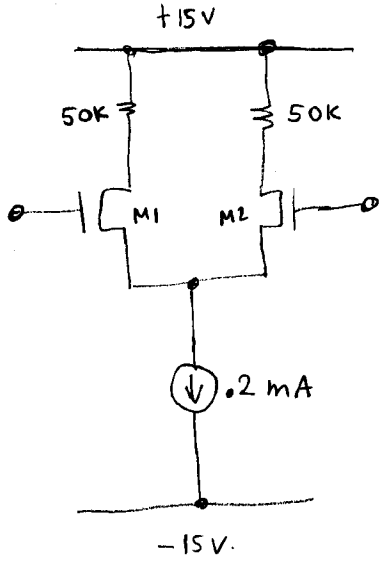
MOSFET differential amp (Chapter 7-1).



$K' = 2 \times 10^{-4}$

$V_{TH} = 2$

$\frac{W}{L} = 10$

Find operating point:

$I_D = .1 \text{ mA} = 10^{-4}$

$= \frac{1}{2} K' \frac{W}{L} (V_{GS} - V_{TH})^2$

$= \frac{1}{2} (2 \times 10^{-4})(10)(V_{GS} - V_{TH})^2$

$10^{-4} = 10^{-3} (V_{GS} - V_{TH})^2$

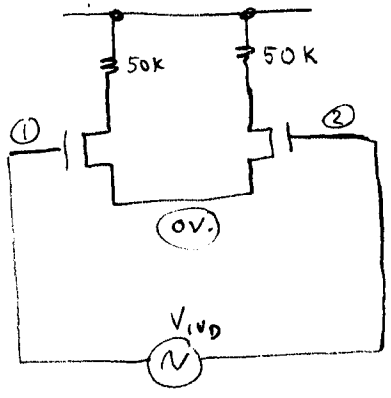
$V_{DD} - V_D = I_D R_D$

$= (10^{-4})(5 \times 10^4)$

$V_{DD} - V_D = 5$

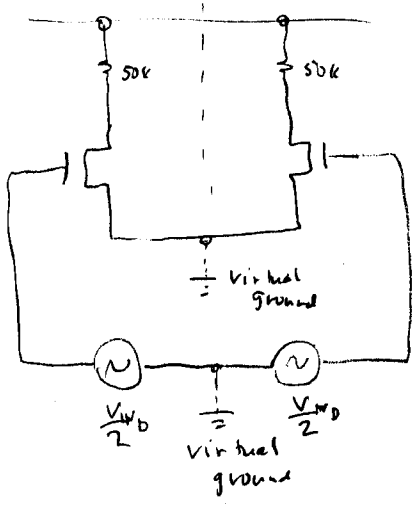
$V_D = +10$

Differential gain



Think about ....

Node ① goes up, Node ② goes down by the same amount



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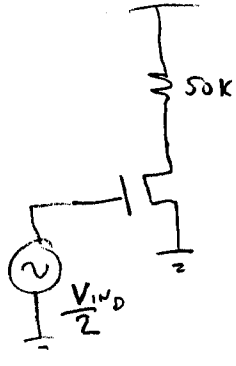
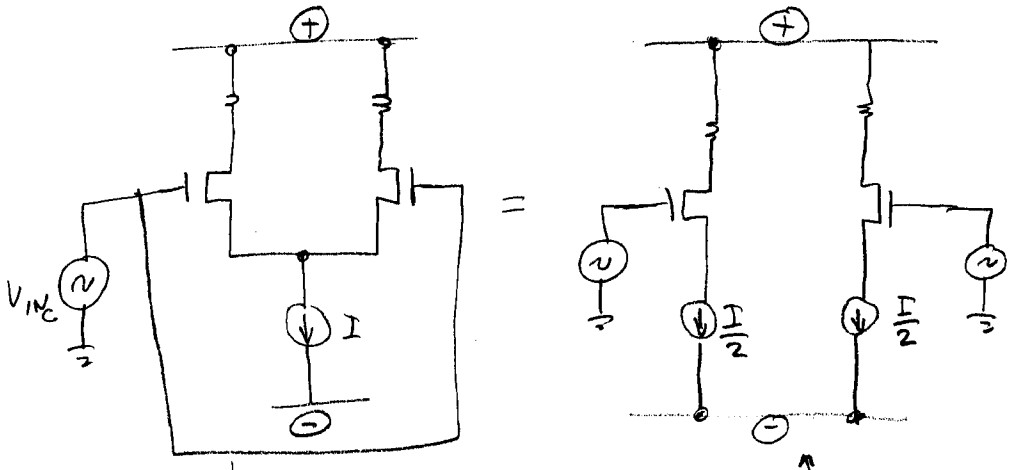


$A = \frac{g_m R_L}{2}$

split to half circuits — analyze each half

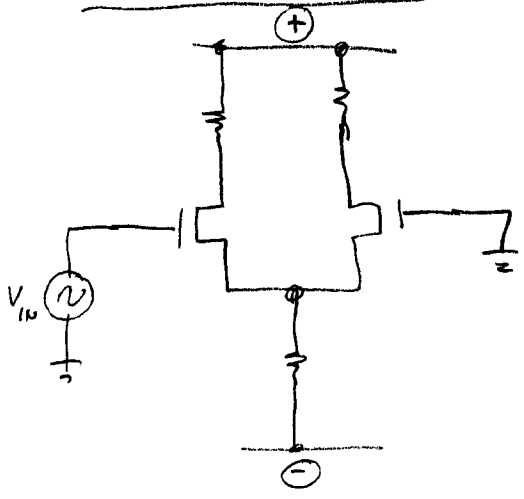
Common mode "gain"



split to half-circuits

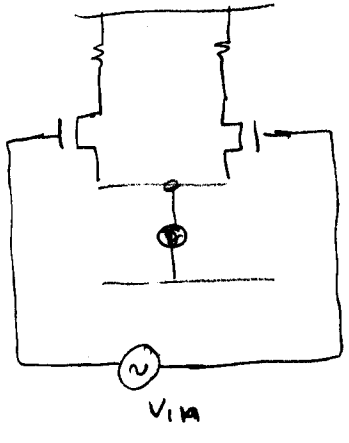
Analyze each half.

Drive one side...



Apply superposition — it consists of both differential mode and common mode.

Differential



Common mode