4.36 A $\lambda/2$ dipole is connected to a 50-ohm lossless transmission line. It is desired to resonate the element at 300 MHz by placing an *inductor or capacitor* in parallel/shunt at its feed points.

(a) What is the reflection coefficient and VSWR of the dipole before the insertion of the parallel/shunt element?

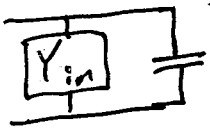
(b) What kind of an element is needed, inductor or capacitor, and what is its value in order to resonate the dipole?

(c) What is the new reflection coefficient and VSWR inside the transmission line after the insertion of the parallel/shunt element?

a) Per (4-93a), $z_{in} = 73 + j42.5\ \Omega$ for $\lambda/2$ dipole.

$$\Gamma = \frac{(73+j42.5)-50}{(73+j42.5)+50} \Rightarrow \underline{\Gamma = 0.37134\angle 42.517^\circ}$$

$$VSWR = \frac{1+|\Gamma|}{1-|\Gamma|} = \frac{1+0.3713}{1-0.3713} \Rightarrow \underline{VSWR = 2.181}$$

b) To counteract the inductive reactance, use a <u>parallel capacitor</u>. 

$$Y_{in} = \frac{1}{z_{in}} = \frac{1}{73+j42.5} = 0.01023 - j0.005956344\ S$$

$$Y_{in} + Y_{cap} = 0.01023\ S \Rightarrow Y_{cap} = +j0.0059563 = j\omega C$$

$$C = \frac{0.005956344}{2\pi(300\times10^6)} \Rightarrow \underline{C = 3.16\,pF}$$

c) $$Y_{res} = \frac{1}{73+j42.5} + j\,2\pi(300\times10^6)(3.16\times10^{-12}) = 0.0102309\ S$$

$$Z_{res} = \frac{1}{0.102309} = 97.74315\ \Omega$$

$$\Gamma_{res} = \frac{97.74315-50}{97.74315+50} \Rightarrow \underline{\Gamma_{res} = 0.32315}$$

$$VSWR_{res} = \frac{1+0.32315}{1-0.32315} \Rightarrow \underline{VSWR_{res} = 1.955}$$