Spring 2019 Purdue University

ECE 255: L30

Diff Amp Exercises

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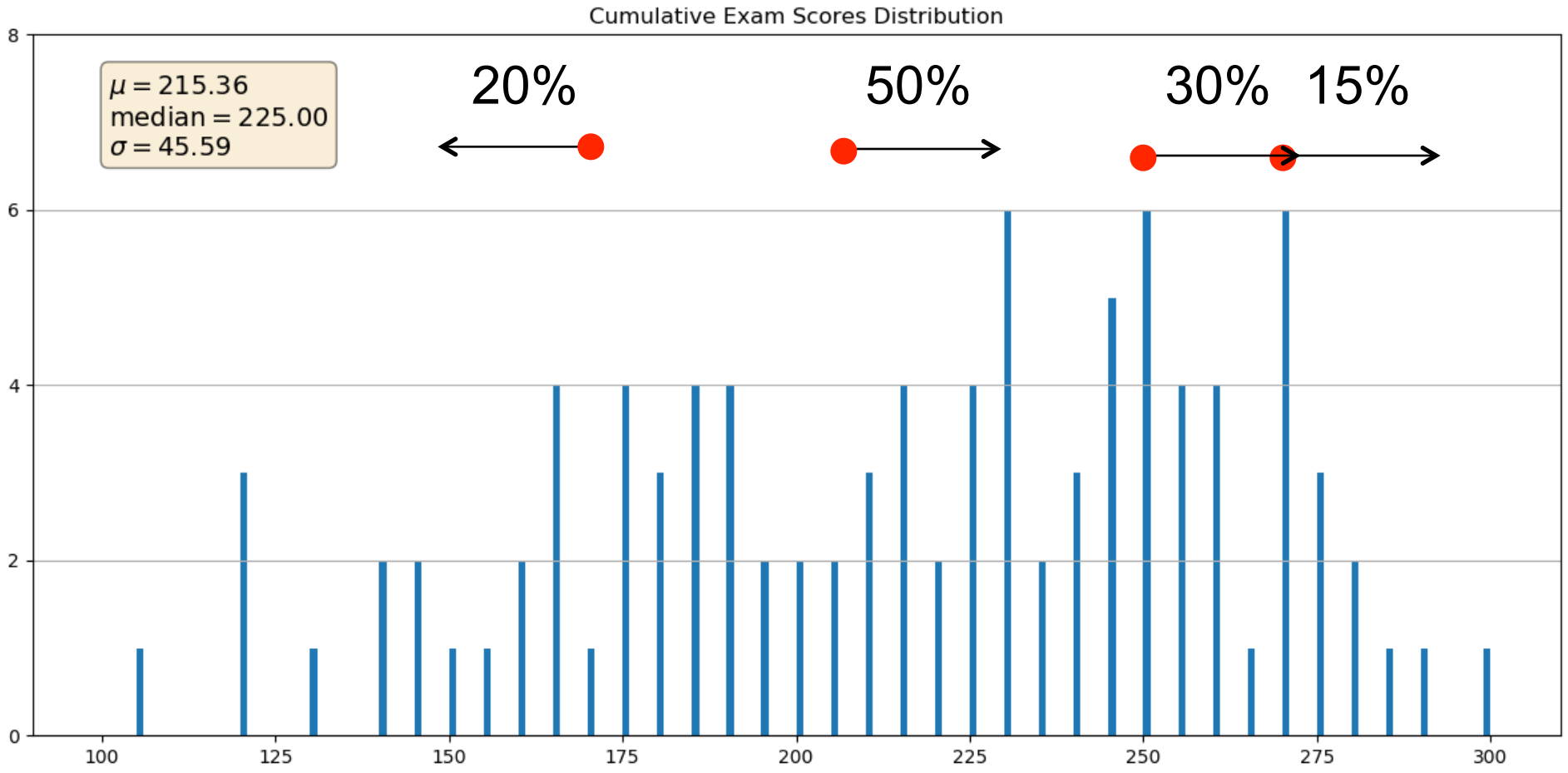
Announcements

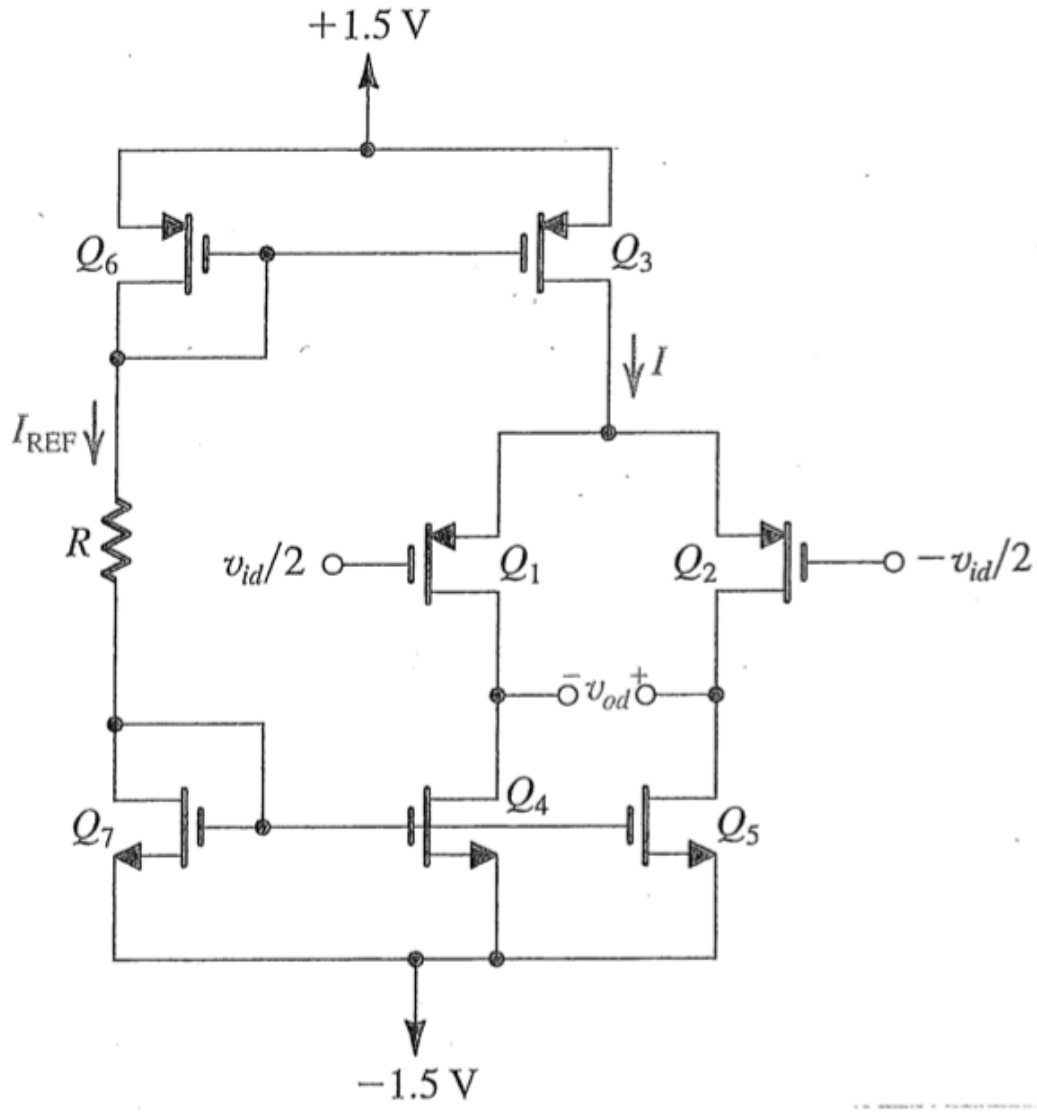
HW9 Due 5:00 PM Friday, April 12 in EE-209 dropbox

