1. Suppose you have the noninverting amplifier shown in Fig. PS4.1

(a) Assuming the op amp is ideal, what is the closed-loop gain $v_o/v_i$ when $R_2 = 99R_1$?

(b) If the values of $R_1$ and $R_2$ from part (a) can vary by as much as ± 0.01%, what is the worst-case (i.e., smallest) closed-loop voltage gain $v_o/v_i$?

(c) If the op amp is no longer ideal, find the minimum open-loop op amp gain that maintains a gain-error of less than 0.01% with $R_2 = 99R_1$.

\[ \text{Figure PS4.1} \]

2. Sedra & Smith, Problem 2.122

3. Sedra & Smith, Problem 2.125
4. For this problem, refer to the circuit in Fig. PS4.2 below.

(a) First assume the op amp is ideal with no DC imperfections (e.g., no offset voltage or input bias current), what is the value of the DC output voltage $v_o$?

(b) Now assume that the op amp has an offset voltage $V_{OS} = \pm 750$ uV and input bias current $I_{bias} = 50$ nA with input offset current $I_{OS} = \pm 2.5$ nA. Taking these nonidealities into account, determine the polarities of $V_{OS}$ and $I_{OS}$ that cause the DC output voltage to deviate furthest from its ideal value (the one found in part (a)). What is this worst-case DC output voltage?

(c) If we consider the absolute DC error this circuit to be the difference between the output voltages in found in parts (a) and (b), is there a better choice for the value of $R_1$ to minimize absolute DC error? If so, what value would you choose?

5. Sedra & Smith, Problem 2.105
6. The voltage transfer characteristic for an op amp is shown in Fig. PS4.3. What are the low-frequency gain $A_o$ and offset voltage for this op amp? Sketch a plot of voltage gain $A_o$ vs. differential input voltage $v_{id}$ for this op amp.

![Figure PS4.3](image_url)