In the amplifier circuit below, the transistors are in saturation and have the following characteristics:

$K_n' = \mu_n C_{ox} = 2 \times 10^{-5}$ A/V^2

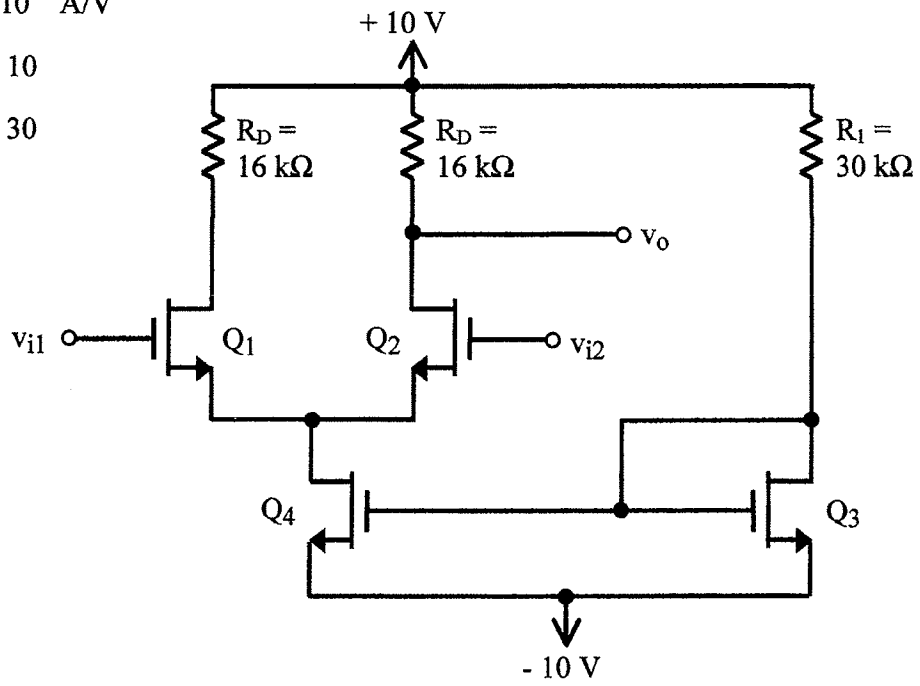
$(W/L)_1 = (W/L)_2 = 10$

$(W/L)_3 = (W/L)_4 = 30$

$V_t = 1$ V

$\lambda_1 = \lambda_2 = \lambda_3 = 0$

$\lambda_4 = 0.01$ V^{-1}



a) For this amplifier, determine the dc bias point value for v_o . (0.5 points)

b) What is the small signal single-ended voltage gain $A_O = v_o / (v_{i1} - v_{i2})$ for this amplifier? (1 point)

c) What is the small signal common mode voltage gain $A_{cm} = (v_o / v_{icm})$ for this amplifier, where $v_{i1} = v_{i2} = v_{icm}$? (1 point)

d) What is the CMRR for this single-ended amplifier? (0.5 points)

e) If the output is connected directly to the inverting input and the input voltage is applied to the non-inverting input, forming a voltage follower, determine the range of input voltages over which the circuit will function correctly as a voltage follower. Note that this range of allowable input voltages is often called the input common-mode range. (1 point)