Exam 1 + Exam 2 + Exam 3

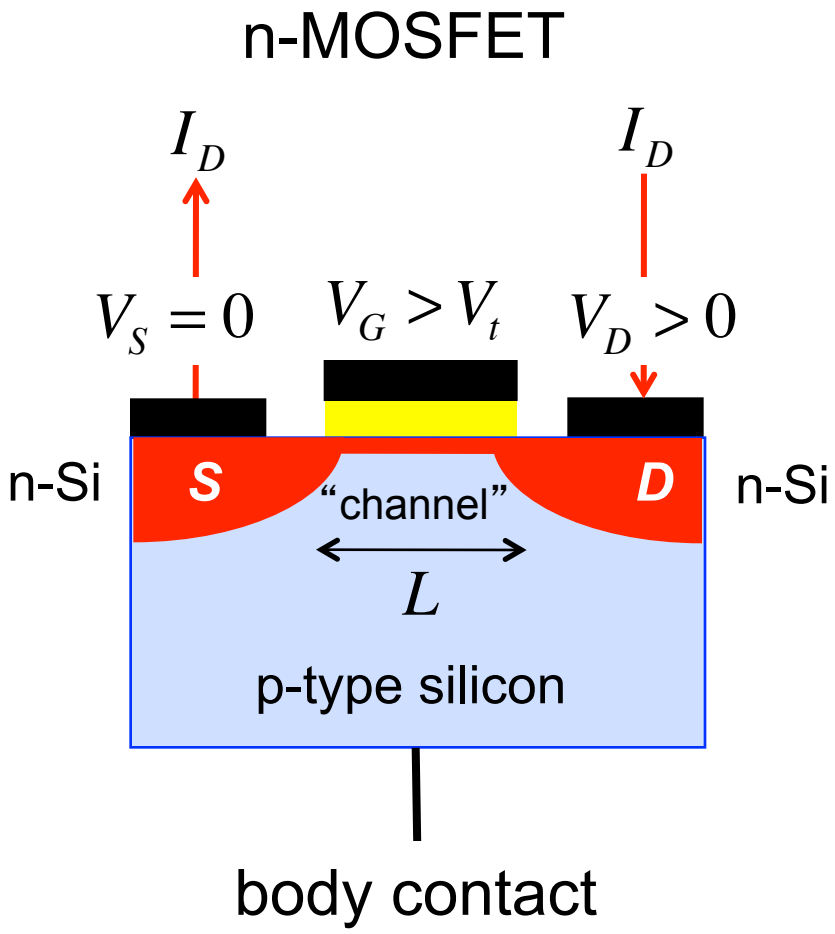


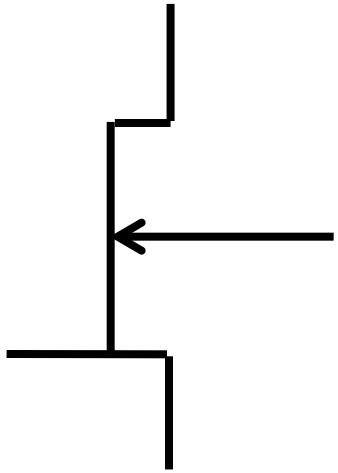
Lundstrom: 2019

Spice Project 3



Spice Project 3

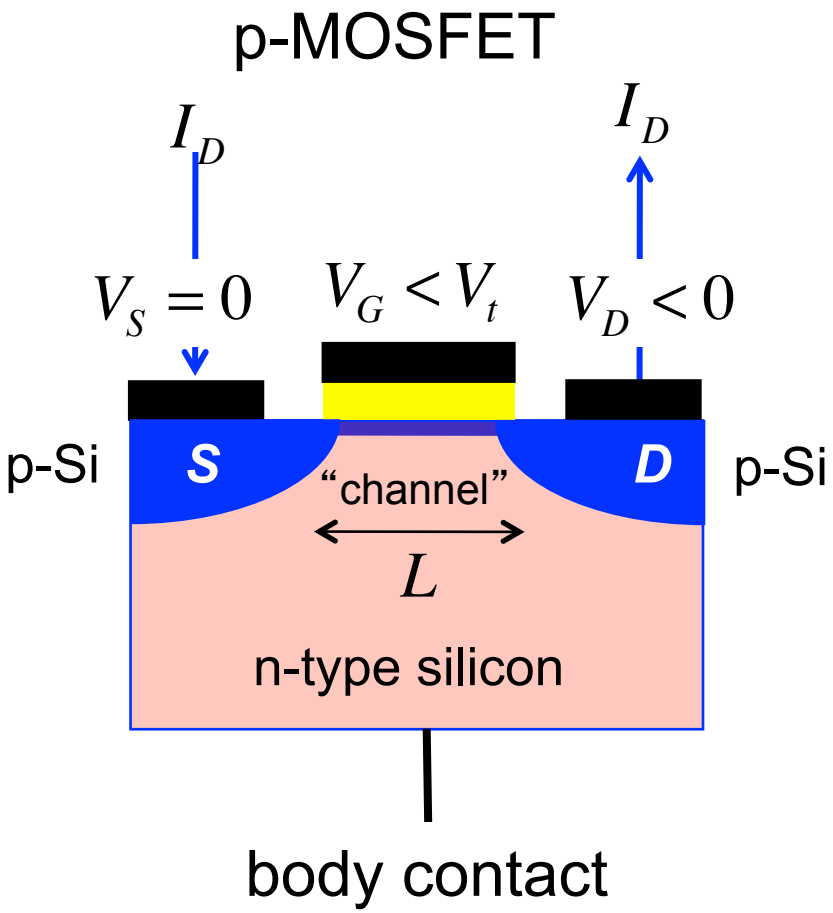


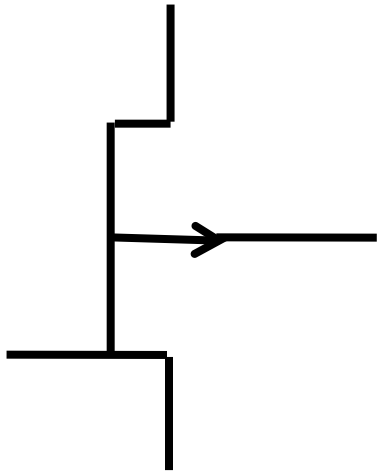


Short to source

The source is the terminal with the **lower** voltage

Spice Project 3

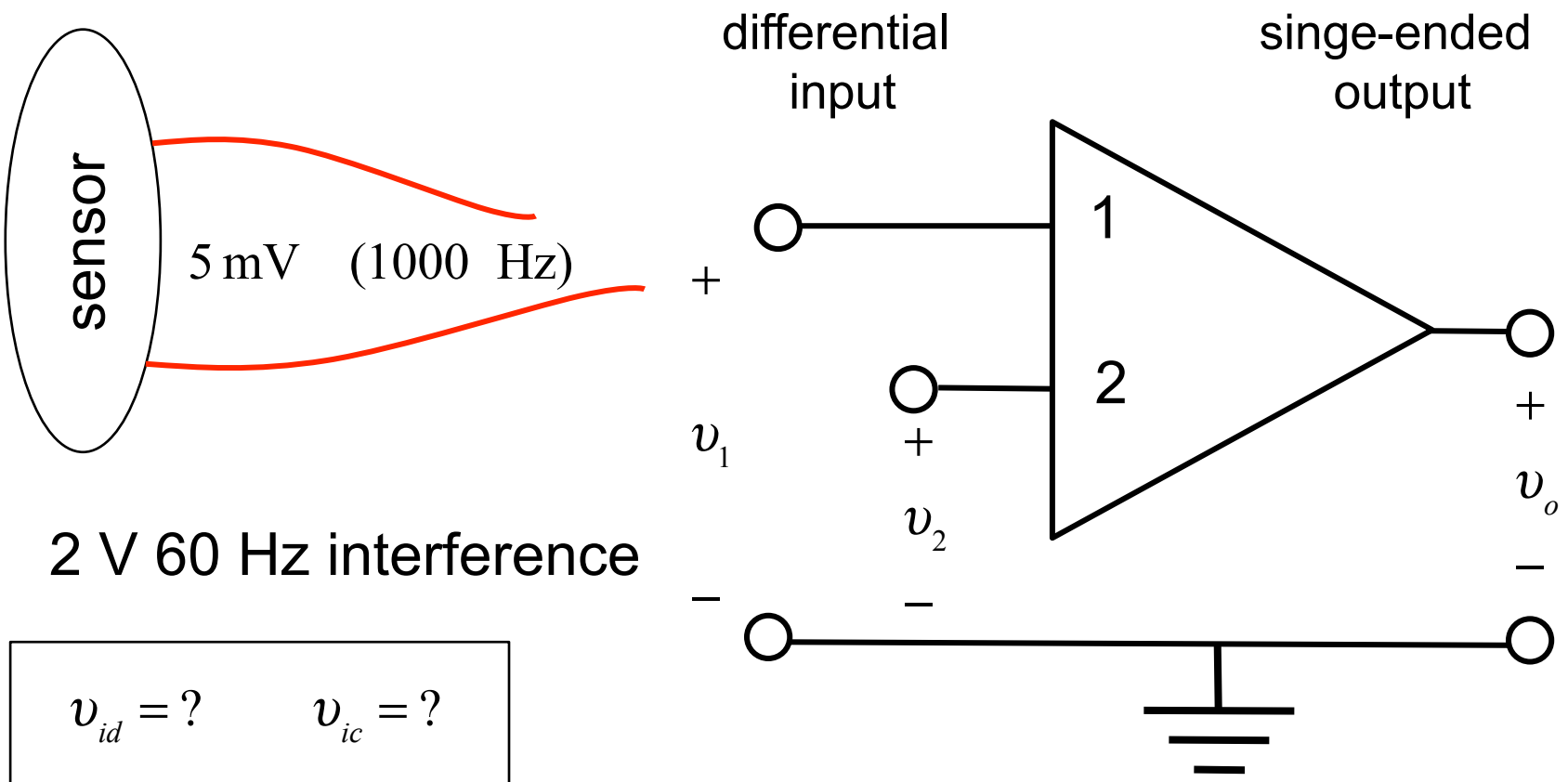




Short to source

