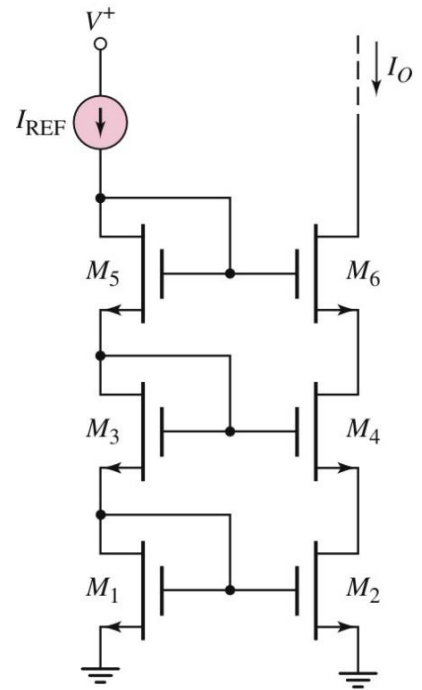


Electronics II, Exam-3, Spring 2022
 Department of Communication Engineering, National Central University
 May 26, 2022, Prof. Dah-Chung Chang (E1-311)

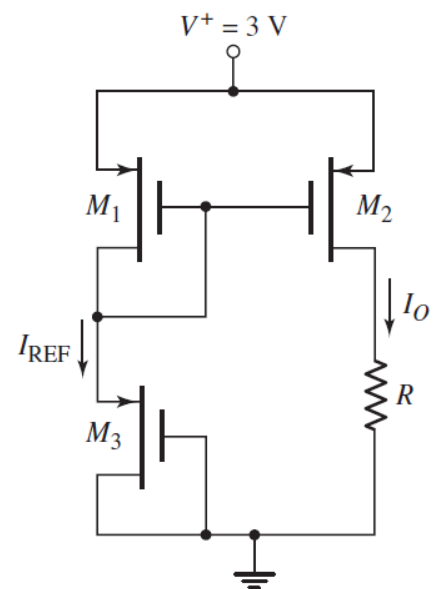
1. (25%) Assume all transistors are matched. Let $I_{REF} = 0.2\text{mA}$, $K_n = 0.2\text{mA}/\text{V}^2$, $V_{TN} = 1\text{V}$, and $\lambda = 0.02\text{V}^{-1}$. Determine the output resistance looking into the drain of M_6 .



Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

2. (25%) The transistor parameters are $V_{TP} = -0.4\text{V}$, $k'_p = 60\mu\text{A}/\text{V}^2$, and $\lambda = 0$. The width-to-length ratios are $(W/L)_1 = 25$, $(W/L)_2 = 15$, and $(W/L)_3 = 5$.

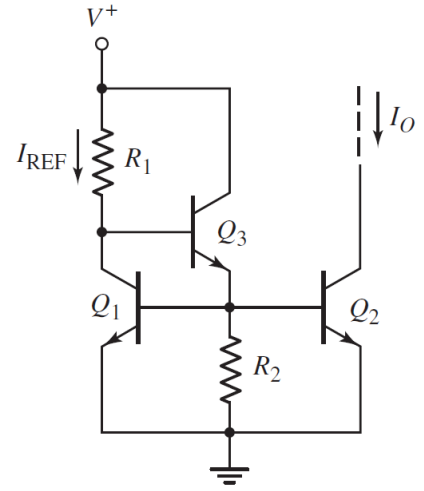
- (a) Determine I_O , I_{REF} , V_{SG1} , and V_{SG3} . (20%)
 (b) What is the largest value of R such that M_2 remains biased in the saturation region? (5%)



3. (25%) The transistor parameters are $\beta = 80$, $V_{BE}(\text{on}) = 0.7V$, and $V_A = \infty$.

(a) Derive the expression for I_O in terms of I_{REF} , β , and R_2 . (15%)

(b) For $R_2 = 10k\Omega$, $I_O = 0.7mA$ and $V^+ = 10V$, find R_1 . (10%)



4. (25%) The transistor M_2 sources a bias current to a load circuit.

Assume the circuit is biased at $V^+ = +5V$ and $V^- = -5V$, and assume the transistor parameters are $V_{TP} = -0.5V$, $k'_p = 50 \mu A/V^2$, $(W/L)_1 = (W/L)_2 = 15$, $(W/L)_3 = 3$, and $\lambda = 0$. Determine I_{REF} , I_O , and $V_{SD2}(\text{sat})$.

