11.39 A lossless 50 Ω line is terminated by a load $Z_L = 75 + j60\ \Omega$. Using a Smith chart, determine (a) the reflection coefficient Γ, (b) the standing wave ratio s, (c) the input impedance at 0.2λ from the load, (d) the location of the first minimum voltage from the load, (e) the shortest distance from the load at which the input impedance is purely resistive.

a) * Normalize Z_L to 50Ω ⇒ $z_L = \frac{75+j60\Omega}{50\Omega} = 1.5 + j1.2$ Ω/Ω

* Plot z_L on Smith Chart, use compass or straight edge to find distance from center of Smith Chart to z_L and "REFL. COEFF, V or I" scale to get

$|\Gamma_L| = 0.47$

* Draw radial line from center thru z_L to get

$\angle \Gamma_L = +41.7°$ ⇒ $\Gamma_L = 0.47\angle +41.7°$

b) use compass & draw arc on SWR (VSWR) scale @ bottom. Read VSWR = S = 2.75

c) use compass to draw circle of radius $|\Gamma| = 0.47$
Move 0.2λ "WAVELENGTHS TOWARD GENERATOR"
from z_L to $z_{in} = 0.55 - j0.65$ Ω/Ω

$Z_{in} = 50(0.55 - j0.65) = 27.5 - j32.5\ \Omega$

d) plot $r_{min} = 1/S = 0.364$. Using "WAVELENGTHS TOWARD GENERATOR" scale $\ell_{min} = 0.5\lambda - 0.192\lambda$

$\ell_{min} = 0.308\lambda$

e) plot $r_{max} = S = 2.75$. (Closest)
use "WAVELENGTHS TOWARD GENERATOR"

$\ell_{max} = 0.25\lambda - 0.192\lambda$

$\ell_{max} = 0.058\lambda$

Simple
Smith Chart

Problem 11.39
$Z_0 = 50\ \Omega$