The source is the terminal with the **higher** voltage

Problem 2.6



2 V 60 Hz interference

$v_{id} = ?$ $v_{ic} = ?$

$v_1 = ?$ $v_2 = ?$

Problem 2.6 related

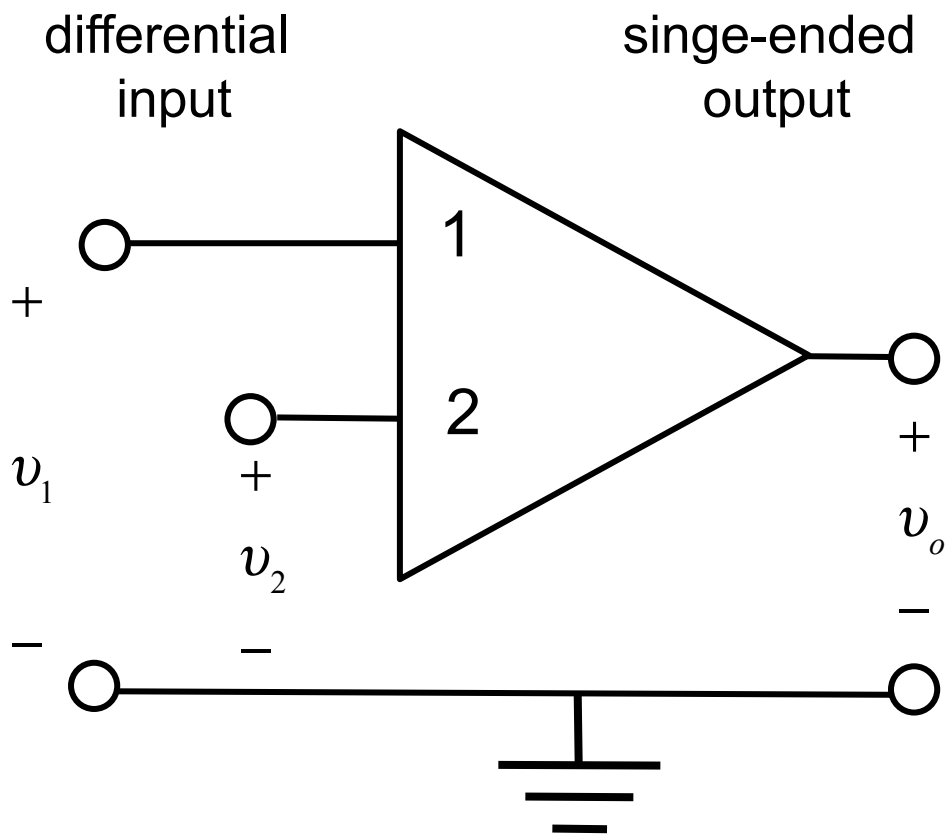
$v_1 = 50\ \text{mV}$

$v_2 = 30\ \text{mV}$

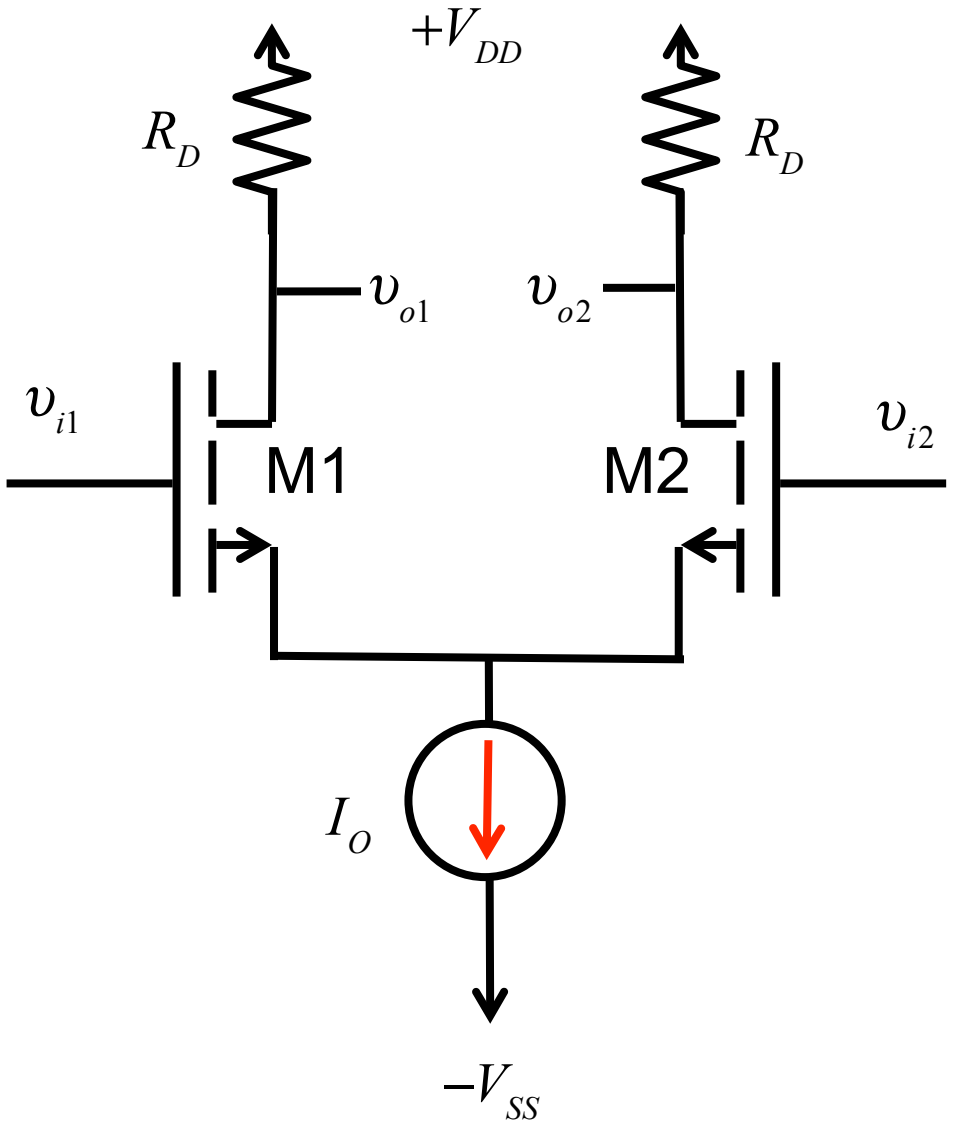
$A_{dm} = 100\ \text{V/V}$

$A_{cm} = 0.1\ \text{V/V}$

$v_o = ?\ \text{mV}$



Problem 9.14 (design)



