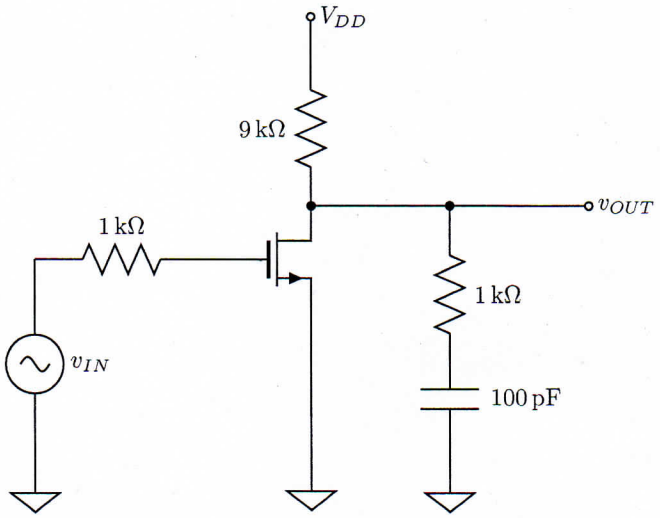
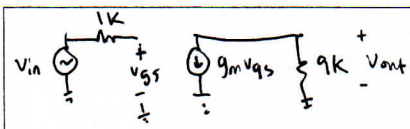
Name:	Section:

Part III:

(16 points) Consider the common source amplifer shown in the figure below. Assume that the transistor has been biased in the saturation region. It has an $I_D = 1\,\text{mA}$, additionally $k = 617 \times 10^{-6}\,\frac{\text{A}}{\text{V}^2}$, $V_A \to \infty$, and $C_{gs} = 1\,\text{pF}$. You may ignore all other parasitic capacitors.



1. What is the low frequency gain (v_{out}/v_{in}) for this amplifier? *(4 points)*

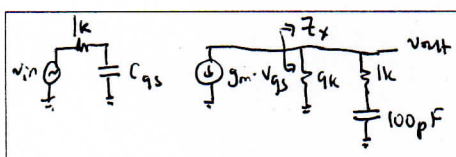


$g_m = \sqrt{4 \cdot K \cdot I_D} = 1.57\,\text{mS}$

$\frac{v_{out}}{v_{in}} = -g_m(9K) = -14.14$

$v_{out}/v_{in} =$ -14.14

2. Find the frequency-dependent transfer function ($v_{out}(s)/v_{in}(s)$) for the amplifier. *(6 points)*



$Z_x = 9K \,//\, \left(1K + \frac{1}{s(100p)}\right) = \frac{9000\,(1 + s/10^7)}{(1 + s/10^6)}$

$v_{gs} = \frac{\frac{1}{sC_{gs}}}{1K + \frac{1}{sC_{gs}}} \cdot v_{in} = \frac{v_{in}}{(1 + s/10^9)}$

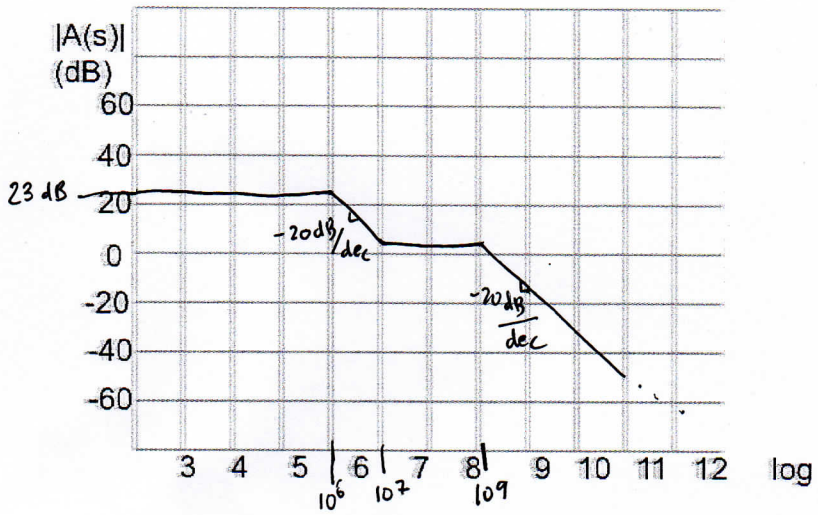
$$v_{out} = -g_m Z_x \cdot v_{gs} = -g_m \left(\frac{9000(1+s/10^7)}{(1+s/10^6)}\right)\left(\frac{v_{in}}{(1+s/10^9)}\right)$$

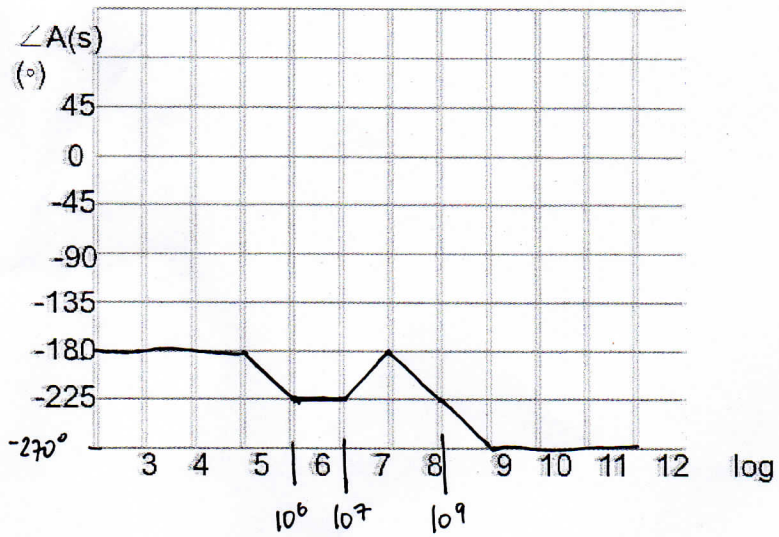
$$\frac{v_{out}}{v_{in}}(s) = \frac{-14.14\,(1+s/10^7)}{(1+s/10^6)(1+s/10^9)}$$

$v_{out}(s)/v_{in}(s) =$ $\dfrac{-14.14\,(1+s/10^7)}{(1+s/10^6)(1+s/10^9)}$

3. Draw the bode plot for the amplifier in the space provided below. (*6 points*)

$A_0 = 20 \log(14.14) = 23$ dB





since amp is inverting, start at $-180°$