1. A transmission line of length $d$ and propagation constant $\beta$ is terminated with a short.
   (a) Find the input impedance.
   (b) Draw a sketch of $Z_{in}$ for $\beta d$ ranging from 0 to $3\pi$ and label the frequency bands where the transmission line looks inductive and where it looks capacitive.
   (c) At what frequencies does this shorted transmission line look like an open circuit?

2. Use the Smith chart to find the following quantities for the transmission line circuit below:
   (a) The SWR on the line
   (b) The reflection coefficient at the load
   (c) The load admittance
   (d) The input impedance of the line.
   (e) The distance from the load to the first voltage minimum
   (f) The distance from the load to the first voltage maximum

![Diagram of a transmission line circuit with a source, characteristic impedance $Z_o = 50 \Omega$, and a load $Z_L = 60 + j50 \Omega$.]

3. A lossless transmission line with characteristic impedance $Z_o = 50 \Omega$ is connected to a source with $V_g = 50 \angle 0^\circ$ V, $Z_g = 50 \Omega$ and a load $Z_R = j50 \Omega$. The line length is $\lambda/4$. 
(a) Find the input impedance $Z_{in}$.

(b) Find the phasor current at the input of the line.

(c) Find the voltage standing wave ratio (VSWR) on the line.

(d) Find the time-average power delivered to the input of the line.

(e) Find the time-average power delivered to the load.

4. A lossless transmission line with characteristic impedance $Z_{01} = 50 \, \Omega$ is connected to an unknown complex load impedance. A quarter-wavelength transformer has been inserted at a location $d = 0.2916 \, \lambda$ from the load. Perfect impedance match is obtained if the transformer is realized with a lossless transmission line with characteristic impedance $Z_{02} = 93.4582 \, \Omega$.

(a) What is the input impedance $Z_{in}$ at the location of insertion of the quarter-wavelength transformer, $d = 0.2916 \, \lambda$?

(b) The location of insertion of the transformer must be at a maximum or at a minimum of the voltage standing wave pattern. What is the situation in this particular case? Explain why in order to get any credits for this answer.

(c) Based on your answer at point (a), find the unknown load impedance