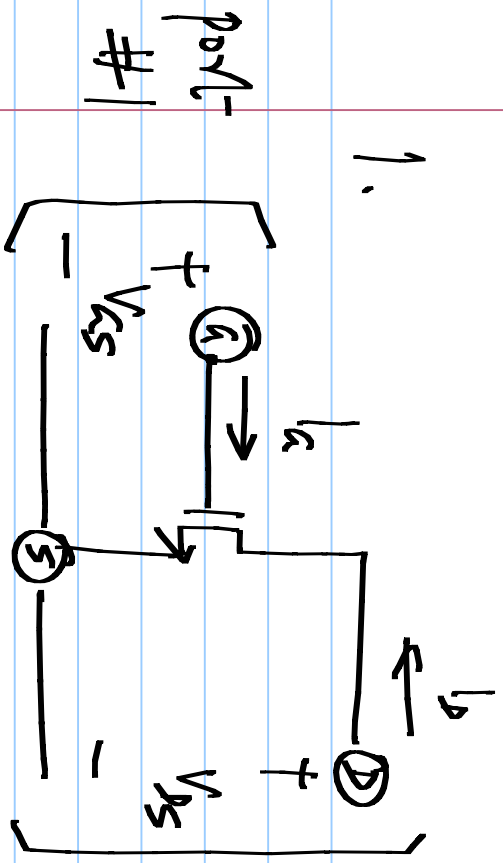


EECE 1010: Electrical and Magnetic circuits.

Problem set #5 (Due on 6th Mar. 2014)



Port #2.

An MOS transistor is a 3 terminal two port with the following relationships between

voltages and currents.

$$I_g = 0; \quad I_d = \frac{\beta}{2} (V_{gs} - V_T)^2 (1 + \lambda V_{ds})$$

β , V_T , and λ are constants.

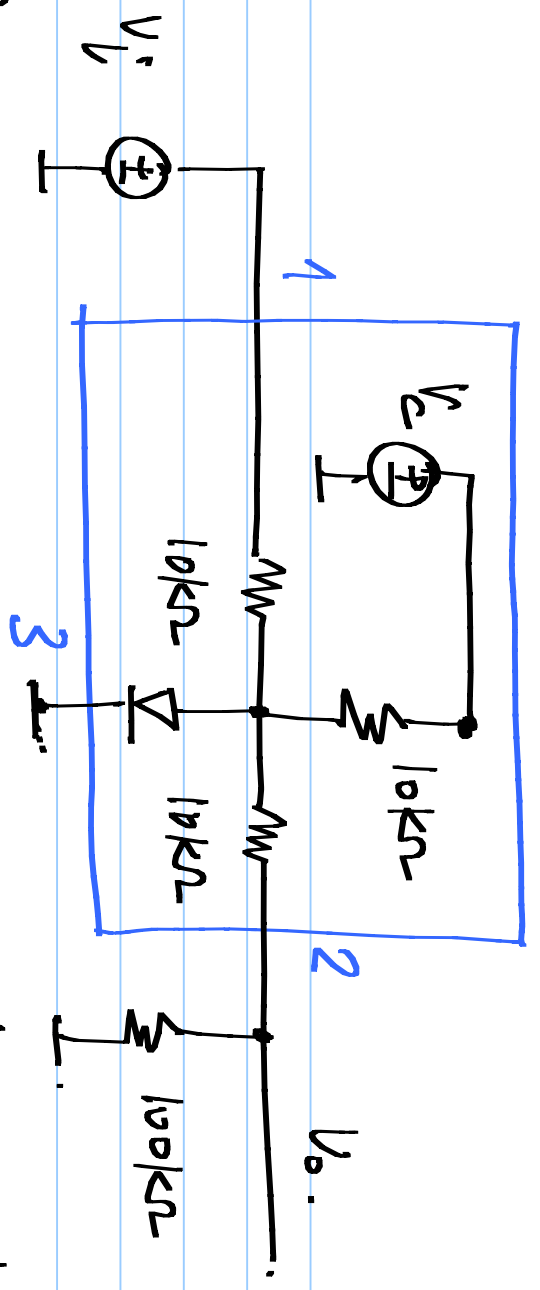
Determine the incremental parameters of the transistor.