$$V_{DD} = V_{SS} = 1\,\text{V}$$

$$P_D < 1\,\text{mW}\,(\text{equilibrium})$$

$$v_{O1} = v_{O2} = 0.2\,\text{V}$$

$$A_{dm} = 10$$

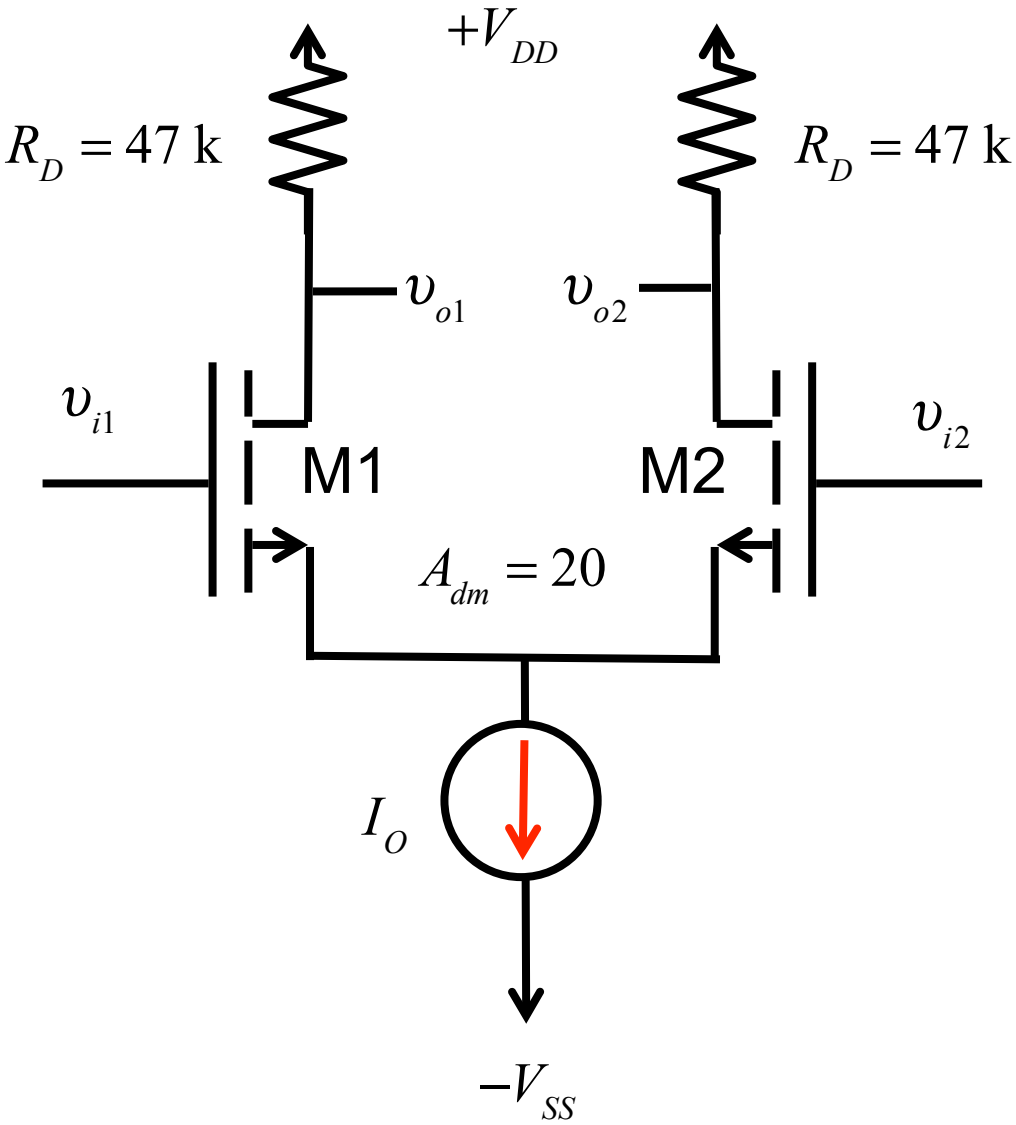
$$\mu_n C_{ox} = 400\,\mu\text{A/V}^2$$

$$V_A = \infty$$

$I_0 = ?$ $\qquad W / L = ?$

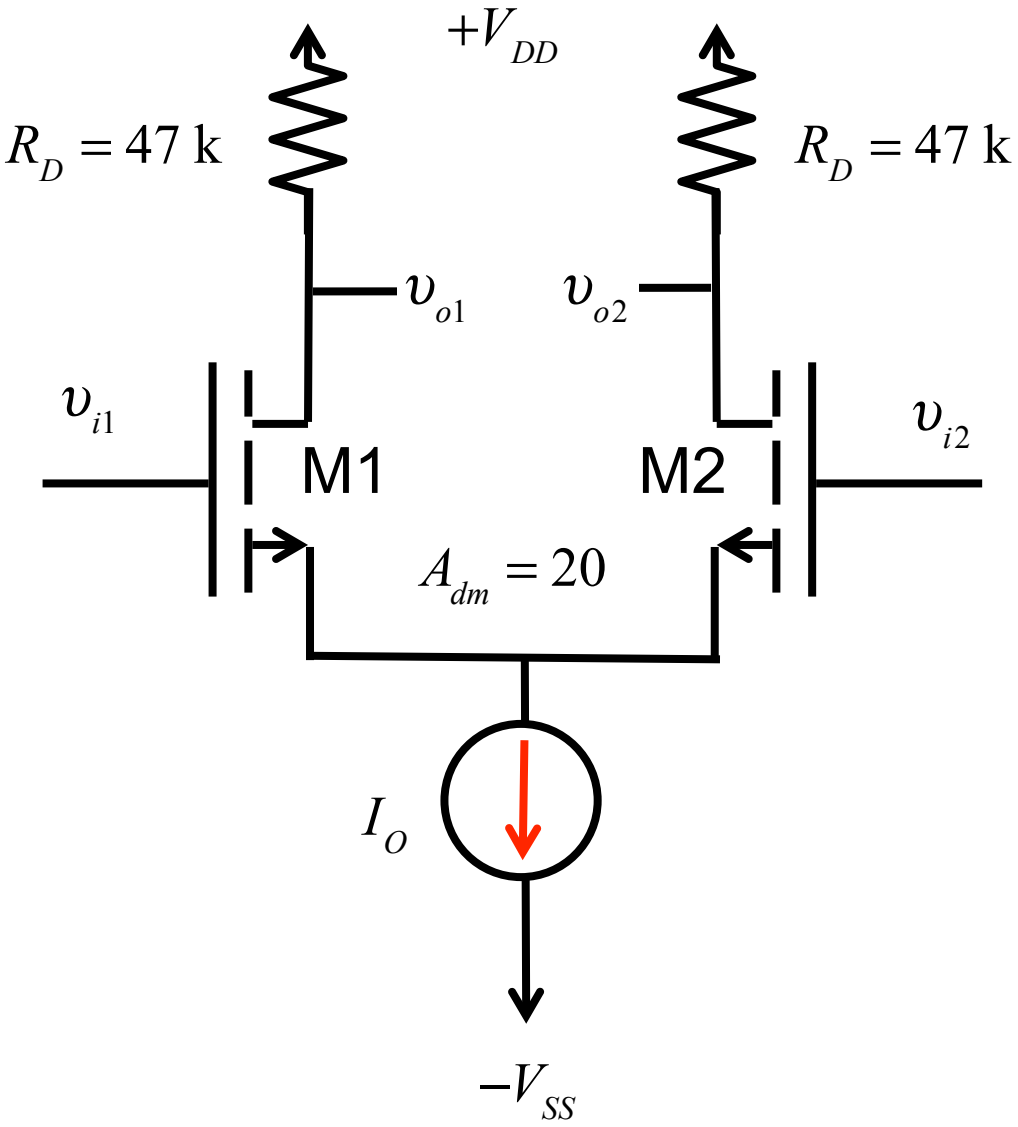
$R_D = ?$

Problem 9.16 (analysis-a)



$g_m = ?$

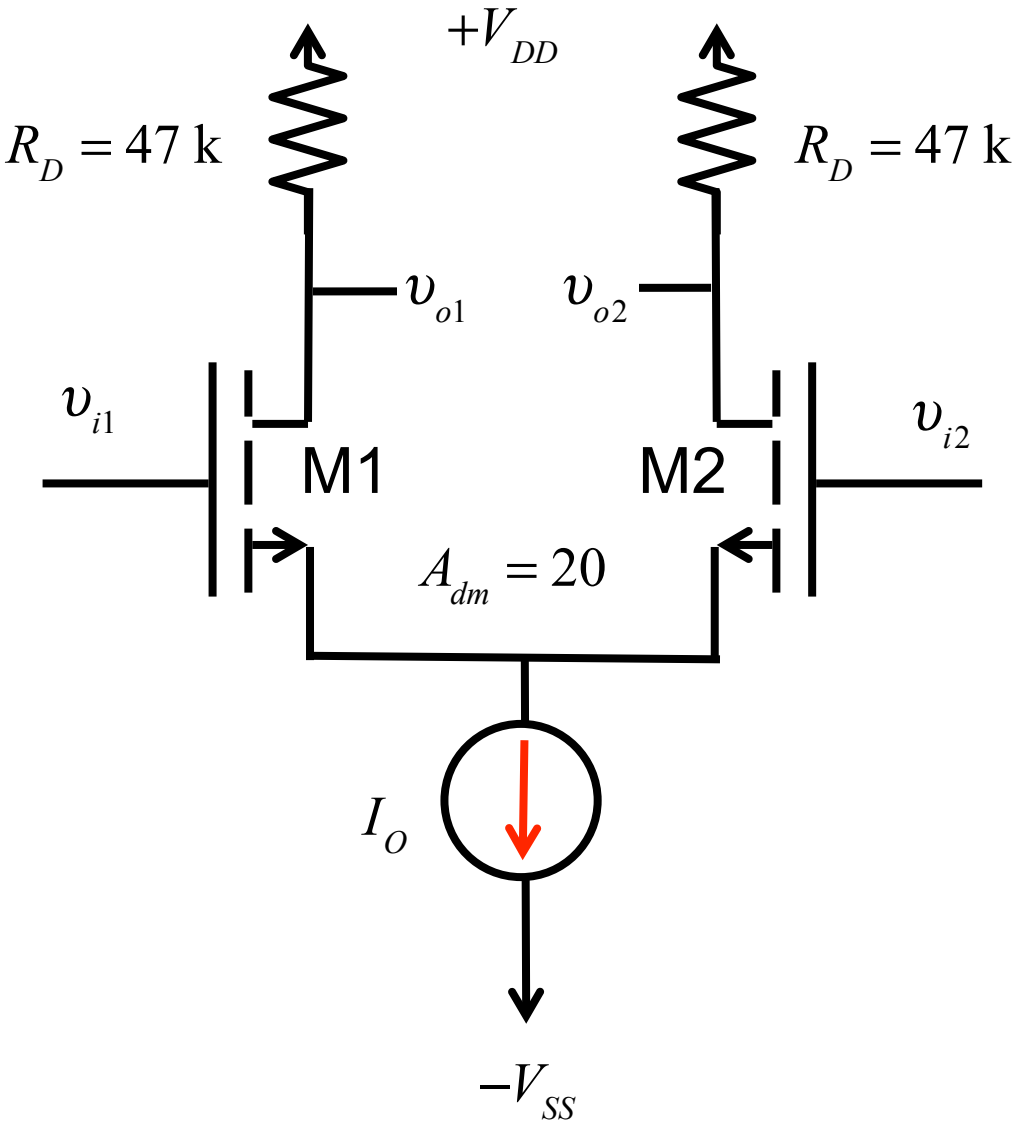
Problem 9.16 (analysis-b)



