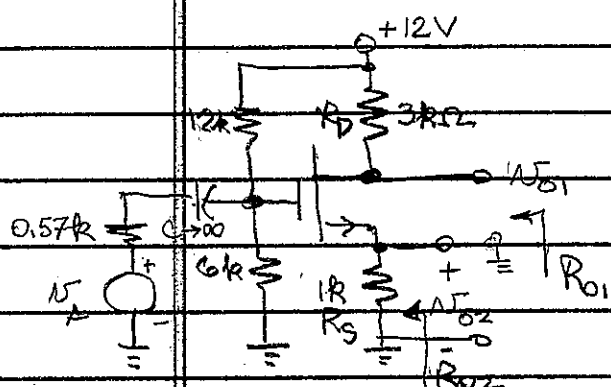


PROBLEM I

The drain characteristics for Q1 are displayed in Fig A and Fig B are its transfer characteristics. Figure C are the drain characteristics of Q2. For  $0 \leq V_{in} \leq 6V$ , plot  $V_o$  vs.  $V_{in}$ .

PROBLEM B

The MOSFET has

$$I_D = 0.8 (V_{GS} - 2)^2 \text{ mA and } V_A \rightarrow 60k\Omega$$

- 1) Determine the dc values of  $V_{o1}$  and  $V_{o2}$ .
- 2) What is  $I_D$ ?

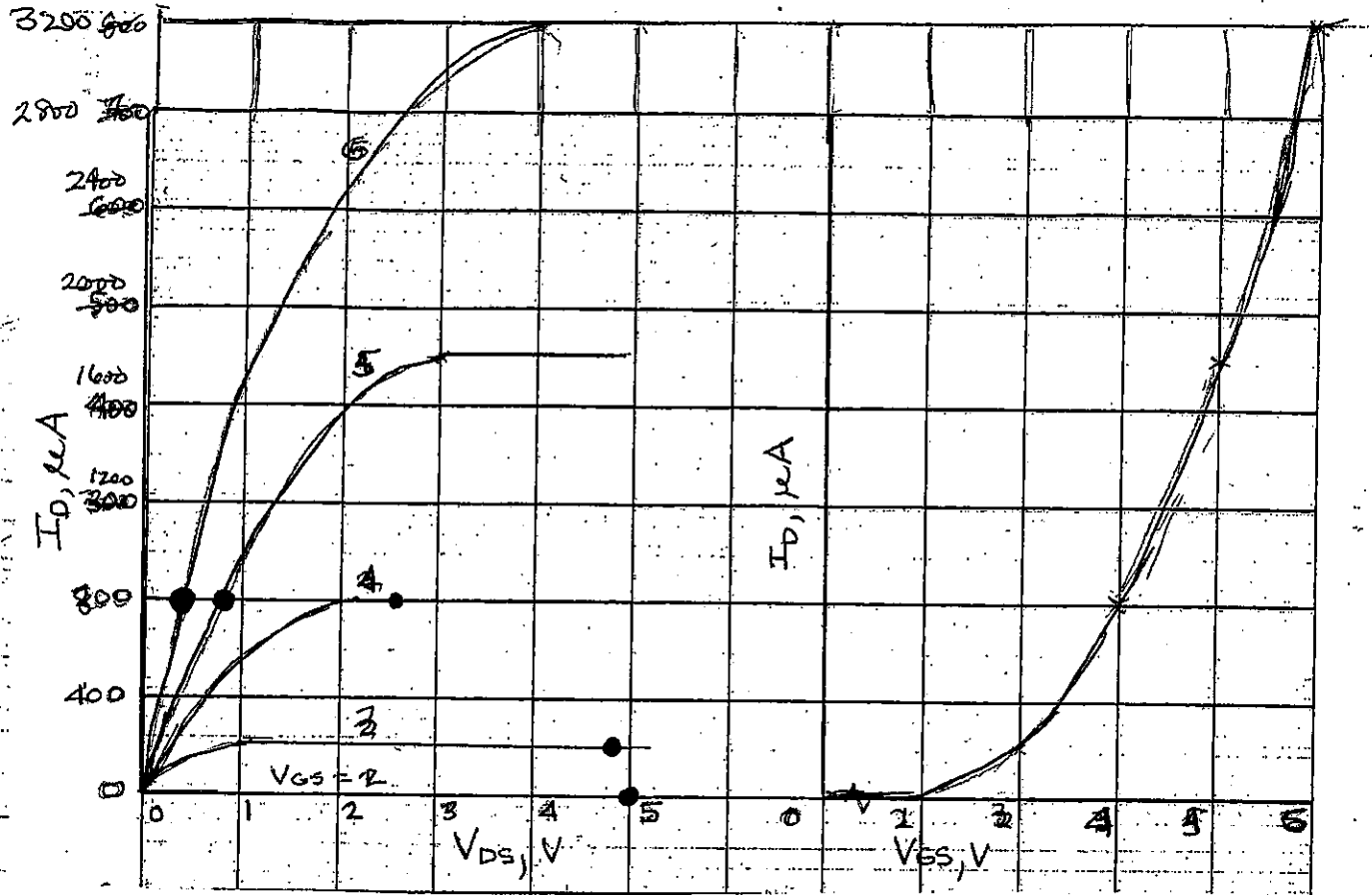
NOTE: This can be solved analytically if one writes an equation for  $I_D$  in the gate loop and another for  $I_D$  in the drain-source loop.