2. Evaluate the y parameters of the previous problem for $\beta = 100 \mu\text{A}/\text{V}^2$; $V_T = 1\text{V}$; $\lambda = 0.01\text{V}^{-1}$ at an operating point of $V_{GS} = 3\text{V}$, $V_{DS} = 5\text{V}$.

If the network in problem 10 of the previous problem set has these

y -parameters, determine $\frac{V_o}{V_s}$ for $R_S = R_L = 100\text{k}\Omega$

3.



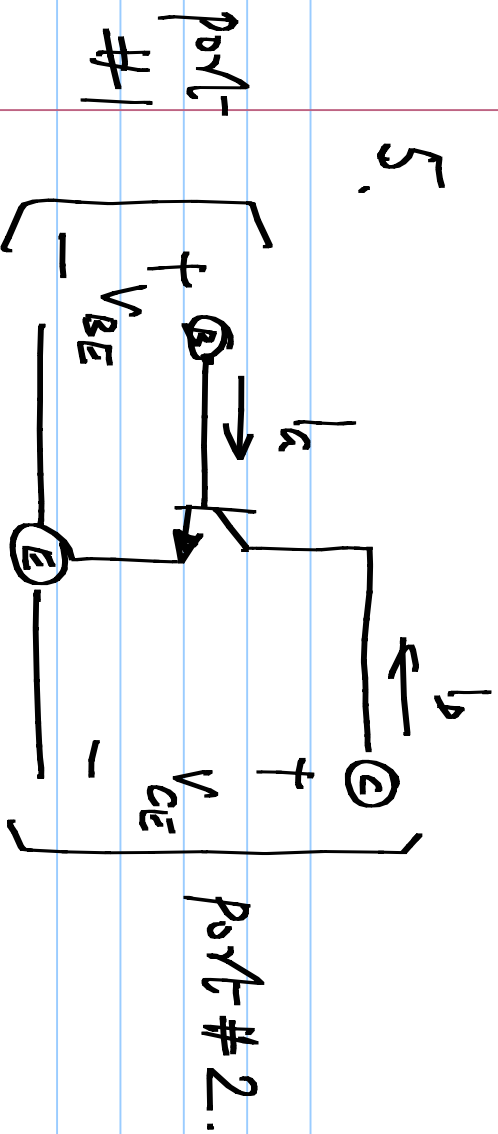
[Treat V_i as an incremental input].

Determine the total output V_o when $V_c = +2.7V$

and $V_i = -2.7V$

4. In the previous problem, determine the small-signal y -parameters of the 3 terminal two port enclosed by the box for $V_C = 2.7V$ and $V_C = -2.7V$.

5.



A bipolar junction

transistor is a

3 terminal two port-

with the following

relationships between voltages and currents.

$$I_B = \frac{I_C}{\beta} \quad ; \quad I_C = I_S \exp\left(\frac{V_{BE}}{V_T}\right) \left(1 + \frac{V_{CE}}{V_A}\right) ;$$

I_S, V_A, β are constants. V_T is the thermal voltage.

Calculate the small-signal y -parameters.

6. Evaluate the y parameters of the previous problem for $\beta = 200$, $I_s = 10^{-15} \text{ A}$, $V_A = 25 \text{ V}$, at an operating point of $V_{BE} = 690 \text{ mV}$, $V_{CE} = 2.5 \text{ V}$ (Use $V_T \approx 25 \text{ mV}$)

If the network in problem 10 of the previous problem set has these

y -parameters, determine $\frac{V_o}{V_s}$ for $R_S = R_L = 100 \text{ k}\Omega$