If $V_{GS} - V_{tn} = 0.2$

$I_0 = ?$

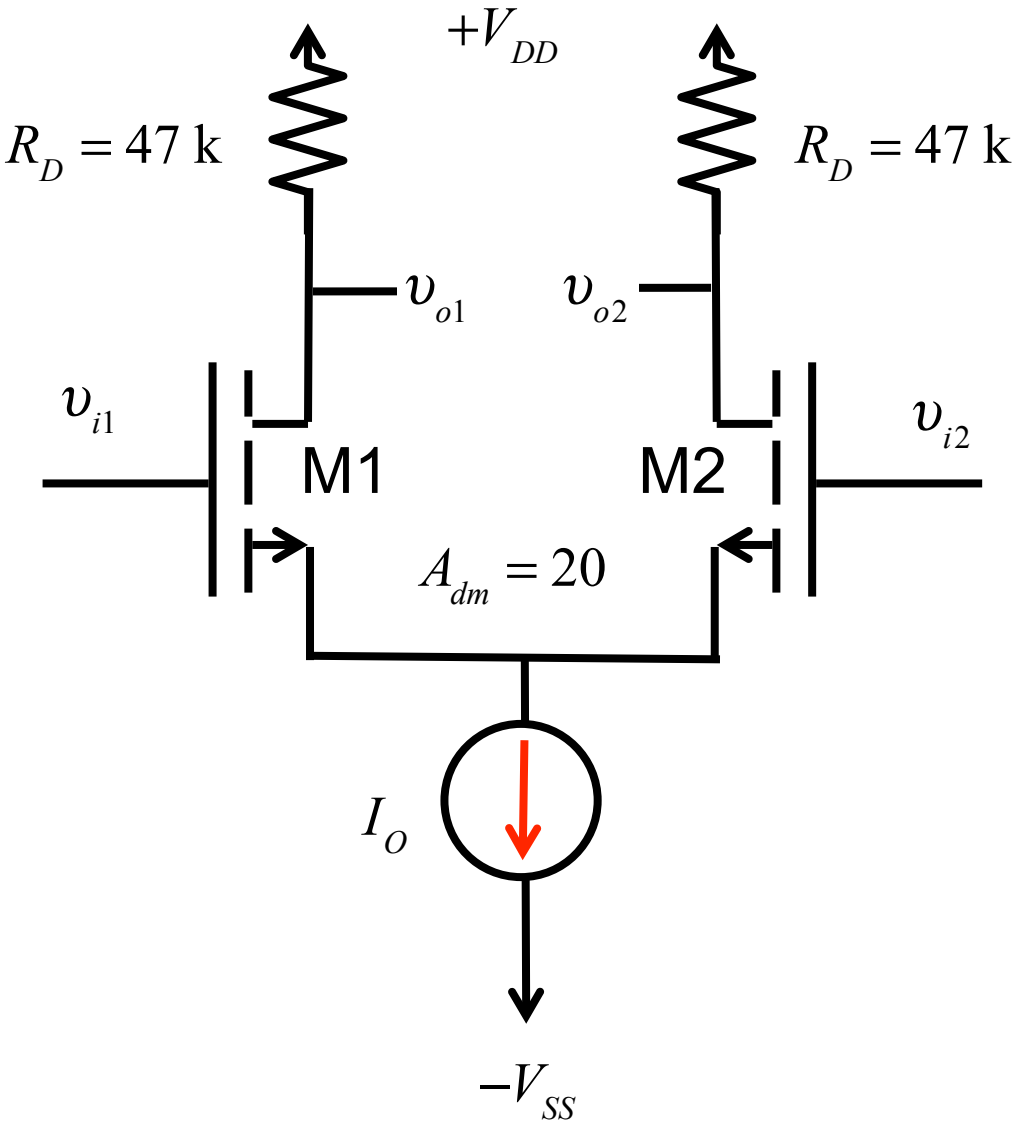
Problem 9.16 (analysis-c)



If $\upsilon_{id} = 0$

$V_{R_D} = ?$

Problem 9.16 (analysis-d)

