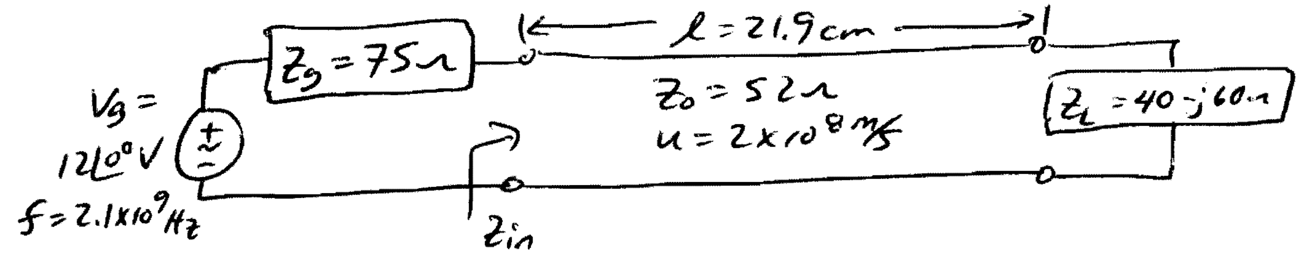
A lossless coaxial transmission line (Z_0 = 52 Ω, $u = 2 \times 10^8$ m/s) of length l = 21.9 cm is terminated with a load Z_L = 40 – j60 Ω. The transmission line is connected to a 75 Ω signal generator operating at 2.1 GHz with a phasor voltage $V_g = 12\angle 0°$ V. First, sketch the transmission line circuit. Then, determine (a) the phase constant β , wavelength λ, & length l (in terms of λ) of the transmission line, (b) input impedance Z_{in}, and (c) total input phasor current I_0 & voltage V_0.



a) $\beta = \frac{\omega}{u} = \frac{2\pi(2.1\times10^9)}{2\times10^8} = \underline{65.973 \text{ rad/m}}$

$\lambda = \frac{2\pi}{\beta} = u/f = \frac{2\times10^8}{2.1\times10^9} = \underline{0.09524 \text{ m} = 9.524 \text{ cm}}$

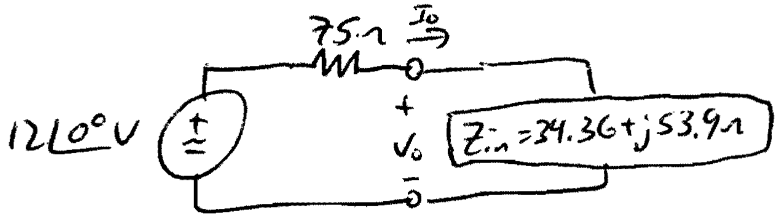
$\ell = \frac{21.9 \text{ cm}}{9.524 \text{ cm}/\lambda} = \underline{2.2995\,\lambda}$

b) (11.34) $Z_{in} = Z_0\left[\frac{Z_L + jZ_0\tan(\beta\ell)}{Z_0 + jZ_L\tan(\beta\ell)}\right]$ where $\beta\ell = \frac{2\pi}{\lambda}2.2995\lambda = 4.599\pi$

$Z_{in} = 52\left[\frac{(40-j60) + j52\tan(4.599\pi)}{52 + j(40-j60)\tan(4.599\pi)}\right]$

$\underline{Z_{in} = 34.356 + j53.892\ \Omega}$

c)



$I_0 = \frac{12\angle 0°}{75 + (34.36 + j53.9)} = \underline{0.09843\angle -26.235° \text{ A}}$

$V_0 = I_0 Z_{in} = \underline{6.291\angle 31.248° \text{ V}}$