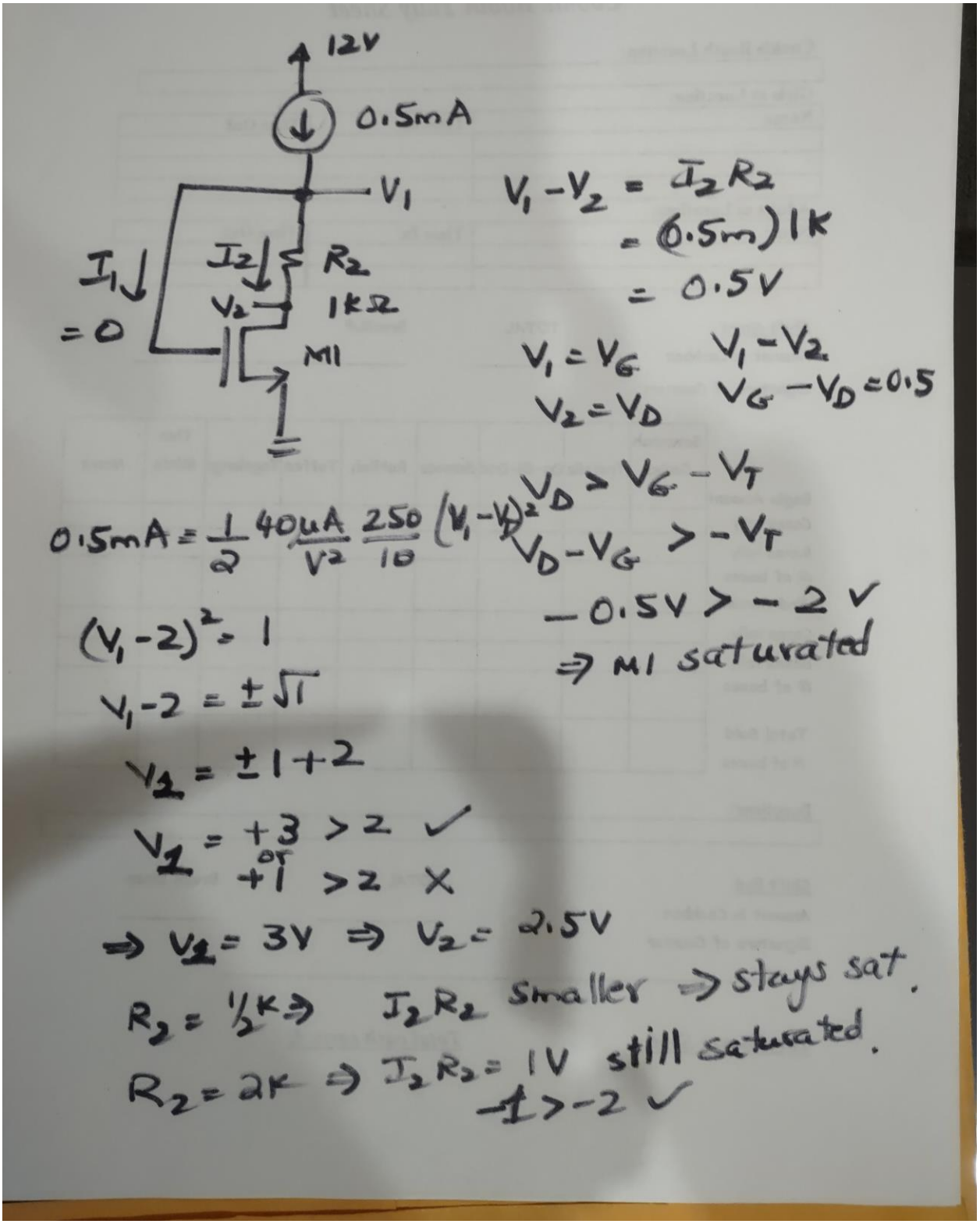
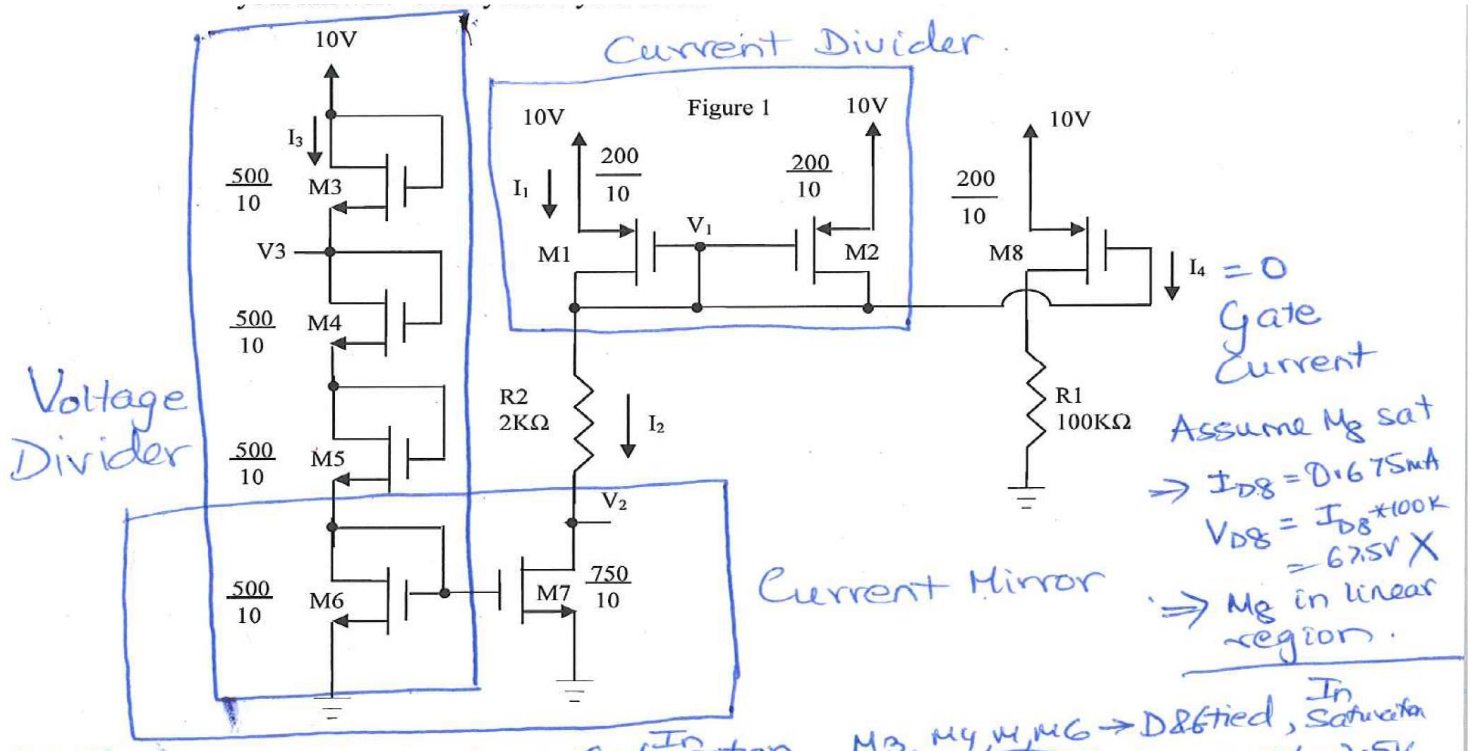
SANTA CLARA UNIVERSITY	ELEN 115 – Spring 2023	S. Krishnan
Homework #8 Solutions		

