Problem #1:

In the CMOS amplifier shown above, answer with the following parameters:
\( \mu C_{ox} = 200 \mu A/V^2 \), \( V_{th} = 0.4V \), and \( W/L = 200 \).

1. What is the nominal input voltage when the output DC voltage is 3V?
2. Estimate the low-frequency small-signal gain \( v_o/v_i \) when \( V_o = 3V \).
3. Also estimate the \(-3\text{dB}\) small-signal bandwidth of this amplifier in Hz.
4. What is the minimum \( V_i \) to keep \( M_1 \) in saturation?
5. Sketch the DC transfer function of \( V_o \) vs. \( V_i \) for the input range from 0 to 2V.

Problem #2:

A feedback amplifier is made using an operational amplifier as shown above. The open-loop transfer function of the operational amplifier \( a(j\omega) \) has a DC gain of 100dB and two poles at 100Hz and 10MHz.

1. Find 2 two frequencies where the gain is unity in Hz.
2. Sketch the Bode plots of the small-signal AC transfer function of \( v_o(j\omega)/v_i(j\omega) \) in Hz.
3. When the AC input is \( v_i(t) = \sin(2\pi(50kHz)t) \), write the equation of the output \( v_o(t) \).
4. Estimate the frequency where the feedback loop gain becomes unity in Hz.
5. With \( C_2 \) removed, repeat the Question 4.