PROBLEM C

1. For the circuit in (B), draw the small-signal model indicating all values.
2. Solve for  $A_{v1} = V_{o1}/V_{in}$  when  $R_S = 0$ .
3. Solve for  $A_{v2} = V_{o2}/V_{in}$  when  $R_D = 0$ .
4. Solve for  $A_{v3} = V_{o1}/V_{in}$  when  $R_S$  is included.
5. Solve for  $A_{v4} = V_{o2}/V_{in}$  when  $R_D$  is included.
6. In (4), if  $R_S = 0$ , do you get the result in (2)?
7. In (5), if  $R_D = 0$ , do you get the result in (2)?

# ENHANCEMENT MOSFETS

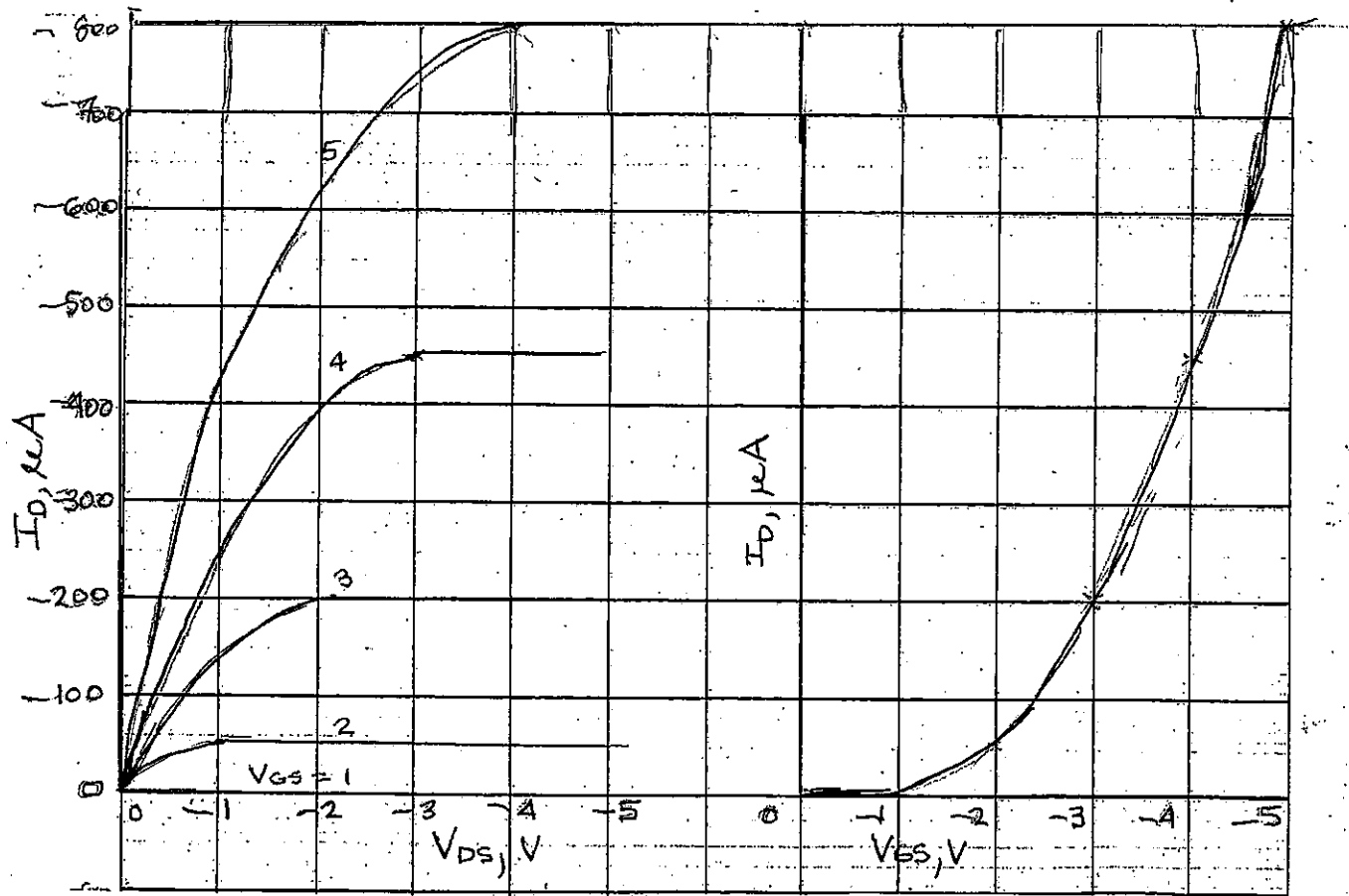
NMOS

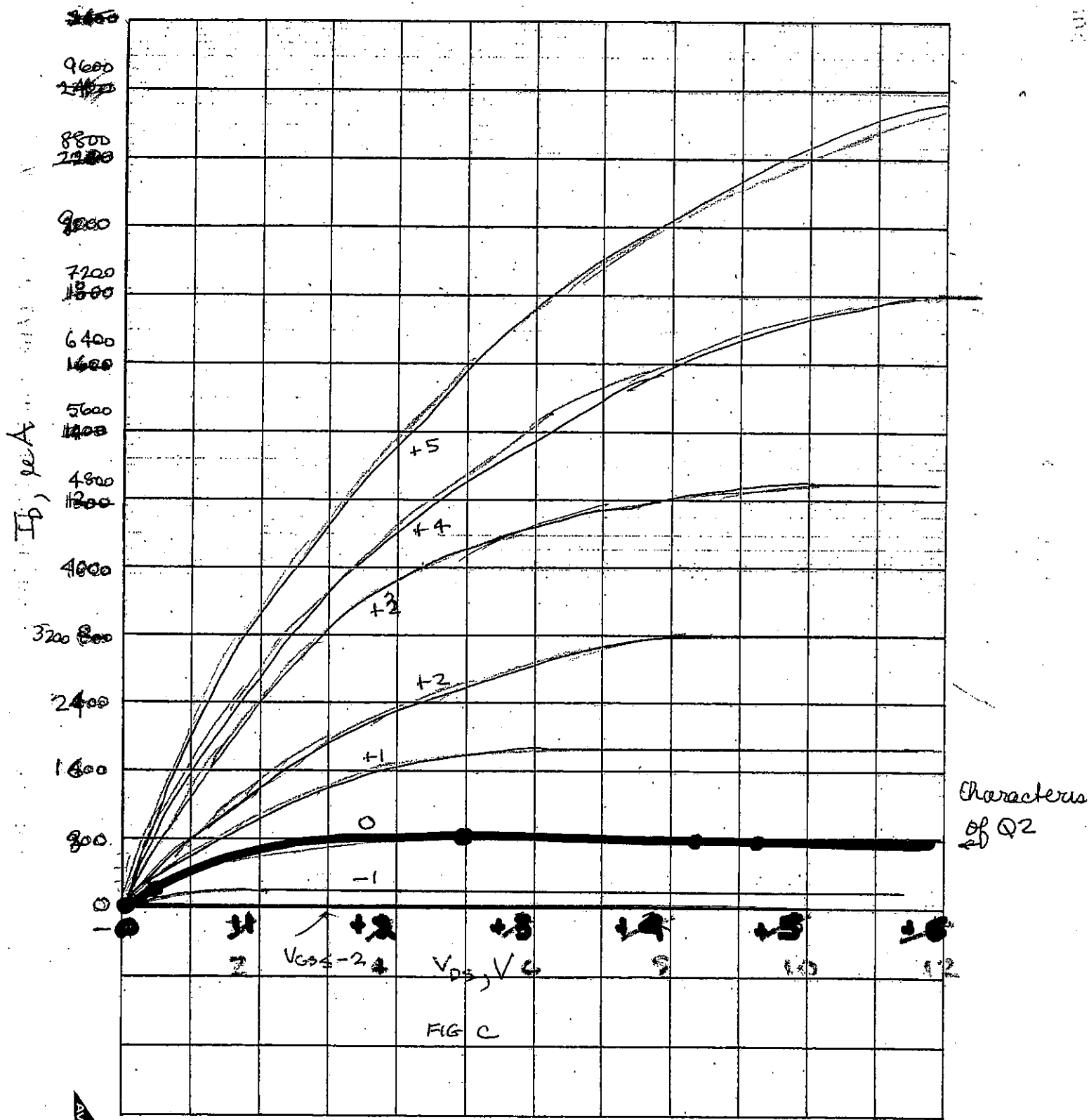


FIGA

FIGB

PMOS





Depletion NMOS



## PROBLEM D

1. With both  $R_S$  and  $R_D$  present in the circuit of Prob. B, evaluate  $R_{o1}$  and  $R_{o2}$  (small-signal)
2. How is  $R_{o1}$  affected by the inclusion of  $R_S$ ?
3. How is  $R_{o2}$  affected by the inclusion of  $R_D$ ?

## PROB. E

1. What change or changes must be made to the circuit in Prob. B if the NMOS transistor is replaced by a PMOS transistor?
2. If the characteristics of the PMOS and NMOS are completely complementary, what changes, if any, in Prob. C exist?