1.



2.



Assume M_8 sat

$\Rightarrow I_{D8} = 0.675mA$

$V_{D8} = I_{D8} * 100K = 67.5V$ X

$\Rightarrow M_8$ in linear region.

PMOS $M_1, M_2 \rightarrow$ D & G tied $\rightarrow$ In Saturation

Current Divider $I_1 = I_2/2 = 675\mu A = I_1$

$M_3, M_4, M_5, M_6 \rightarrow$ D&G tied, In Saturation

Voltage Divider $\Rightarrow 10/4 = 2.5V$ across each NMOSFET. $V_{GS} = 7.5$

$V_{GS3} = +2.5V$

$I_3 = \frac{1}{2} * 25\mu A * \frac{500}{10} (2.5-1)^2$

$V_3 = 7.5V$

$I_3 = 900\mu A$

$M_6/M_7 \rightarrow$ Current Mirror [To prove M_7 saturated]

$\frac{I_{D6}}{I_{D7}} = \frac{(W/L)_6}{(W/L)_7} \Rightarrow I_{D7} = 900\mu A * \frac{750/10}{500/10} = 1.35mA = I_2$

$I_{D1} = 675\mu A = \frac{1}{2} * 15\mu A * \frac{200}{10} [V_{GS1} - (-1.5)]^2$

$(V_{GS1} + 1.5)^2 = 4.5$

$V_{GS1} + 1.5 = \pm\sqrt{4.5} = \pm 2.12$

$V_{GS1} = +0.621 < -1.5$ X

$V_{GS1} = -3.621 < -1.5$ ✓

$\Rightarrow V_{GS1} = -3.621 = V_1 - 10$

$\Rightarrow V_1 = 6.378V$

$V_2 = V_1 - I_2 R_2$

$= 6.378 - 1.35 * 2$

$= 3.678V$

$V_{D2} = V_2 = 3.678 >$

$V_{G2} - V_T = 2.5 - 1.3$ ✓ M_7 Sat