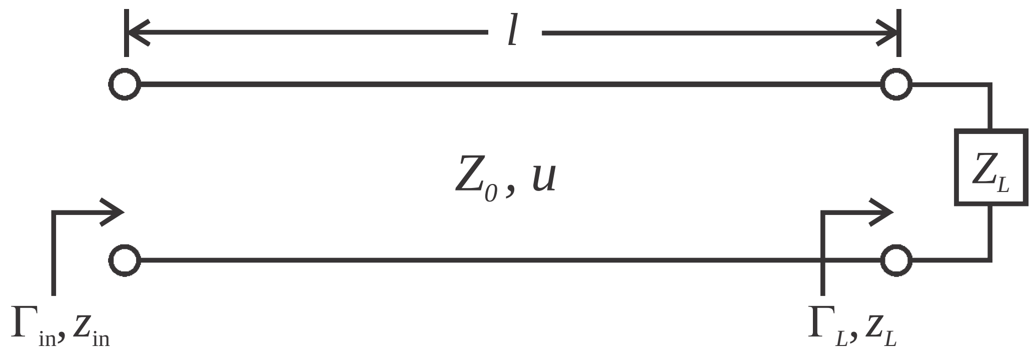



For the lossless transmission line circuit shown: $f = 100$ MHz, $u = 3\times10^8$ m/s, $l = 3.3$ m, $Z_0 = 50\,\Omega$, and $Z_L = 75 + j\,50\,\Omega$.

## 1) Normalize and plot load impedance

- Normalize $z_L = Z_L / Z_0 = (75 + j\,50)/50 \Rightarrow$ **$z_L = 1.5 + j\,1\ \Omega/\Omega$**.
- Plot $z_L$ on Smith chart by finding intersection of $r = 1.5$ circle with $x = 1$ arc.

## 2) Find load reflection coefficient and VSWR

- Set compass to distance between center of Smith chart and $z_L$. Use compass to mark the "REFL. COEFF. V or I" scale at bottom right of Smith chart to determine $|\Gamma_L| = 0.42$.
- Use compass to draw $|\Gamma| = 0.42$ arc, centered on Smith chart scales, through SWR (VSWR) scale on bottom left. Read **VSWR = 2.4** .
- Use straight-edge to draw radial line from center of Smith chart through $z_L$ and outer rings of Smith chart. Use "ANGLE OF REFLECTION COEFFCIENT IN DEGREES" scale to read $\angle\,\Gamma_L = 41.8°$.
- Put magnitude and angle together to get **$\Gamma_L = 0.42\angle 41.8°$**. For comparison, the analytic result is $\Gamma_L = 0.4152\angle 41.63°$.