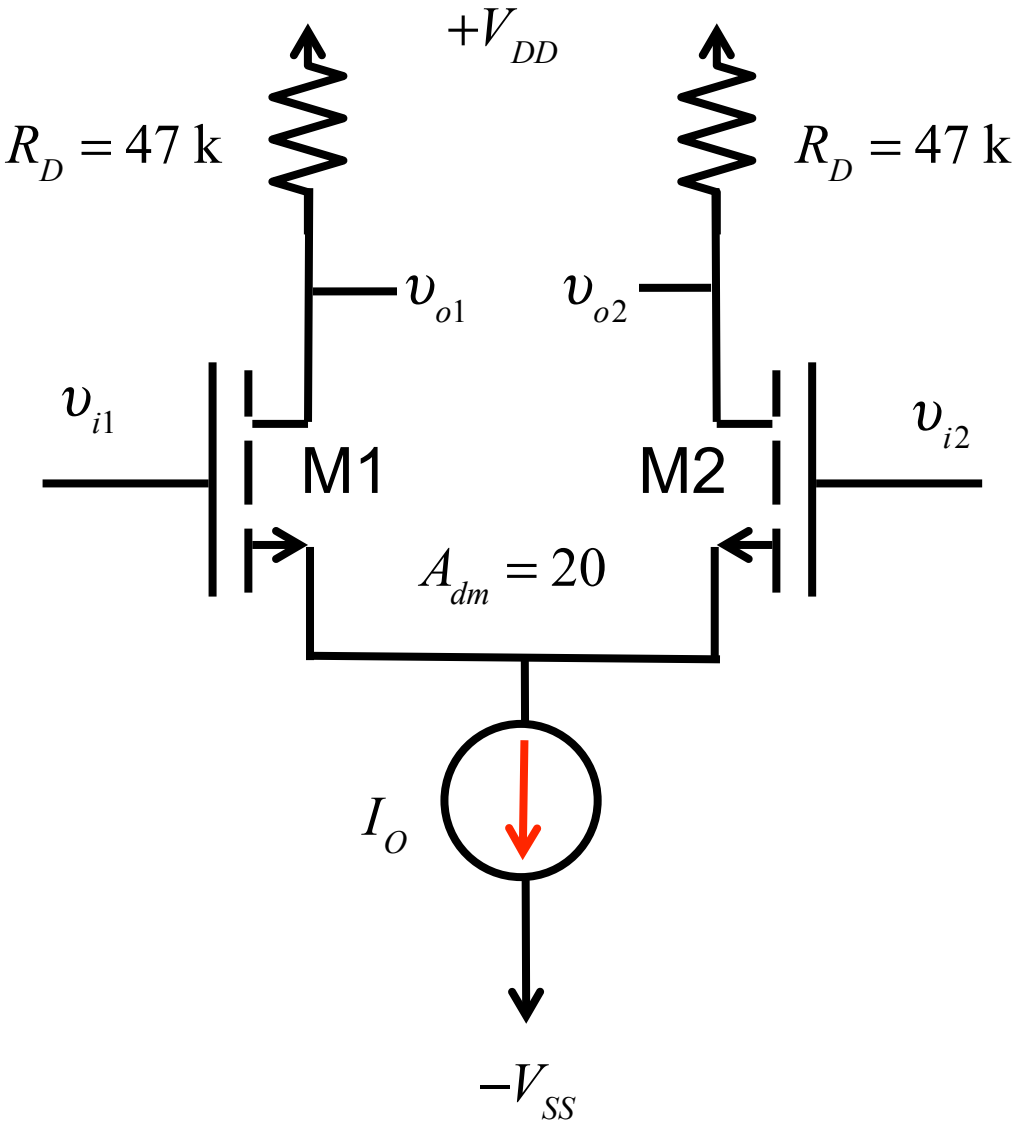


If $\upsilon_{id} = 20 \sin \omega t\ \text{mV}$

$V_{CM} = 0.5\ \text{V}$

$\upsilon_{o2} = ?$

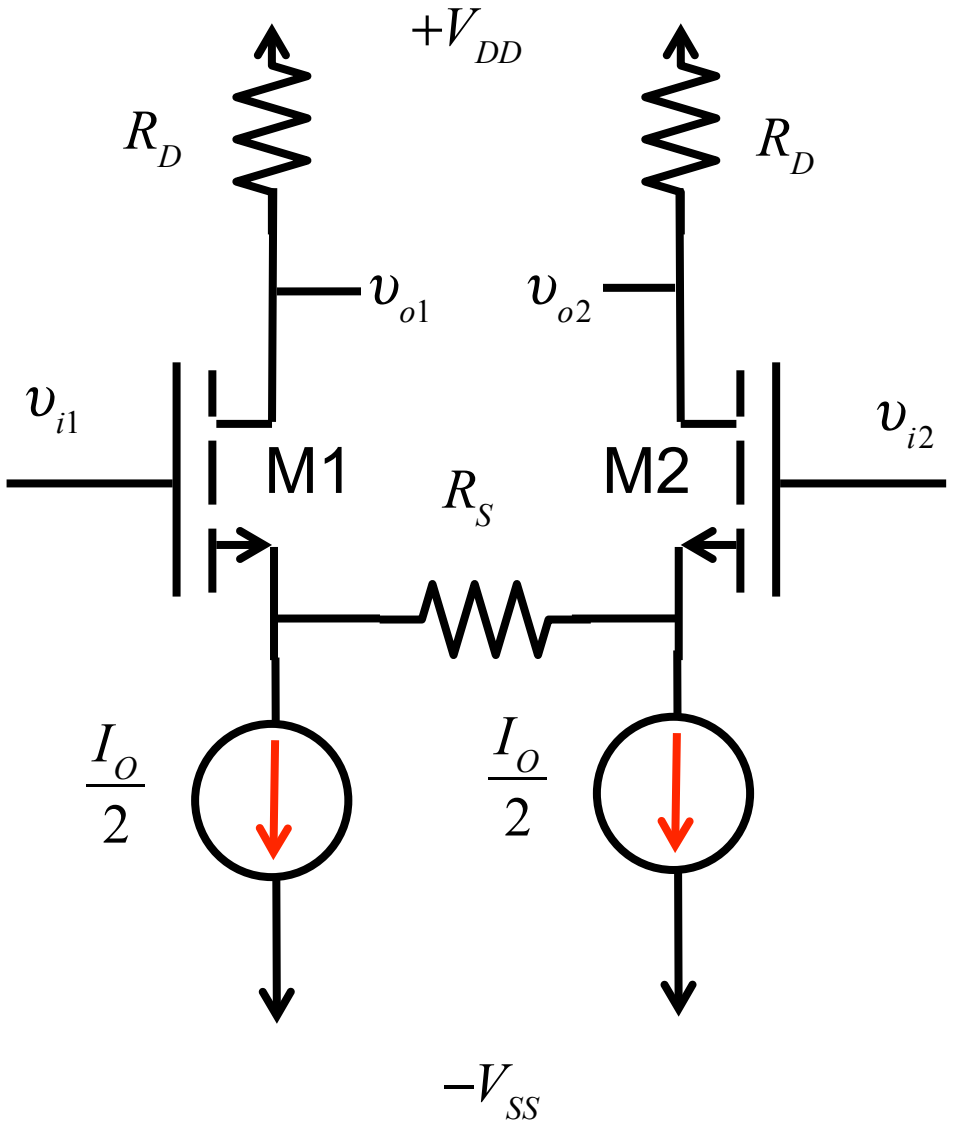
Problem 9.16 (analysis-e)



