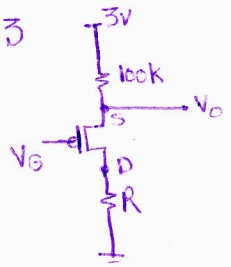
3.33



$V_o = 1.2 \rightarrow |I_{ds}| = \frac{V_o - 3}{100k} \rightarrow |I_{ds}| = 18\mu A$

$V_D = 0.8 \rightarrow R = \frac{0.8}{18\mu A} \rightarrow R = 44.4k\Omega$

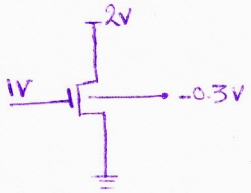
Assuming Linear

$$|I_{ds}| = |k_p|\left(\frac{W}{L}\right)\left[(|V_{gs}| - |V_{tp}|)|V_{ds}| - \frac{V_{ds}^2}{2}\right]$$

$$18\mu A = 50\mu A/V^2 * 3 * \left[(|V_{gs}| - 0.4)(|0.8 - 1.2|) - \frac{0.4^2}{2}\right] \Rightarrow$$

$$|V_{gs}| = 1.1 \longrightarrow V_g = 0.1$$

3.36



$V_{SB} = 0 - (-0.3) = 0.3V$

$$V_t = V_{to} + \gamma\left(\sqrt{|2\phi_F + V_{SB}|} - \sqrt{|2\phi_F|}\right)$$

$$V_t = 0.5V + 0.1V^{1/2}\left(\sqrt{|0.7 + 0.3|} - \sqrt{|0.7|}\right)$$

$V_t = 0.5163\,V$

$V_{gs} - V_t \;?\; V_{ds}$

$1 - 0.5163 < 2 \longrightarrow$ Saturation

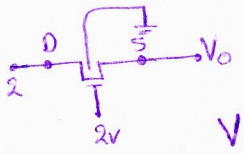
$$I_{ds} = \frac{200\mu A/V^2}{2} * 3\left[1 - 0.5163\right]^2 = 70.2\mu A$$

3.37 $V_T = V_{TO} + \gamma\left(\sqrt{|2\phi_F + V_{SB}|} - \sqrt{|2\phi_F|}\right)$

$$\sqrt{|2\phi_F + V_{SB}|} = \sqrt{|2\phi_F|} + \frac{V_T - V_{TO}}{\gamma} \longrightarrow V_{SB} = \left(\sqrt{|2\phi_F|} + \frac{V_T - V_{TO}}{\gamma}\right)^2 - |2\phi_F|$$

$$V_{SB} = 86.17\,mV \longrightarrow V_{BS} = -86.17\,mV$$

3.38



$$V_T = V_{TO} + \gamma\left(\sqrt{2\phi_F + V_{SB}} - \sqrt{2\phi_F}\right)$$

$$V_T = 0.6V + 0.25\left(\sqrt{0.7 + V_o} - \sqrt{0.7}\right)$$

$$(\text{Maximum } V_o) = V_{dd} - V_T \longrightarrow V_T = 2 - V_o$$

$$\Rightarrow V_o = 1.26\,V, \quad V_T = 0.74\,V$$