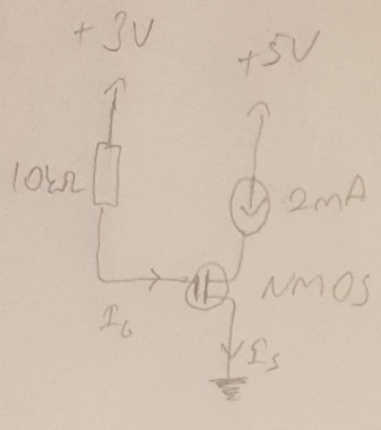
Q4)



Saturation

$I_D = 1/2\, k_n V_{OV}^2$

$V_{OV} > 0$

$V_T = 1V$ $\quad k_n = 1mA/V^2$

$V_{OV} = ?$

$I_G = ?$ $\quad I_S = ?$

$I_G = 0$

$I_D = 2mA$ $\quad I_S = I_D = 2mA$

$V_G = 3V - 10k\Omega . I_G = 3V$ $\quad V_S = 0$

$I_D = 2mA = \frac{1}{2} k_n (V_{OV})^2 = \frac{1}{2} k_n (V_{GS} - V_T)^2$

$V_{GS} - V_T = 2V = V_{OV}$

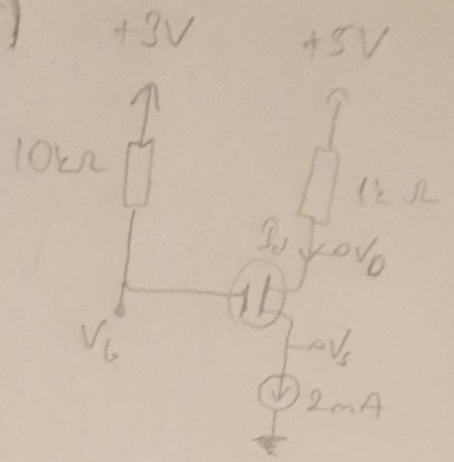
$V_{OV} = \sqrt{\frac{2 I_D}{k_n}} = 2V$

$V_{OV} = 2V$

$I_G = 0$

$I_S = 2mA$

(Q5)



Saturation

$I_D = \frac{1}{2} k_n (V_{OV})^2$

$V_{OV} > 0$

$V_T = 1V$ $\quad k_n = 1mA/V^2$

$V_G = ?$ $\quad I_D = ?$

$V_D = ?$ $\quad V_{OV} = ?$ $\quad V_S = ?$

$I_G = 0$

$V_G = 3 - 10k\Omega \cdot I_G = 3V$

$I_D = 2mA = \frac{1}{2} \cdot k_n V_{OV}^2$

$V_{OV} = \sqrt{\frac{2I_D}{k_n}} = 2V$

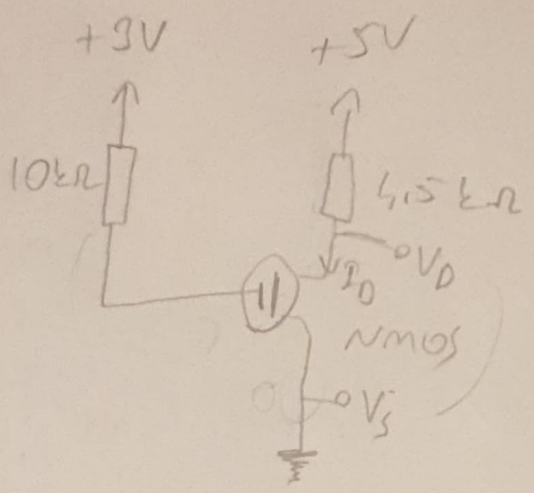
$V_{OV} = V_{GS} - V_T = 2V$

$V_{GS} = 3V$ then $V_S = 0$

$V_D = 5 - 1k\Omega \, I_D = 3V$

$V_G = 3V$
$I_D = 2mA$
$V_D = 3V$
$V_{OV} = 2V$
$V_S = 0$

Q6)



Linear

$I_D = k_n \cdot V_{OV} V_{DS}$

$V_{OV} > V_{DS} > 0$

$V_T = 1V$ $k_n = 1mA/V^2$

$V_{DS} = 0.5V$ $I_D = ?$

$I_G = 0$

$V_G = 3V - 10k\Omega \cdot I_G = 3V$

$V_S = 0$

$V_{DS} = 0.5V < V_D - V_S$

$V_{GS} = V_G - V_S = 3V$

$V_D = 0.5V$

$I_D = \frac{5 - V_D}{4,5k\Omega} = 1mA = I_D$

$V_{OV} = V_{GS} - V_T = 2V$

$I_D = 1mA$