

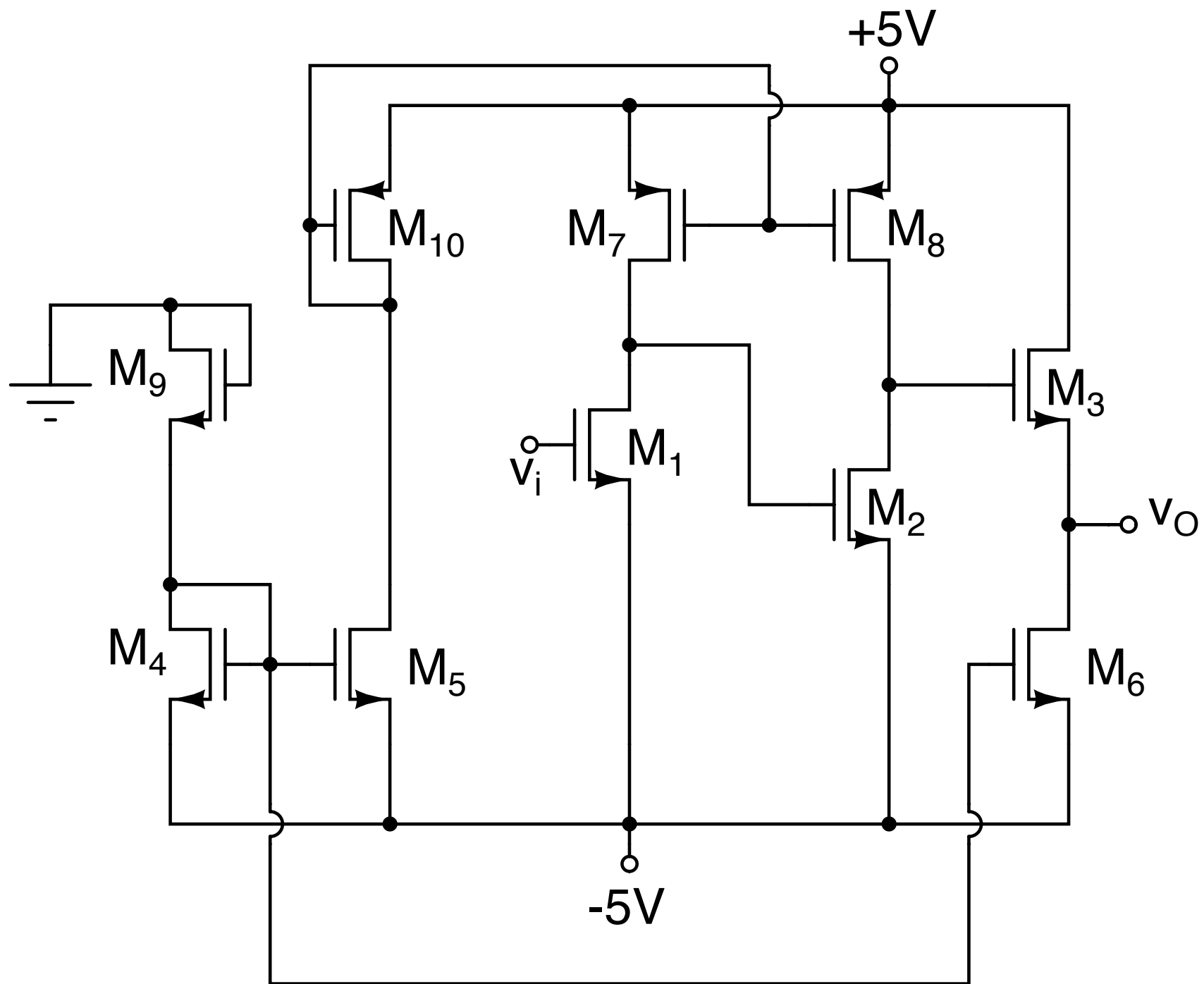
Examen 3

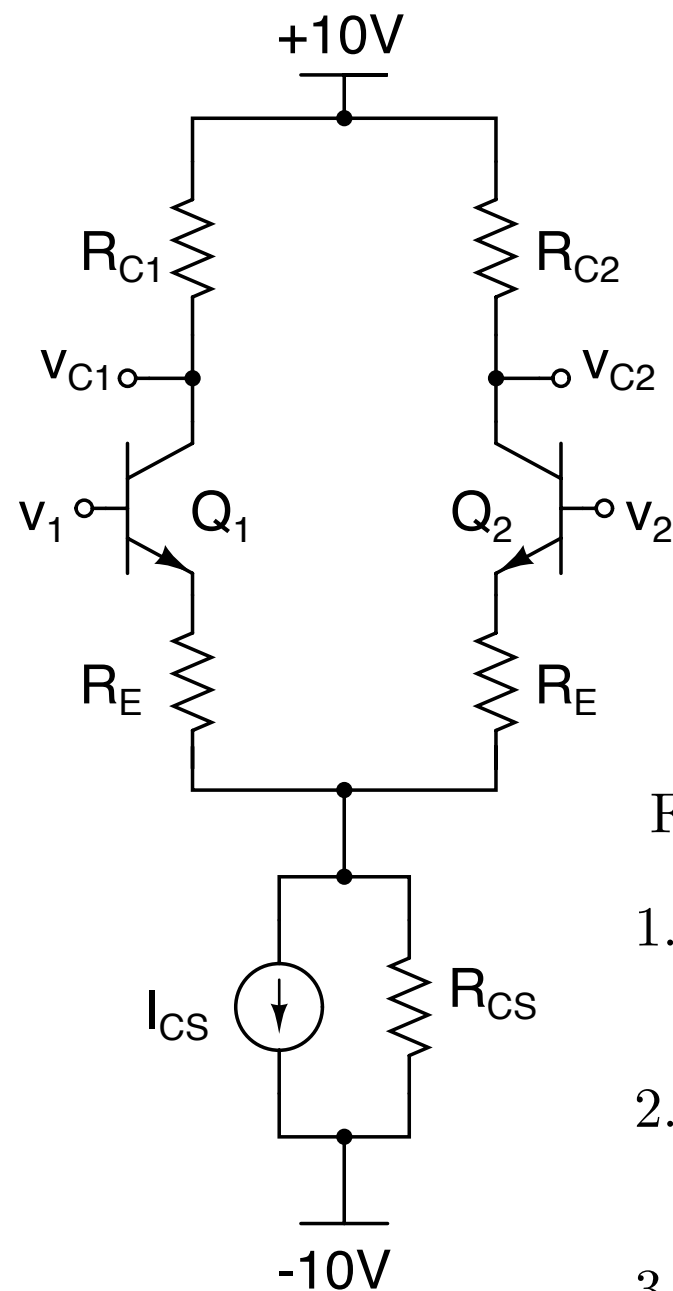
INEL 4202 - Electrónica II
Primer semestre 2009-2010

1. Amplificadores Operacionales: análisis ideal y aplicaciones
2. Espejos de corriente
 - (a) Diseño
 - (b) Calculo de la corriente
 - (c) Calculo de la R_o
3. Amplificadores diferenciales
 - (a) ganancia diferencial con salida diferencial y salida *single-ended*
 - (b) ganancia de modo común con salida *single-ended*, CMRR
 - (c) ganancia de modo común si hay diferencias en las R_C o en las g_m 's
 - (d) resistencias en el emisor (*emitter degeneration*)
 - (e) Cargas activas
4. Amplificadores multi-etapas y operacionales
 - (a) BJT: simples, uA741
 - (b) CMOS simples, folded-cascode

The following diagram shows a multistage amplifier biased by current mirrors. The transistor parameters are: $k'_n = 80\mu A/V^2$, $k'_p = 40\mu A/V^2$, $V_{tn} = -V_{tp} = 0.7V$, $\lambda_n = \lambda_p = 1/100V$, $(W/L)_{1,2,4,5,7,10} = 2/1$ and $(W/L)_{3,6,8,9} = 8/1$. Determine the following quantities:

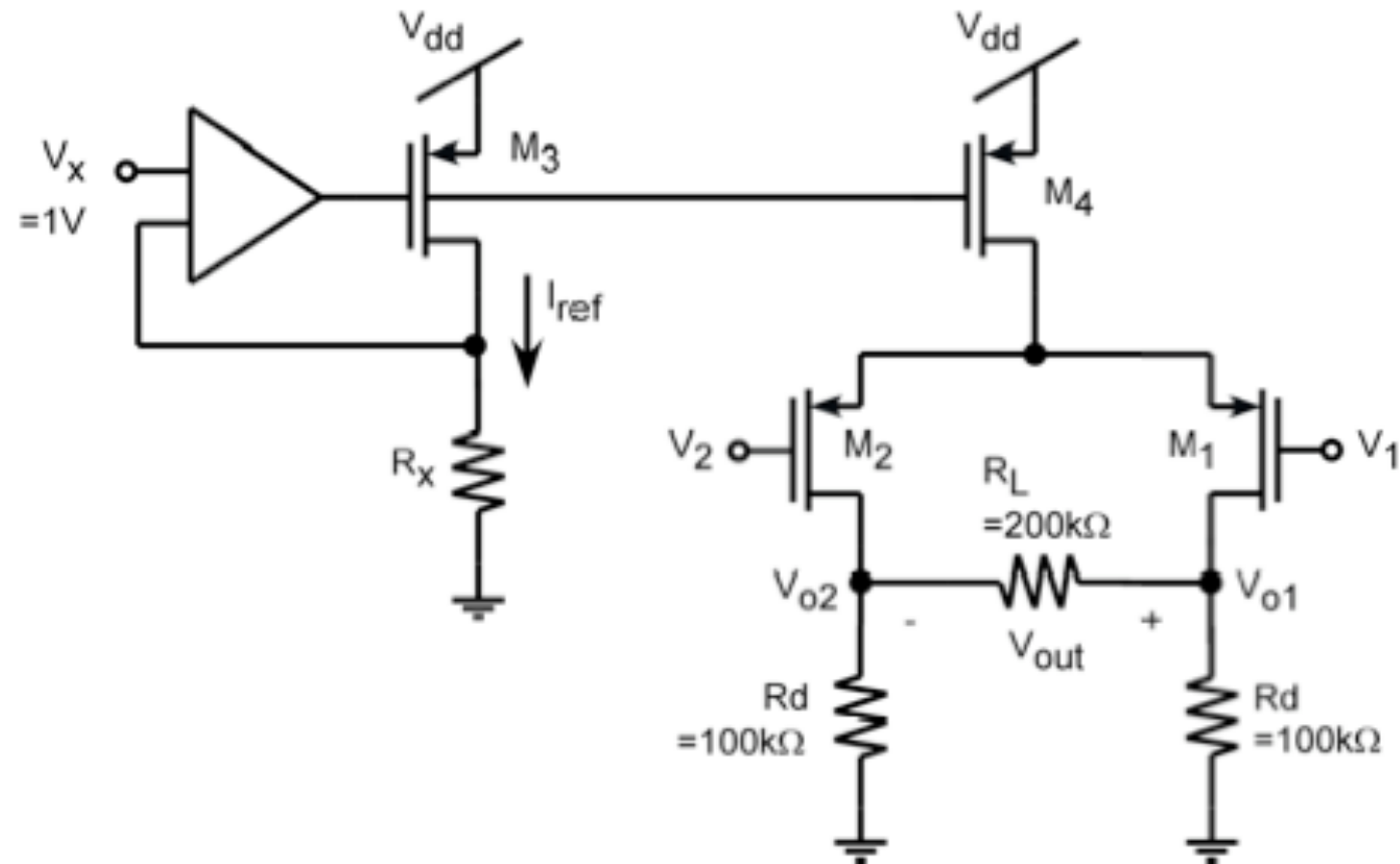
1. bias currents for all transistors.
2. overall voltage gain if no load is present.
3. voltage gain and power dissipated if $R_L = 1k\Omega$ is attached to the output.





Find

1. The differential gain $A_d = \frac{v_{C1} - v_{C2}}{v_d}$ when $v_1 = +v_d/2$ and $v_2 = -v_d/2$, $R_{C1} = R_{C2} = 20k\Omega$, $R_E = 0$, $R_{CS} = \infty$ and $I_{CS} = 200\mu A$.
2. The differential gain $A_d = \frac{v_{C1} - v_{C2}}{v_d}$ when $v_1 = +v_d/2$ and $v_2 = -v_d/2$, $R_{C1} = R_{C2} = 20k\Omega$, $R_E = 500\Omega$, $R_{CS} = \infty$ and $I_{CS} = 200\mu A$.
3. The common-mode rejection ratio if $v_O = v_{C1}$, $R_{C1} = R_{C2} = 20k\Omega$, $R_E = 0$, $R_{CS} = 500k\Omega$ and $I_{CS} = 200\mu A$.
4. The common-mode rejection ratio A_{cm}/A_d if $v_O = v_{C1} - v_{C2}$, $R_{C1} = 20.5k\Omega$, $R_{C2} = 19.5k\Omega$, $R_E = 0$, $R_{CS} = 500k\Omega$ and $I_{CS} = 200\mu A$.



For the following circuit, where V_x is DC bias voltage:

- determine the correct polarity of the amplifier terminals so that it works properly with negative feedback
- determine the value of the resistor R_x for a reference current of $10\mu\text{A}$
- find the differential mode gain $A_d = V_{out}/V_{id}$ (use $I_{ref} = 10\mu\text{A}$)
- determine the common mode gain $A_{cm} = V_{o1}/V_{cm}$ (use $I_{ss} = 10\mu\text{A}$)

Assume: Ideal Amplifier ($A_v = \infty$), $K_{p3} = 500\mu\text{A/V}^2$, $K_{p4}/K_{p3} = 2$, $\lambda_{p1} = \lambda_{p2} = 0$, $\lambda_{p4} = 0.01\text{V}^{-1}$