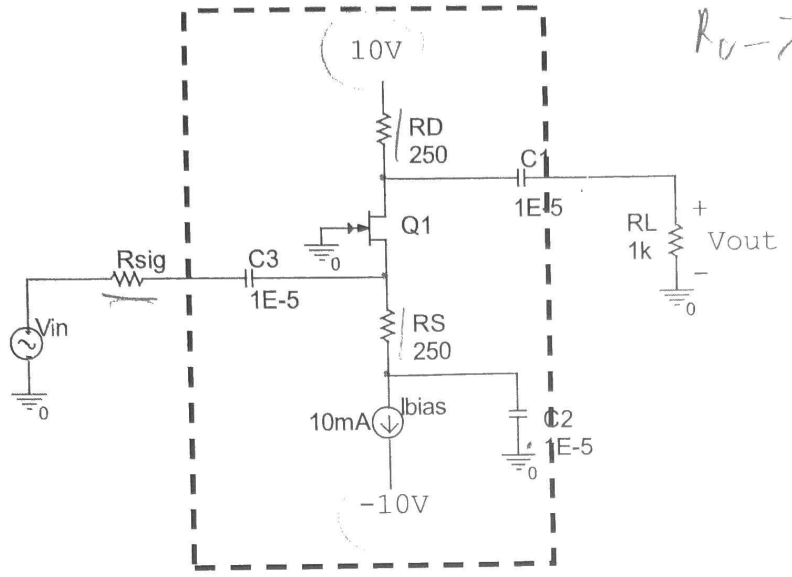
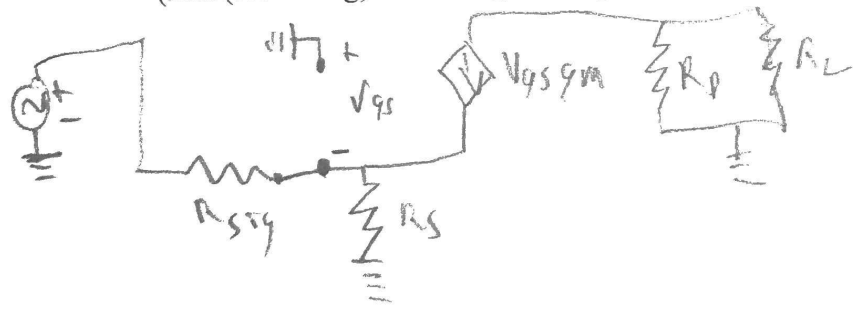
Homework 13

Reading: 7.1, 7.2-5 (FET discussion)
Problem 1) Common Gate



The NMOSFET in the above circuit has characteristics VTN = 2.2V, and Kn = 40 mA/V^2
(If you used Kn = 400, you do not need to redo your work.)
(Same DC bias circuit as HW12)

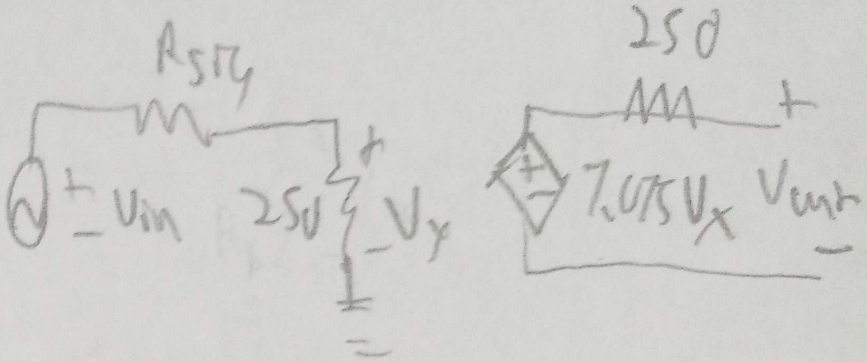
a) Sketch the small signal model of the circuit.
b) For Rsig = 0 and RL → ∞, determine the open circuit gain, Avo = Vout$_o$/Vin$_o$.
c) Using the dashed box to define the input and output impedance, find Rin and Rout.
d) Redraw the circuit, using the general amplifier model with Rin, Rout and Avo.
e) What is the maximum value of Rsig such that the 'first' parenthesis term (Rin/(Rin+Rsig) has a magnitude greater than 0.8.



C: $R_{in} = 250\,\Omega \leq R_S$

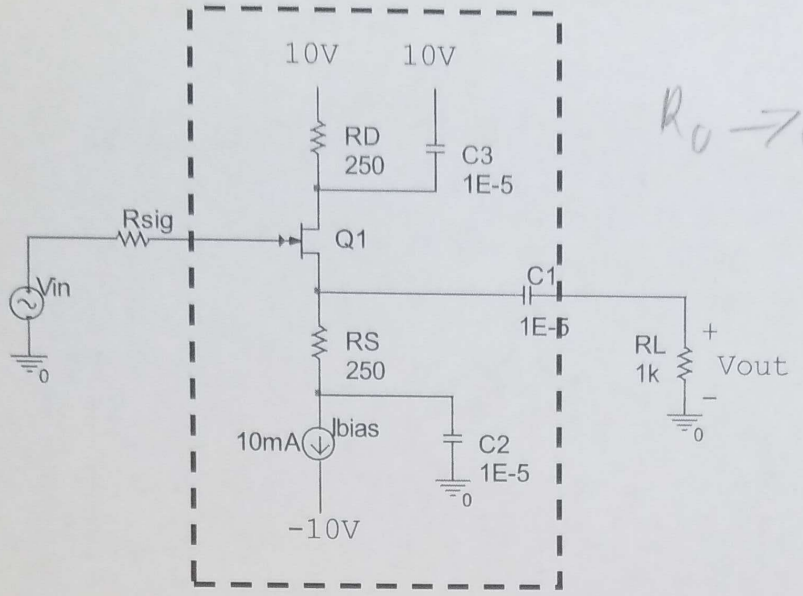
$R_{out} = R_D = 250\,\Omega$

D:



