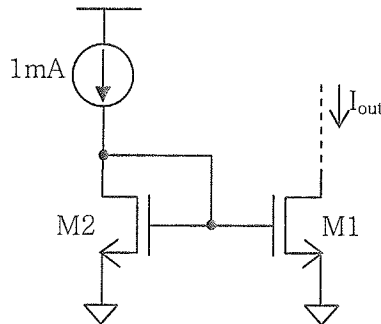
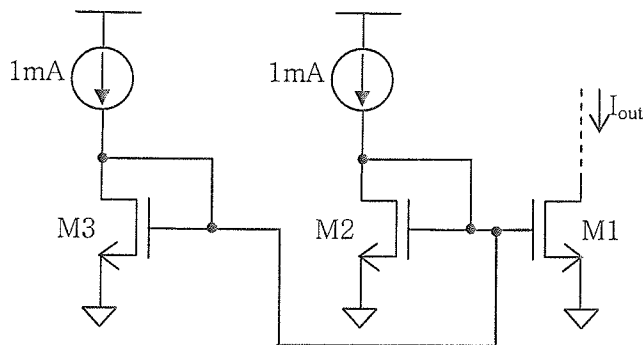


Problem 1 [25 points] (a) [12 points] In the circuit shown below, find I_{out} . Assume all transistors have a same size, and are in saturation. Assume $r_{o1} = r_{o2} = r_{o3} = \infty$. Assume the current source is ideal. Ignore short channel effect.

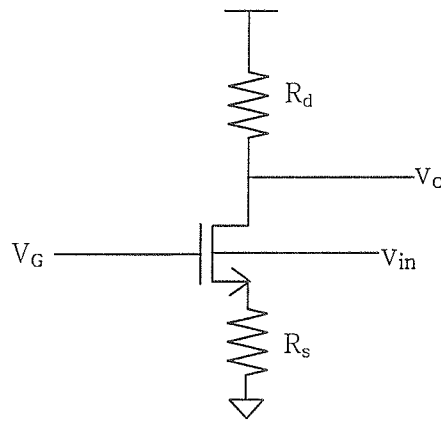


(b) [13 points] Find I_{out} again for the circuit shown below.



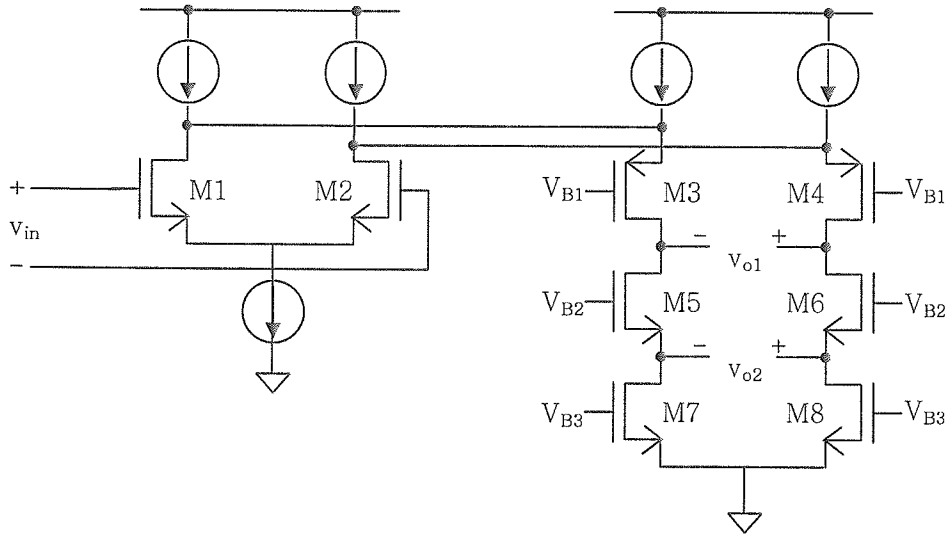
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Problem 2 [25 points] In the circuit shown below, find its small signal transfer function $H(s) = v_o/v_{in}$. Assume all transistors are in saturation and $r_o = \infty$. Ignore C_{gd} , C_{sb} , and C_{db} . Include C_{gs} and body effect.



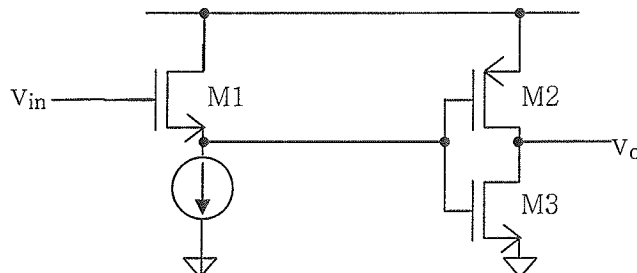
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Problem 3 [25 points] In the circuit shown below, find the low frequency gains v_{o1}/v_{in} and v_{o2}/v_{in} in terms of g_m and r_o . Assume all transistors are in saturation and the current sources are ideal. Ignore body effect.



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Problem 4 [25 points] In the circuit shown below, find its small signal transfer function $H(s) = v_o/v_{in}$ in terms of g_m , r_o , and C_{gs} of the transistors. Assume $r_{o1} = \infty$. Assume all transistors are in saturation. Ignore C_{gd} , C_{sb} , C_{db} , and body effect. Assume the current source is ideal.



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