A lossless transmission line (75 Ω, 2.1×10^8 m/s) of length 10 cm has a measured input impedance of $16.5 - j34.5\ \Omega$ at 4.6 GHz. Using a Smith chart, find: a) input reflection coefficient, b) input admittance, c) load reflection coefficient, d) SWR, e) return loss, and f) load impedance.

* $z_{in} = \frac{Z_{in}}{Z_0} = \frac{16.5 - j34.5\ \Omega}{75} = 0.22 - j0.46$ Ω/Ω

* Plot z_{in} on Smith Chart

a) Draw radial line through z_{in} and read $\angle \Gamma_{in} = -129°$ on ANGLE OF REFLECTION... scale

Use compass & RFL COEFF, E or I scale @ bottom of Smith Chart $|\Gamma| = 0.695$

$$\Gamma_{in} = 0.695 \angle -129°$$

b) Draw circle through z_{in} using compass. Draw line through z_{in} & center of Smith chart to circle on other side. Read

$y_{in} = 0.85 + j1.78$ S/S

$$Y_{in} = y_{in}/Z_0 = (0.85 + j1.78)/75 = 0.0113 + j0.02375$$

c) Calculate $\ell/\lambda = \frac{10 \times 10^{-2}}{2.1 \times 10^8 / 4.6 \times 10^9} = \frac{0.1}{0.04565} = 2.1905$
↳ 0.1905

Move from 0.0701 to (0.0701+0.1905) = 0.2606 along $|\Gamma|$ circle in the "WAVELENGTHS TOWARD LOAD" direction. Read $\angle \Gamma_L = 7.8°$ & $|\Gamma| = 0.695$

$$\Gamma_L = 0.695 \angle 7.8°$$

d) Use compass and SWR scale to get

$(r_{max} = 5.6)$ $\underline{SWR = 5.6}$

e) Use compass and RTN. LOSS (dB) scale to get

$\underline{RL = 3.2\ dB}$

f) Where Γ_L radial line intersects $|\Gamma|$ circle, read $z_L = 4.8 + j1.8$ Ω

$Z_L = z_L Z_0 = (4.8 + j1.8)\,75$

$\underline{Z_L = 360 + j135\ \Omega}$

Bonus: The exact answers are:

a) $\Gamma_{in} = 0.6945 \angle -128.81°$

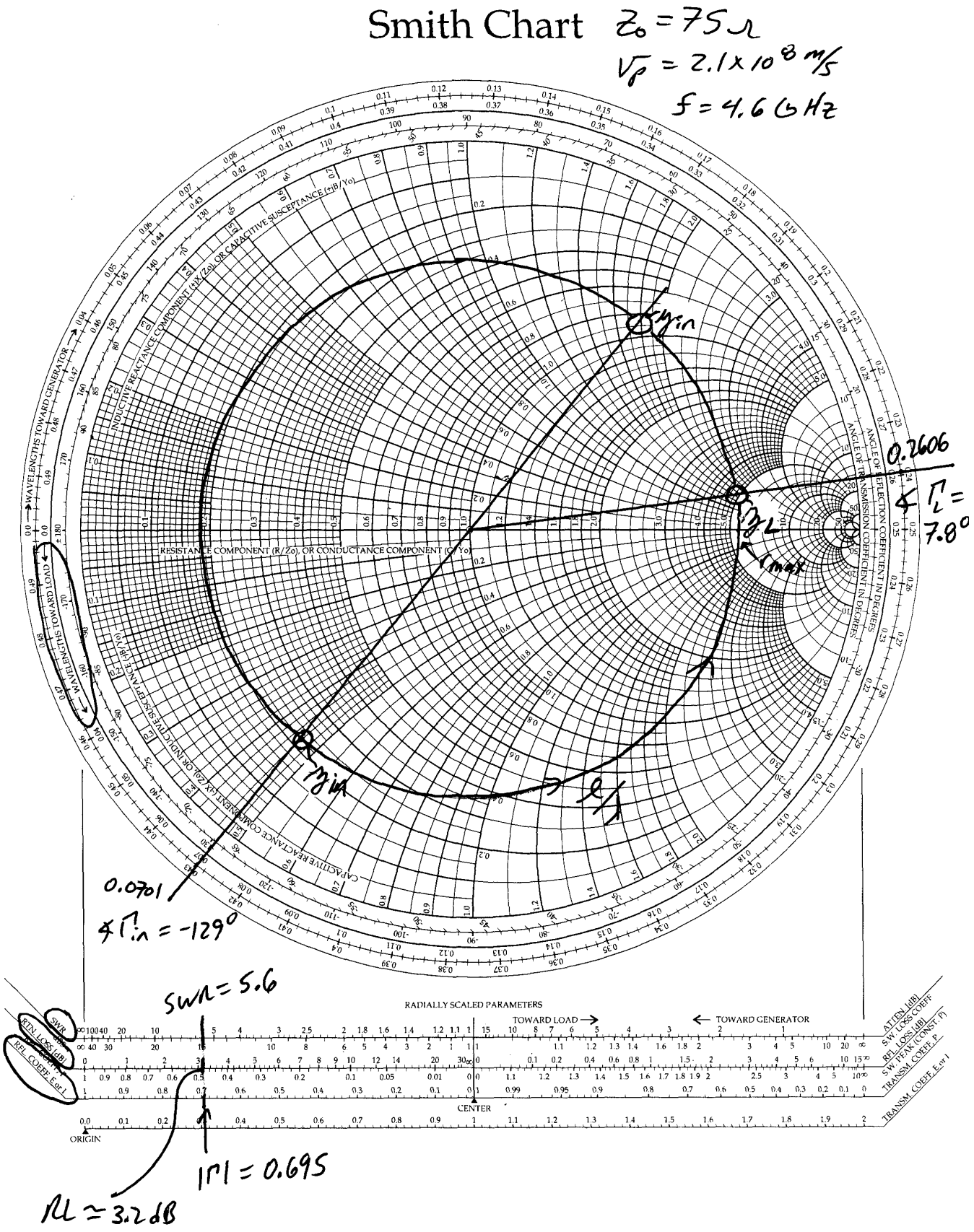
b) $Y_{in} = 0.01128 + j0.02359$ S

c) $\Gamma_L = 0.6945 \angle 8.3315°$

d) SWR = 5.547

e) RL = 3.166 dB

f) $Z_L = 359.545 + j139.7975\ \Omega$


Smith Chart $Z_0 = 75\,\Omega$
$v_p = 2.1 \times 10^8$ m/s
$f = 4.6$ GHz
z_{in}
z_L
y_{in}
y_L
z_{max}
0.2606
$\angle \Gamma_L = 7.8°$
0.0701
$\angle \Gamma_{in} = -129°$
SWR = 5.6
$|\Gamma| = 0.695$
$RL \simeq 3.2$ dB
RADIALLY SCALED PARAMETERS
TOWARD LOAD
TOWARD GENERATOR
CENTER
ORIGIN
WAVELENGTHS TOWARD GENERATOR
WAVELENGTHS TOWARD LOAD
RESISTANCE COMPONENT (R/Zo), OR CONDUCTANCE COMPONENT (G/Yo)
INDUCTIVE REACTANCE COMPONENT (+jX/Zo), OR CAPACITIVE SUSCEPTANCE (+jB/Yo)
CAPACITIVE REACTANCE COMPONENT (-jX/Zo), OR INDUCTIVE SUSCEPTANCE (-jB/Yo)
ANGLE OF REFLECTION COEFFICIENT IN DEGREES
ANGLE OF TRANSMISSION COEFFICIENT IN DEGREES
SWR
RETN. LOSS (dB)
REFL. COEFF. Γ or τ
ATTEN. (dB)
S.W. LOSS COEFF
REFL. LOSS (dB)
S.W. PEAK (CONST. P)
TRANSM. COEFF. Γ or τ