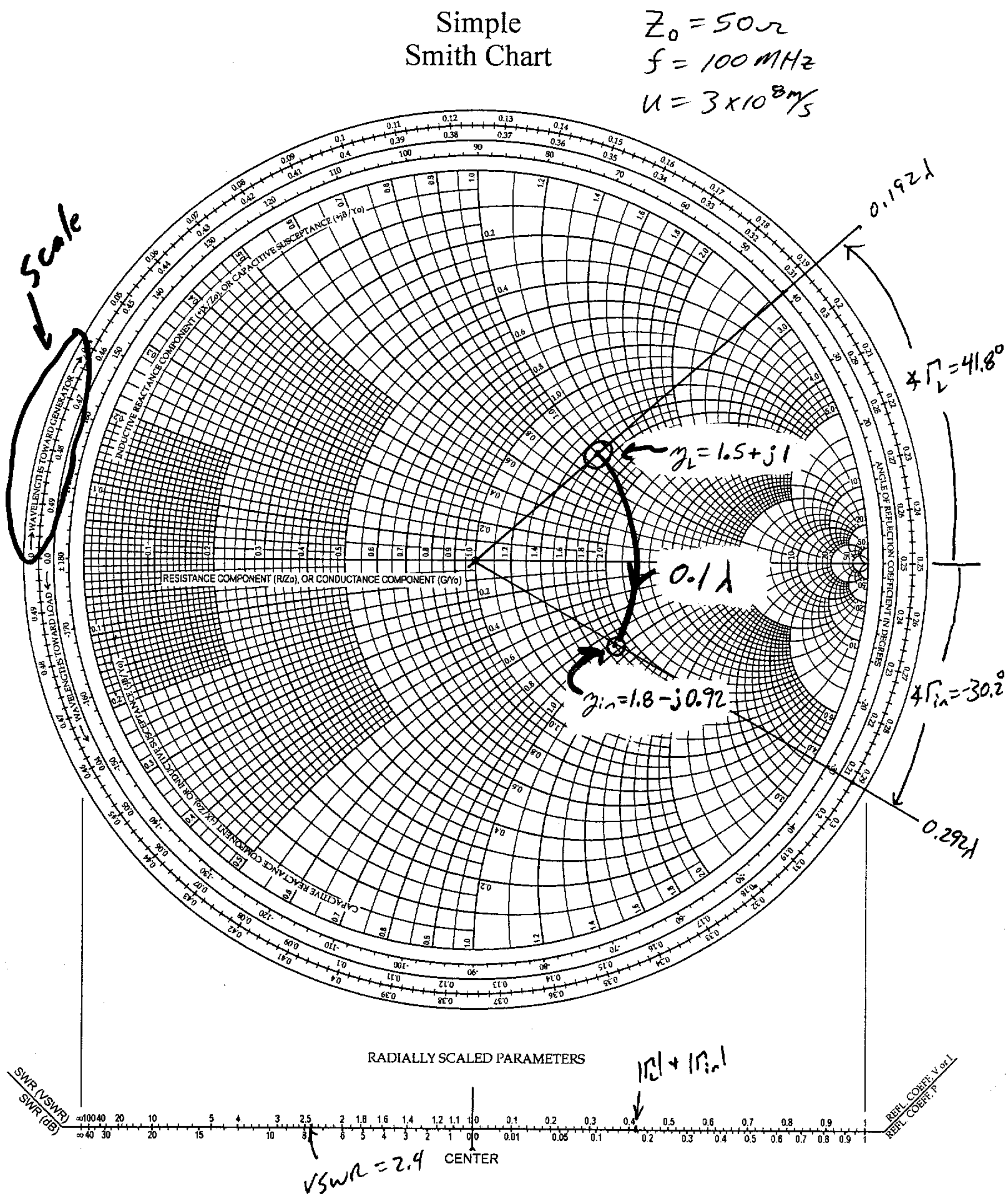
## 3) Find input reflection coefficient

- Calculate $l/\lambda = l\,f/u = 3.3\,(100\times10^6)/3\times10^8 = 1.1$. Subtract 2(0.5) = 1 (i.e., remove integer multiples of $n\lambda/2$) to get $\Rightarrow$ $l/\lambda = 0.1$.
- On the Smith chart, the radial line through $z_L$ reads 0.192 on the "WAVELENGTHS TOWARD GENERATOR" scale. Add 0.192 + $l/\lambda$ to get 0.292 and draw a radial line from the center of the Smith chart through this point on the scale.

- Draw an arc, centered on Smith chart, from $z_L$ through radial line at 0.292. The intersection of the arc and radial line is the $\Gamma_{in}$ / $z_{in}$ point. Use the "ANGLE OF REFLECTION COEFFCIENT IN DEGREES" scale to read $\angle \Gamma_{in} = -30.2°$ and note $|\Gamma_{in}| = |\Gamma_L| = 0.42$.
- Put magnitude and angle together to get $\mathbf{\Gamma_{in} = 0.42\angle -30.2°}$.

**4) Find input impedance**

- At $\Gamma_{in} = 0.42\angle -30.2°$ point, locate and read/interpolate value of appropriate "*r*" circle as $r_{in} = 1.8$.
- At $\Gamma_{in} = 0.42\angle -30.2°$ point, locate and read/interpolate value of appropriate "*x*" arc as $x_{in} = -0.92$.
- Put together to get normalized input impedance $\mathbf{z_{in} = 1.8 - j0.92\ \Omega/\Omega}$.
- Find input impedance by multiplying $z_{in}$ w/ characteristic impedance to get $Z_{in} = Z_0 z_{in} = 50(1.8 - j0.92) \Rightarrow \mathbf{Z_{in} = 90 - j46\ \Omega}$.


Simple
Smith Chart
Z0 = 50Ω
f = 100 MHz
u = 3x10^8 m/s
Scale
0.192λ
∡Γ_L = 41.8°
z_L = 1.5 + j1
0.1λ
z_in = 1.8 - j0.92
∡Γ_in = -30.2°
0.292λ
WAVELENGTHS TOWARD GENERATOR
WAVELENGTHS TOWARD LOAD
RESISTANCE COMPONENT (R/Zo), OR CONDUCTANCE COMPONENT (G/Yo)
ANGLE OF REFLECTION COEFFICIENT IN DEGREES
RADIALLY SCALED PARAMETERS
|Γ_L| + |Γ_in|
SWR (VSWR)
SWR (dB)
REFL. COEFF. V or I
REFL. COEFF. P
VSWR = 2.4
CENTER