1. The MOSFET in the circuit shown above has $V_t = 1$ V, $k_	ext{m} W L = 0.8$ mA/V$^2$, and $V_A = 40$ V.

(a) Find the values of $R_S$, $R_D$ and $R_G$; so that $I_D = 0.1$ mA, the largest possible value for $R_D$ is used while a maximum signal swing at the drain of ± 1V is possible, and the input resistance at the gate is 10 MΩ.

(b) Find the values of $g_m$ and $r_o$ at the bias point.

(c) If terminal Z is grounded, terminal X is connected to a signal source having a resistance of 1 MΩ, and terminal Y is connected to a load resistance of 40 kΩ, find the voltage gain from signal source to load.

(d) If terminal Y is grounded, find the voltage gain from X to Z with Z open-circuited. What is the output resistance of the source follower?

(e) If terminal X is grounded and terminal Z is connected to a current source delivering a signal current of 10 μA and having a resistance of 100 kΩ, find the voltage signal that can be measured at Y. For simplicity, neglect the effect of $r_o$. 

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**Diagram:**

- A circuit diagram with MOSFET symbols, resistors, and voltage sources labeled with $R_S$, $R_D$, $R_G$, $V_D = 5$ V, and $V_S = -5$ V.
2.
(a) The NMOS transistor in the source-follower circuit (left) has \( g_m = 5 \text{ mA/V} \) and a large \( r_o \). Find the open-circuit voltage gain and the output resistance.
(b) The NMOS transistor in the common-gate amplifier (right) has \( g_m = 5 \text{ mA/V} \) and a large \( r_o \). Find the input resistance and the voltage gain.
(c) If the output of the source follower on left is connected to the input of the common-gate amplifier on the right, use the results of (a) and (b) to obtain the overall voltage gain \( v_o/v_i \).
3. Derive an expression for $R_{out}$ in the circuit shown below assuming that $g_m$, $g_{mb}$ and $r_{ds}$ are known. Find $R_{out}$ if $g_m = 2 \text{mA/V}$, $g_{mb} = 0.3 \text{mA/V}$, $r_{ds} = 60 \text{k}\Omega$ and $R_S = 1 \text{k}\Omega$. 
4. The circuit shown below is a cascode amplifier. Both devices have values of $\mu W C_{ox}/2L = 0.5$ mA/V², $V_T = 0.8$ V, and $\lambda = 0$. Calculate the voltage gain for the circuit. Ignore the body effect.