If $V_{tn} = 0.5\ \text{V}$

$V_{DD}\big)_{\text{min}} = ?$

Problem 9.20

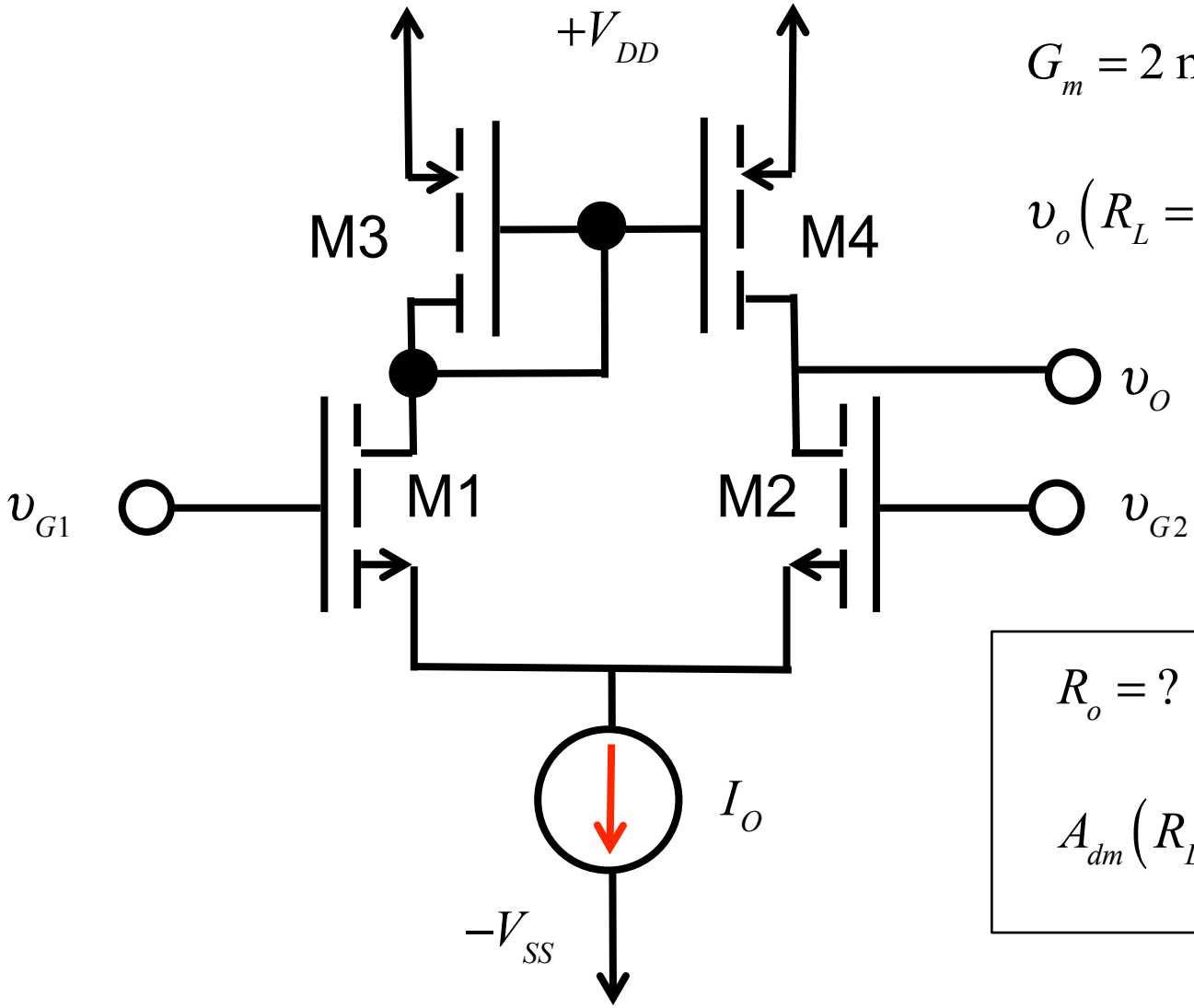


$$A_{dm} = ?$$

$$A_{dm}(R_S = 0) = ?$$

$$A_{dm}(R_S = ?) = \frac{A_{dm}(R_S = 0)}{2}$$

Problem 9.85



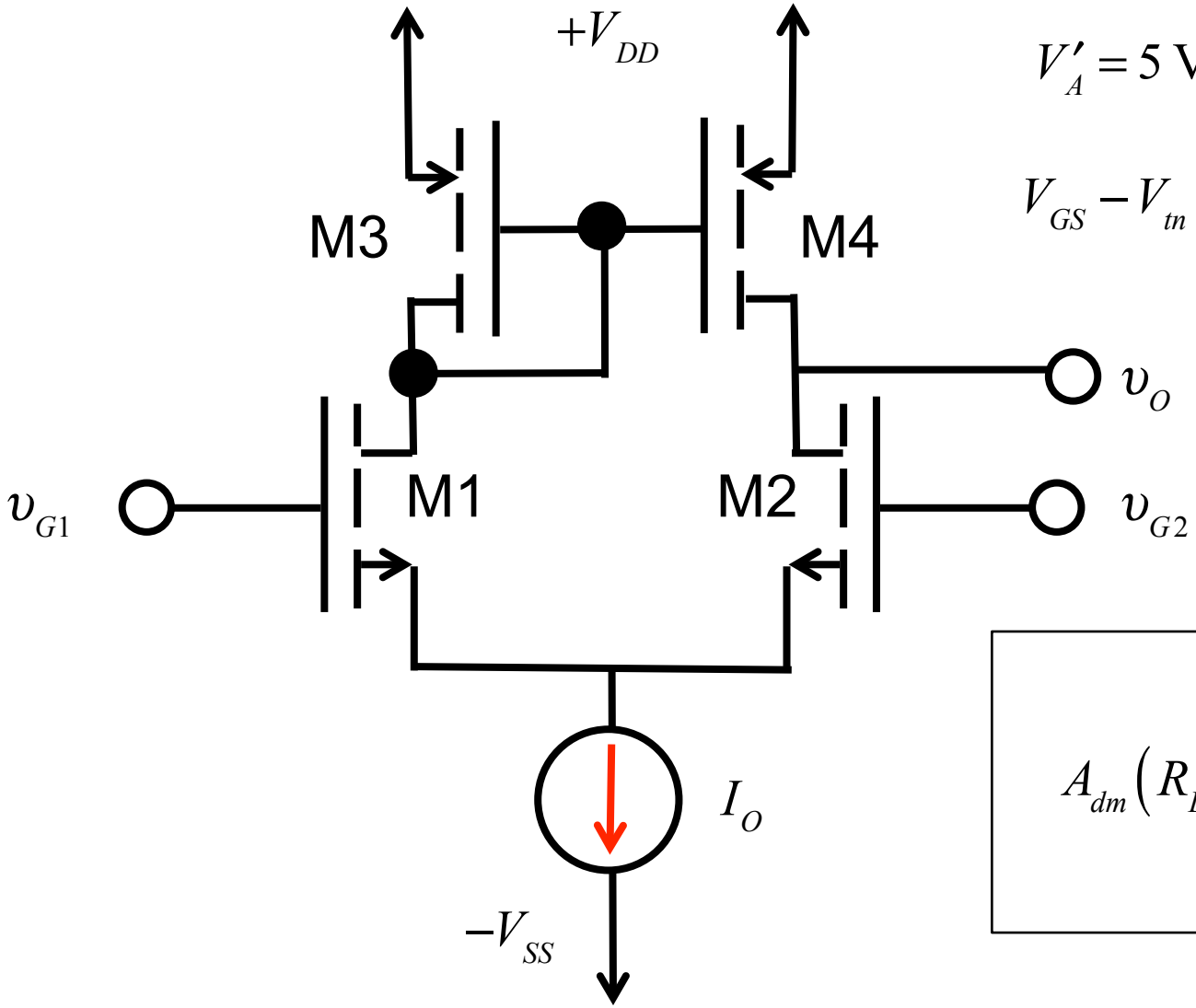
$$G_m = 2\ \text{mA/V}$$

$$\upsilon_o\left(R_L = 20\ \text{k}\right) = \frac{\upsilon_o\left(R_L = \infty\right)}{2}$$

