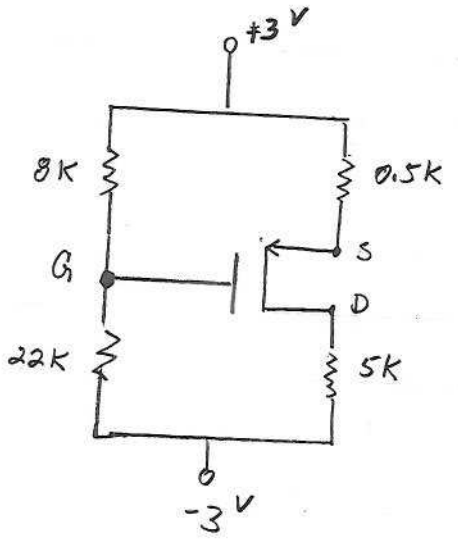
3.30



$V_{TP} = -0.8\ V$

$K_p = 0.5\ mA/V^2$

Find: I_D, V_{SG}, V_{SD}

① $V_G = \left(\frac{22}{22+8}\right)(6) - 3 = 1.40\ V$

$I_D = \frac{3 - V_S}{0.5k} = K_p(V_S - V_G + V_{TP})^2$ { Assume SAT. }

$3 - V_S = (0.5)(0.5)(V_S - 1.4 + (-0.8))^2$

$3 - V_S = 0.25(V_S - 2.2)^2 = 0.25(V_S^2 - 4.4V_S + 4.84)$

$12 - 4V_S = V_S^2 - 4.4V_S + 4.84$

$V_S^2 - 0.4V_S - 7.16 = 0$

$V_S = \boxed{2.88}$ or -2.48

$V_{SG} = 2.88 - 1.40 = \boxed{1.48\ V}$

$I_D = \frac{3 - 2.88}{0.5k} = \boxed{0.24\ mA}$

$V_{SD} = V_S - V_D = 2.88 - [(0.24)(5) - 3]$

$\boxed{V_{SD} = 4.68\ V}$