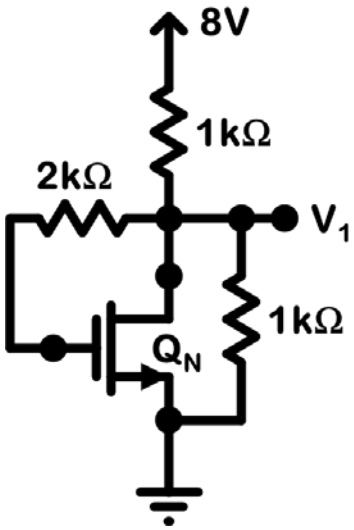
EECS312-Quiz 5

For the circuit to the right, the NMOS (Q_N) is characterized by:

$k_n = 5\ mA/V^2$

$V_{tn} = 1V$



Find the voltage V_1 using saturation mode: $i_D = 0.5k_n(v_{GS}-V_{tn})^2$.

Verify whether saturation is correct.

Show you work for each step and label each step (steps 1 and 5 are completed for you).

1. Guess: Saturation
2. _____
3. _____
4. _____
5. Done:

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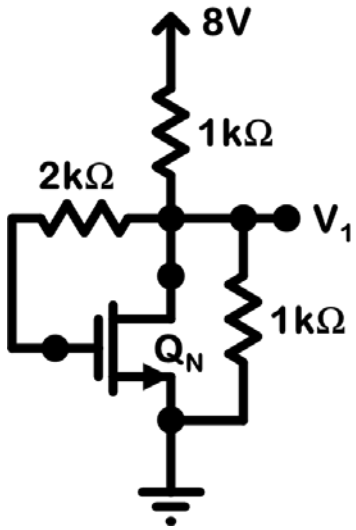

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Verify whether saturation is correct.

Show you work for each step and label each step (steps 1 and 5 are completed for you).

1. Guess: Saturation

2. Enforce
   $i_D = 0.0025(v_{DS}-1)^2$

3. Solve
   $iD = i1-i2$
   $.0025(v_{DS}-1)^2 = (8-v_{DS})/1000 - v_{DS}/1000$
   $2.5v_{DS}^2 - 5v_{DS} + 2.5 = 8 - 2v_{DS}$
   $2.5v_{DS}^2 - 3v_{DS} - 5.5 = 0$

   $v_{DS} = (3 +/- sqrt(9 + 4*2.5*5.5))/5$
   $v_{DS} = (3 +/- sqrt(64))/5 = 11/5$ or -1 choose $11/5 = 2.2$
   $V_1 = v_{DS} = 2.2V$

4. Check
   $v_{GS} > V_{tn}$, $2.2 > 1$, Yes
   $v_{DS} > v_{GS}-V_{tn}$, $2.2 > 1.2$, Yes

5. Done: