1) Given the circuit in Figure 1, $R_1=R_2=10 \text{ M}\Omega$, $V_{dd}=1.8 \text{V}$ and $W/L=1/1$.
   a) Sketch $V_{out}$ and $I_d$ of the transistor as $V_{in}$ varies from 0 to $V_{dd}$. Label the breakpoints, end points of the curve and indicate operation region of the transistor. (Hint: do the necessary approximation)
   b) Find out dc voltage $V_{in}$ such that $V_{out}$ is $V_{dd}/2$. And calculate the small signal parameters, $g_m$, $R_{out}$, $R_{in}$ at this operation point.
   c) Use HSPICE and the following device model to verify your hand calculations for a) and b). Compare your results with SPICE simulations. Print out the results and SPICE deck. (Note: $\phi_f=0.3 \text{ V}=\phi/2$)

```
.model nch nmos LEVEL=1 TOX=25 VTO=0.4 KP=100.0e-6 LAMBDA=0 +GAMMA=0.01 PHI=0.6
```

![Figure 1](image-url)