Problem O.2. Effects of op-amp imperfections in a basic non-inverting amplifier

In the non-inverting amplifier shown below, the feedback resistances are $R_1 = 10 \, \text{K}\Omega$, and $R_2 = 1 \, \text{M}\Omega$. The load resistance is $R_L = 2 \, \text{K}\Omega$. You can neglect the resistance tolerances. The supply voltages are $V_{CC} = V_{EE} = +2.5 \, \text{V}$. The input voltage $v_I$ has zero DC component, $V_I = 0$. The op-amp is LMH6642 (see the attached data sheet). Given the specified supply voltages, note that you should consider 5V Electrical Characteristics of the op-amp in this problem.

\[ R_2 \]
\[ R_1 \]
\[ R_x \]
\[ \text{v}_I \]
\[ V_{CC} \]
\[ V_{EE} \]
\[ v_O \]
\[ v_x \]
\[ R_L \]

a) From the op-amp data-sheet, find the following parameters at room temperature (25°C):
- The minimum value of the op-amp open-loop gain $A_o$ (hint: see the entry for $A_{vol}$ in the data sheet)
- The maximum input offset voltage $V_{OS}$
- The typical input offset voltage drift $\Delta V_{OS}/\Delta T$
- The maximum input bias current $I_B$
- The maximum input offset current $I_{OS}$ (note that the ± sign is incorrectly missing in the data sheet)
- The typical output voltage swing limits $V_{omin}$, $V_{omax}$.
- The typical input common-mode voltage range limits, $V_{CMmin}$, $V_{CMmax}$.

b) Choose $R_x$ to minimize the worst-case DC output voltage $V_O$ of the amplifier. For this $R_x$, find the worst-case DC output voltage at room temperature, taking into account the values for $V_{OS}$ and $I_{OS}$ from part (a).

c) Taking into account the result from part (b), and the voltage swing limits $V_{omin}$, $V_{omax}$ from part (a), find the maximum amplitude $V_{imax}$ of the input signal $v_I$ such that the output stays undistorted, i.e. so that the output $v_O$ stays within the saturation limits. For this $V_{imax}$, do the op-amp input voltages stay within the input common-mode voltage range?