1. Consider the circuit shown in Figure 1.

For the transistor above, consider only its $g_m$ and $C_{GS}$. (i.e. $r_o \to \infty$, $C_{GD}=0$, etc)

a) Determine the size of L1 and L2 such that the input impedance is purely real and exactly 50ohms at an operating frequency of 5GHz. $g_m=10\text{mS}$, $C_{GS}=80\text{fF}$

b) Calculate the $G_m$ of this circuit for the parameters given and L1, L2 as determined from part (a)
2. Consider the circuit in figure 2

![Circuit Diagram](image_url)

**Figure 2**

a) At an operating frequency of \( \omega_0 \), we seek to use an inductor to cancel out the capacitance at the output, \( C_L \). Determine the size of the inductor, \( L \), that is required in terms of \( C_L \), \( \omega_0 \), \( Q_{\text{ind}} \), and \( R_L \). Note that the inductor has a finite \( Q (=Q_{\text{ind}}) \), so that the relationship between \( R_{\text{ind}} \) and \( L \) is:

\[
R_{\text{ind}} = \frac{\omega \cdot L}{Q_{\text{ind}}}
\]

b) Calculate the expression for the gain at \( \omega = \omega_0 \) of the circuit with and without the inductor present.

c) Re-do parts (a) and (b) for the following device parameters:

\[
\begin{align*}
g_m &= 10 \text{mS} \\
R_L &= 1 \text{kohm} \\
C_L &= 1 \text{pF} \\
\omega_0 &= 2\pi \times 5 \text{GHz} = 31.41 \text{ Grad/s} \\
Q_{\text{IND}} &= 10 (@ 5 \text{GHz})
\end{align*}
\]

d) Verify the gain calculations from part (b) in spice with the parameters from part (c)