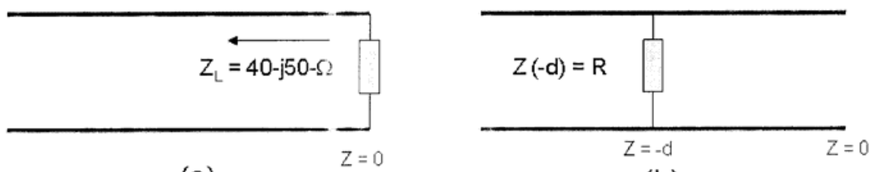
A 50Ω lossless transmission line is terminated with a load Z_L. The phase velocity is 2.0×10^{10}cm/s at the frequency of 10GHz. The impedance of the load is Z_L = 40-j50-Ω (see figure (a)). When the load is removed and reconnected into the transmission line at a distance *d* from the original point (z = -*d*). The total impedance measured at this point was pure resistive (see figure (b)). Find out: (1) the distance *d*; (2) the total impedance at the point.



(a) (b)

Solution: (1) normalized load $z_L = \frac{Z_L}{Z_0} = 0.8 - j1$,

the normalized admitance $y_L = 0.5 + j0.6$

the total admitance y_{total} @ $z = -d$

$$y_{total} = y_L + y_{open}\Big|_{z=-d}$$

$$= 0.5 + j0.6 + y_{open} \quad \leftarrow \text{pure resistor}$$

$\Rightarrow y_{open}\Big|_{@\, z=-d} = -j0.6$, point A

open circuit point @ B

$\Rightarrow d = 0.414\,\lambda$

$$\lambda = \frac{V_p}{f} = \frac{2\times10^{10}\ \text{cm/s}}{10\times10^{9}\ /\text{s}} = 2\,\text{cm}$$

$\Rightarrow d = 0.444\lambda \cdot = 0.828$ cm

(2) $y_{total} = 0.5 \Rightarrow z_{total} = 2 \Rightarrow$

$Z_{total} = Z_0 \cdot z_{total} = 100\,\Omega$

$d = 0.414\lambda$