EEE105 Tutorial Question Set 8
Solutions

1. In the notes we developed for the conductance of such a channel

$$G = G_0\left[1-\left(\frac{V_g}{V_p}\right)^{0.5}\right]$$

so

$$R = R_0\left[1-\left(\frac{V_g}{V_p}\right)^{0.5}\right]^{-1}$$

for the two cases given

$$3x10^3 = R_0\left[1-\left(\frac{2}{V_p}\right)^{0.5}\right]^{-1}$$

$$2x10^3 = R_0\left[1-\left(\frac{1}{V_p}\right)^{0.5}\right]^{-1}$$

dividing one by the other gives

$$1.5 = \frac{\left[1-\left(\frac{1}{V_p}\right)^{0.5}\right]}{\left[1-\left(\frac{2}{V_p}\right)^{0.5}\right]}$$

and manipulating this gives V_p=5.03V.

Plugging this back into either of the two cases above gives R_0=1.11 kΩ, and hence the resistance for V_g=3 V can be calculated to be 4.87 kΩ.

2. Assuming a single sided "planar" JFET, V_p can be calculated from:

$$V_p = \frac{qN_A a^2}{2\varepsilon}$$

No ρ=0.1 Ωm, so using the conventional formula relating resistivity to mobility and carrier concentration we can obtain $N_A=1.25x10^{21}$ m^{-3}.

Hence **V_p=3.8 V**

The channel half width at $V_g=V_p/2$ and $I_d=0$ can be obtained from:

$$b = a\left[1-\left(\frac{V_g}{V_p}\right)^{1/2}\right]$$

where $V_g = V_p/2 = 1.9$ V

Thus **b=0.59 μm**

(Note: as we used 'a' for the channel thickness with the built-in potential applied, rather than the physical thickness of the channel layer, we ignore the V_0 terms in the equations here)