Design a common emitter amplifier given the following specifications.

\[ V_{cc} = 10V \]
\[ V_c = 5V \]
\[ R_L = 1k \]
\[ Z_{out} = 500 \text{ Ohms} \]
\[ Z_{in} = 1k \]
\[ \text{Gain} = \frac{v_o}{v_{in}} = 5 \text{ (small signal)} \]

a. Run a DC analysis to verifying that \( V_{cq} = 5V \) and report the result.
b. Run a Transient analysis with \( v_{in} \) at 500kHz. Plot \( v_{in}(t) \), \( v_c(t) \) and \( v_o(t) \) to verify the gain.
   Set the amplitude of \( v_{in} \) so that \( v_o \) is undistorted. Show the graph.
   How large can you make \( v_{in} \) before \( v_c(t) \) and \( v_o(t) \) distorts? Show the graph.
   Plot about 4 or 5 cycles of the signals and make sure that you plot enough points per cycle (about 100) to get smooth curves for all your plots.
c. Rerun the transient analysis with \( v_{in} \) at 500Hz. Did the gain change? Speculate why?