E: $\frac{250}{250 + R_{STG}} > .8 \quad R_{STG} < 62.5$

Problem 2) Common Drain

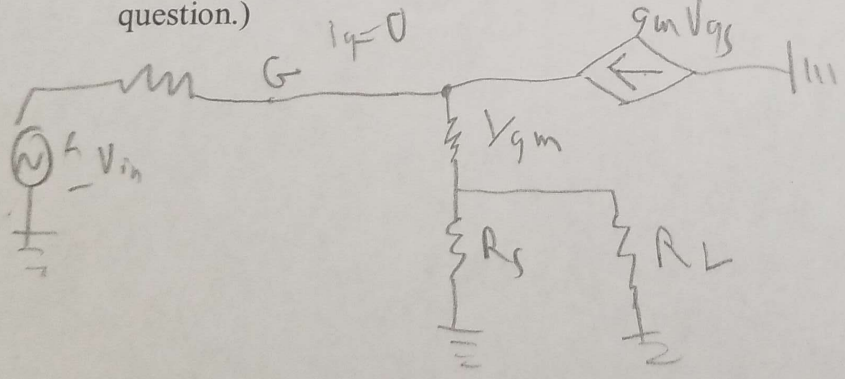


$R_D = 700$

The NMOSFET in the above circuit has characteristics VTN = 2.2V, and Kn = 40 mA/V^2
(If you used Kn = 400, you do not need to redo your work.)
(Same DC bias circuit as HW12) → $I_D = 10mA$ $V_{GS} = 2.91V$ $V_{DS} = 16.4V$ $g_m = 0.028$

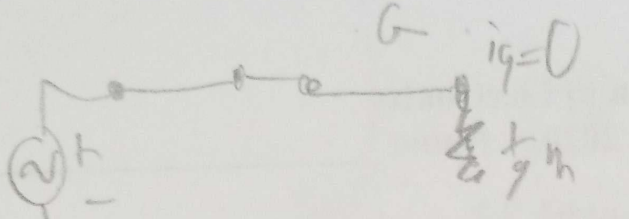
a) Sketch the small signal model of the circuit.
b) For Rsig = 0 and RL → ∞, determine the open circuit gain, Avo = $Vout_o/Vin_o$.
c) Using the dashed box to define the input and output impedance, find Rin and Rout.
d) Redraw the circuit, using the general amplifier model with Rin, Rout and Avo.
e) What is the maximum value of Rsig such that the 'first' parenthesis term (Rin/(Rin+Rsig) has a magnitude greater than 0.8? (This is kind of a trick question.)

A:

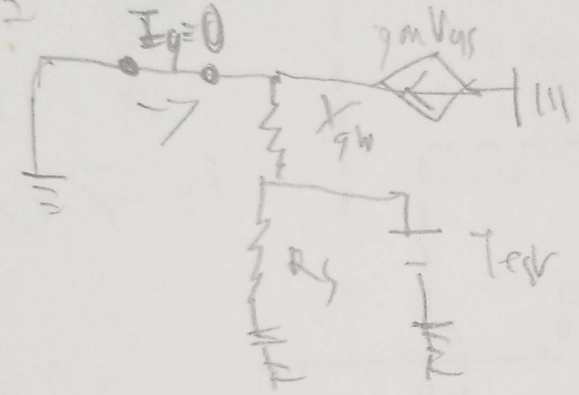


B: $V_{out} = \frac{R_S}{R_S + \frac{1}{g_m}} \cdot V_{in}$ $A_V = \frac{R_S}{R_S + \frac{1}{g_m}} = 0.88$

C:



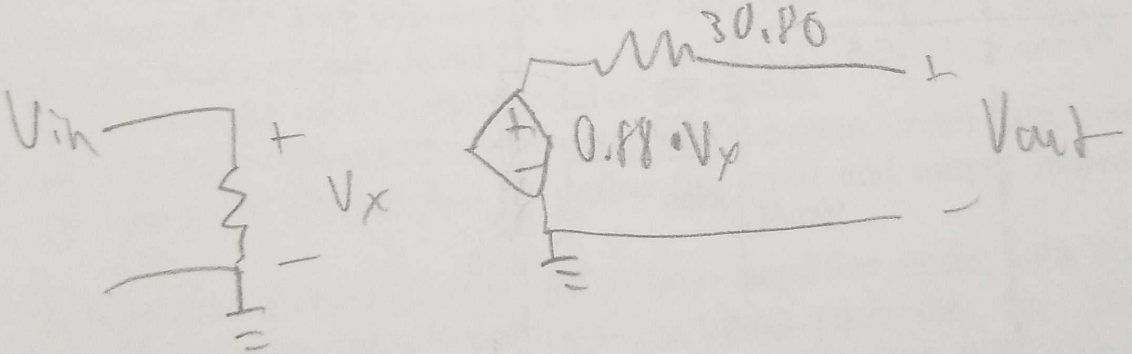
$R_{in}=0$



$I_{test} = \frac{V_T}{R_S} + \frac{V_T - V_y}{\frac{1}{g_m}}$ $V_T = I_{test}(R_{out})$

$I_{test} = \frac{V_T}{R_S} + \frac{V_T}{\frac{1}{g_m}}$ $R_{out} = 30.8\Omega$

D:



E: There is no term because $R_{in}=0$.