2.63 A 50-Ω lossless line 0.6λ long is terminated in a load with $Z_L = (50 + j25)\ \Omega$. At 0.3λ from the load, a resistor with resistance $R = 30\ \Omega$ is connected as shown in Fig. P2.63. Use the Smith chart to find Z_{in}.

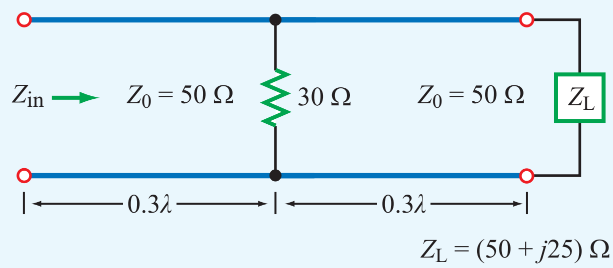

Figure P2.63 Circuit for Problem 2.63.

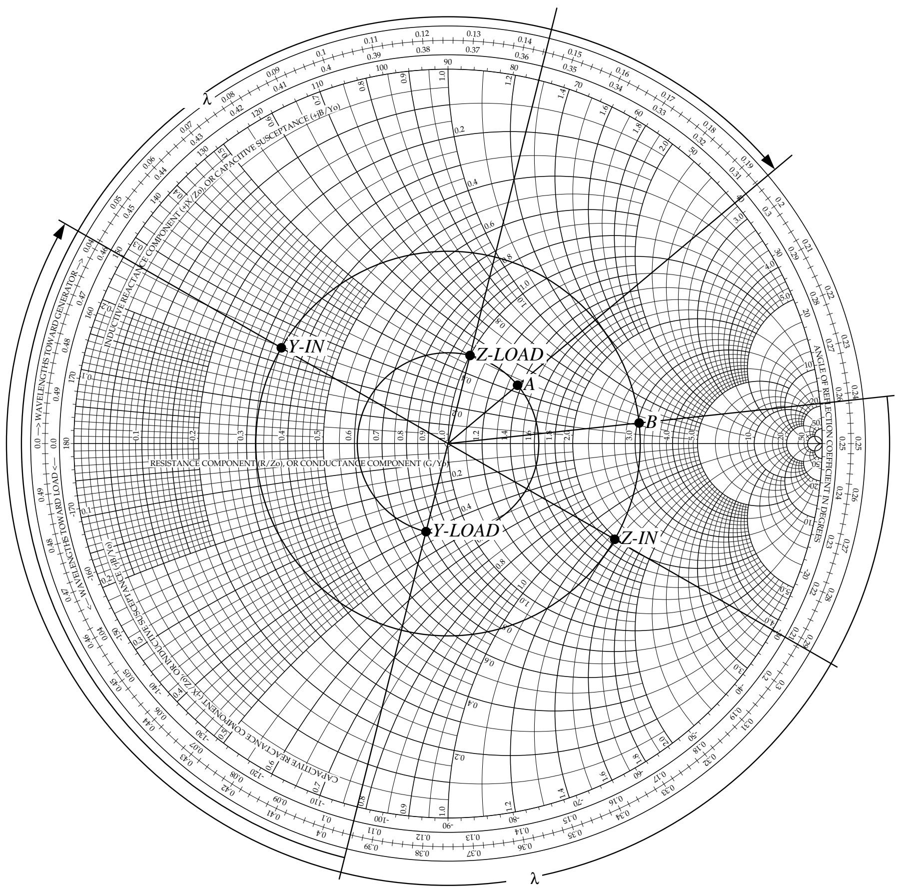

Figure P2.63: (b) Solution of Problem 2.63.

Solution: Refer to Fig. P2.63(b). Since the 30-Ω resistor is in parallel with the input impedance at that point, it is advantageous to convert all quantities to admittances.

$$z_L = \frac{Z_L}{Z_0} = \frac{(50 + j25)\ \Omega}{50\ \Omega} = 1 + j0.5$$

and is located at point *Z-LOAD*. The corresponding normalized load admittance is at point *Y-LOAD*, which is at 0.394λ on the WTG scale. The input admittance of the load only at the shunt conductor is at $0.394\lambda + 0.300\lambda - 0.500\lambda = 0.194\lambda$ and is denoted by point *A*. It has a value of

$$y_{\text{in}A} = 1.37 + j0.45.$$

The shunt conductance has a normalized conductance

$$g = \frac{50\ \Omega}{30\ \Omega} = 1.67.$$

The normalized admittance of the shunt conductance in parallel with the input admittance of the load is the sum of their admittances:

$$y_{\text{in}B} = g + y_{\text{in}A} = 1.67 + 1.37 + j0.45 = 3.04 + j0.45$$

and is located at point B. On the WTG scale, point B is at 0.242λ. The input admittance of the entire circuit is at $0.242\lambda + 0.300\lambda - 0.500\lambda = 0.042\lambda$ and is denoted by point Y-IN. The corresponding normalized input impedance is at Z-IN and has a value of

$$z_{\text{in}} = 1.9 - j1.4.$$

Thus,

$$Z_{\text{in}} = z_{\text{in}} Z_0 = (1.9 - j1.4) \times 50\ \Omega = (95 - j70)\ \Omega.$$