

Find  $\Gamma_{in}, \Gamma_L, V_0, I_0, I_L, V_L$ , and  $V_{SWR}(S)$ .

$$\Gamma_{in} = \Gamma(0) = \frac{Z_{in} - Z_0}{Z_{in} + Z_0} = \frac{(60 + j30) - 75}{(60 + j30) + 75} = \underline{\underline{0.2425 \angle 104.04^\circ}}$$

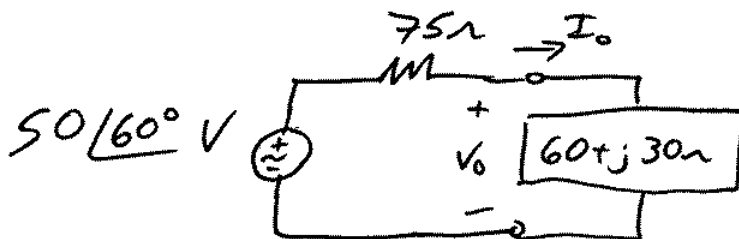
$$\beta = \frac{\omega}{u} = \frac{2\pi f}{u} = \frac{2\pi (890 \times 10^6)}{2.1 \times 10^8}$$

$$\underline{\underline{\beta = 26.6287 \text{ rad/m}}}$$

$$\Gamma_L = \Gamma_{in} e^{+j2\beta l} \quad \text{from } \Gamma(z=0) = \Gamma_L e^{-j2\beta(l-z)}$$

$$\Gamma_L = (0.2425 \angle 104.04^\circ) e^{j2(26.6287)10} = \underline{\underline{0.2425 \angle 18.322^\circ}}$$

To find  $V_0$  +  $I_0$ , draw equivalent circuit.



$$V_0 = V_g \frac{Z_{in}}{Z_0 + Z_{in}} = (50 \angle 60^\circ \text{ V}) \frac{60 + j30}{75 + (60 + j30)} = \underline{\underline{24.254 \angle 74.04^\circ \text{ V}}}$$

$$I_0 = \frac{V_g}{Z_0 + Z_{in}} = \frac{50 \angle 60^\circ}{75 + (60 + j30)} = \underline{\underline{0.3616 \angle 47.47^\circ \text{ A}}}$$

ex. cont.

To find  $Z_L$ , we can NOT use (circular argument)

$$Z_L = Z_{in}(z=l) = Z_0 \left[ \frac{Z_L + j Z_0 \tan(\beta l)}{Z_0 + j Z_L \tan(\beta l)} \right] = Z_L \quad \leftarrow \text{since } l' = l - \frac{l}{\beta} = 0 \text{ and } \tan(\beta l') = 0$$

So, we use

$$Z_L = Z_{in}(z=l) = Z_0 \frac{1 + \Gamma(z=l)}{1 - \Gamma(z=l)} = Z_0 \frac{1 + \Gamma_L}{1 - \Gamma_L}$$

$$Z_L = (75) \frac{1 + 0.2425 \angle 18.32^\circ}{1 - 0.2425 \angle 18.32^\circ} = \underline{\underline{117.97 + j19.113 \Omega}}$$

$$VSWR = \frac{1 + |\Gamma|}{1 - |\Gamma|} = \frac{1 + 0.2425}{1 - 0.2425} = \underline{\underline{1.64}}$$

To find  $V_L$  and  $I_L$ , we will need  $V_0^+$ 

$$V_0^+ = \frac{1}{2} (V_0 + I_0 Z_0), \text{ or}$$

$$= \frac{V_0}{1 + \Gamma(0)} \quad \text{from } V_s(z) = V_0^+ e^{-j\beta z} (1 + \Gamma(z)) \text{ w/ } z=0$$

$$V_0^+ = \frac{24.254 \angle 74.04^\circ}{1 + 0.2425 \angle 104.04^\circ} = \underline{\underline{25 \angle 60^\circ \text{ V}}} \quad \leftarrow \text{same as } \frac{V_g}{2} ! \text{ (because } Z_0 = Z_g)$$

$$V_s(z=l) = V_L = V_0^+ e^{-j\beta l} (1 + \Gamma_L) = 25 \angle 60^\circ e^{-j26.63(10)} (1 + 0.2425 \angle 18.32^\circ)$$

$$\underline{\underline{V_L = 30.815 \angle -73.597^\circ \text{ V}}}$$

$$\underline{\underline{I_L = \frac{V_L}{Z_L} = 0.2578 \angle -82.8^\circ \text{ A}}}$$