$$R_o = ?$$

$$A_{dm}\left(R_L = \infty\right) = ?$$

Problem 9.86

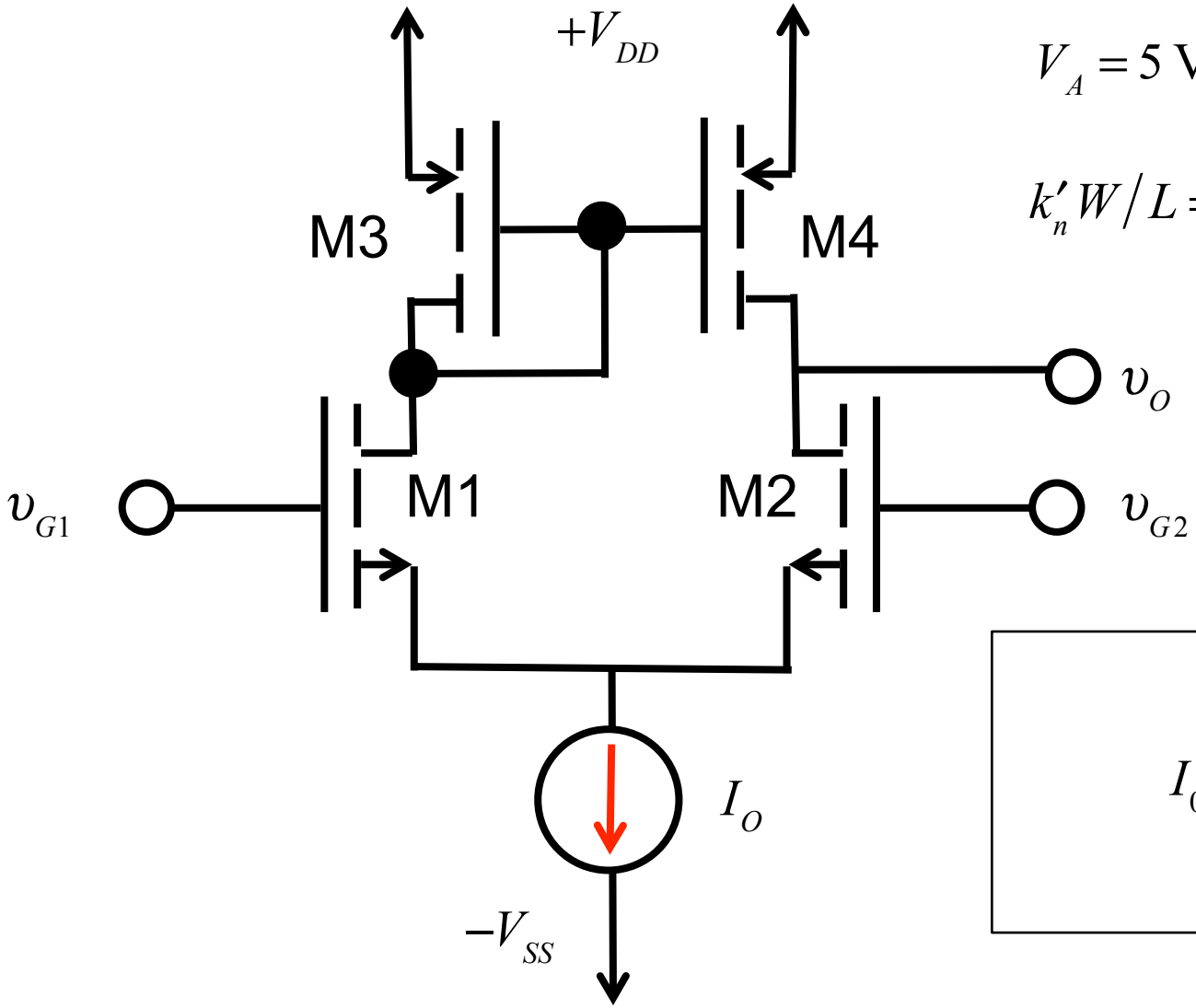


$V_A' = 5\ \text{V}/\mu\text{m}$ $\quad L = 0.5\ \mu\text{m}$

$V_{GS} - V_{tn} = 0.25\ \text{V}$

$A_{dm}\left(R_L = \infty\right) = ?$

Problem 9.88

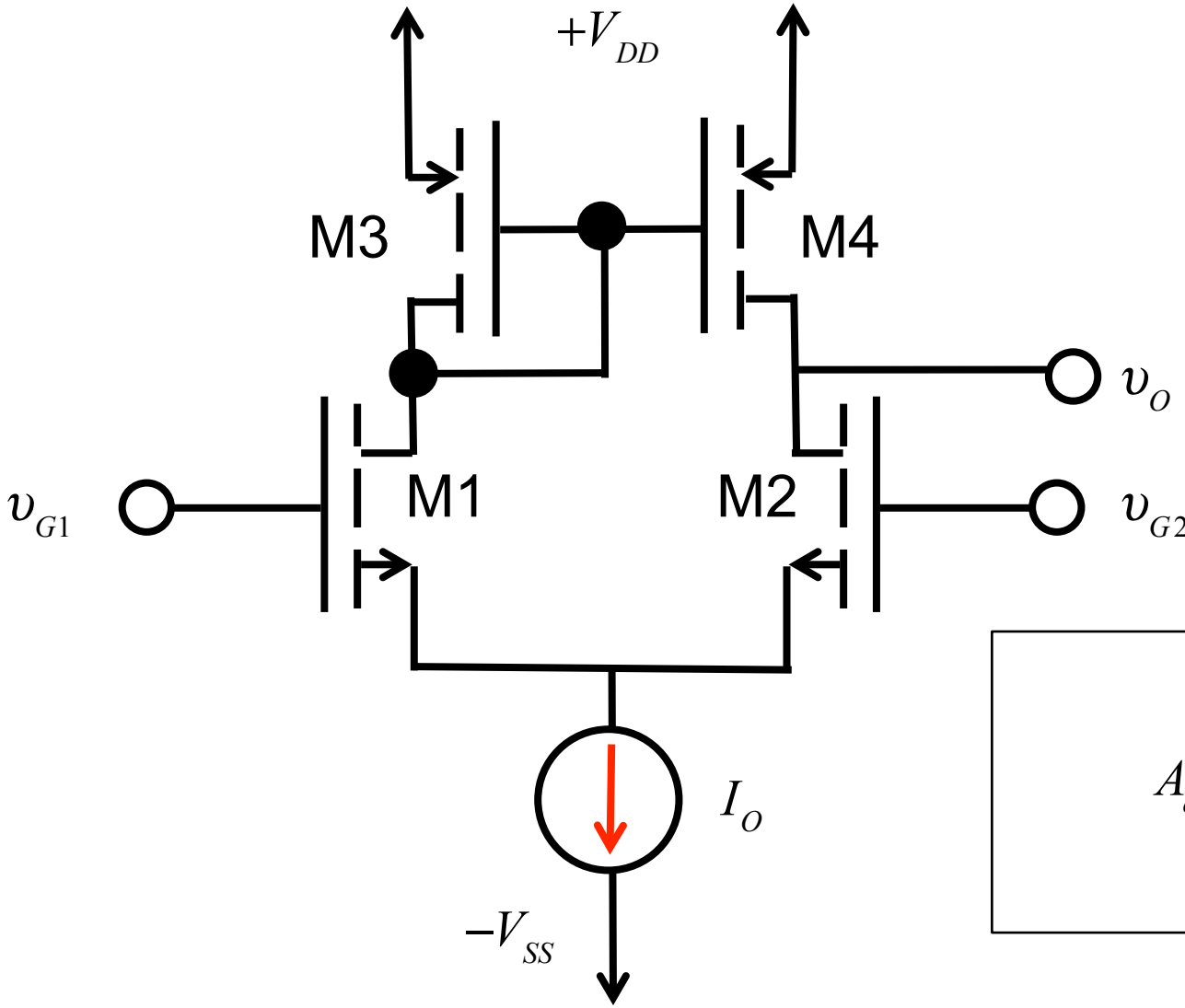


$V_A = 5\ \text{V}$ $\qquad A_{dm} = 20$

$k_n' W/L = k_n = 4\ \text{mA/V}^2$

$I_0 = ?$

Problem 9.87



$I_0 = 200\ \mu\text{A}$

$W/L)_{M1} = W/L)_{M2} = 50$

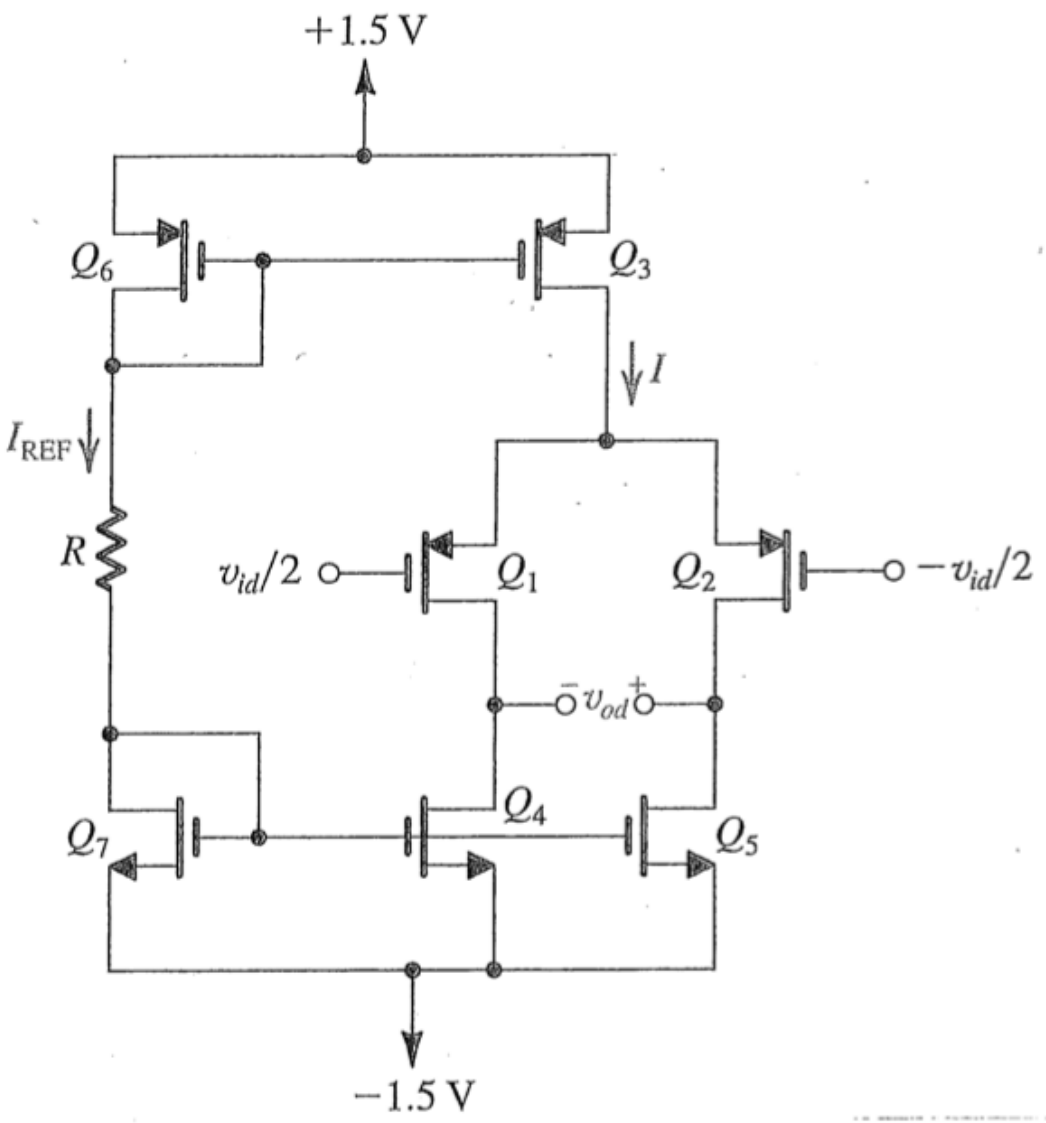
$\mu_n C_{ox} = 200\ \mu\text{A/V}^2$

$L = 0.5\ \mu\text{m}$

$V'_A = 5\ \text{V}/\mu\text{m}$

$A_{dm} = ?$

Problem 9.23 (Design)



Problem 9.23 (Design)

$$I_{REF} = I = 200\ \mu\text{A}$$

$$A_{dm} = 50$$

$$V_{G6} = V_{G3} = 0.8\ \text{V}$$

$$V_{G7} = V_{G4} = V_{G5} = -0.8\ \text{V}$$

$$R = ? \qquad W/L) = ?$$

$$I_D = ? \qquad V_{GS} = ?$$

$$\mu_n C_{ox} = 2.5\mu_p C_{ox} = 250\ \mu\text{A/V}^2 \qquad V_{tn} = |V_{tp}| = 0.5\ \text{V} \qquad V_{An} = V_{Ap} = 10\ \text{V}$$

Problem 9.23 (Design)

$$I_{REF} = I = 200\ \mu\text{A}$$

$$V_{tn} = \left|V_{tp}\right| = 0.5\ \text{V}$$

$$V_{An} = V_{Ap} = 10\ \text{V}$$

$$\mu_n C_{ox} = 2.5\mu_p C_{ox}$$

$$= 250\ \mu\text{A/V}^2$$