1. (30%) A lossless transmission line λ/8 is terminated in an unknown impedance. If the characteristic impedance is 100-Ω, and the input impedance is measured to be Z_{in} = -j25-Ω. Find the load Z_L.

Solution:

$$z_{in} = \frac{Z_{in}}{Z_0} = \frac{-j25}{100} = -j0.25$$

point A on Smith Chart

Point A on WTL reading: 0.04 λ

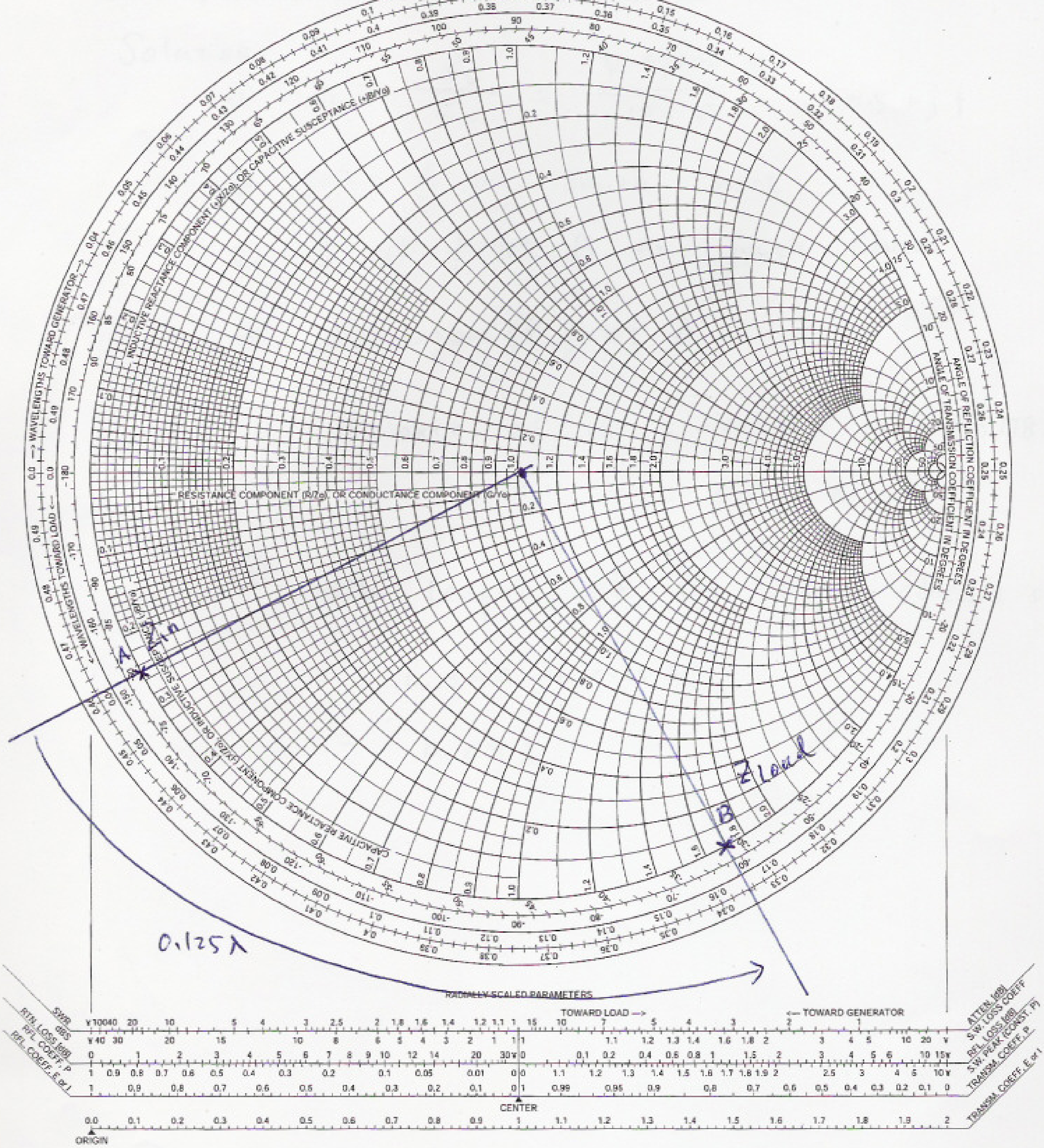
On WTL scale, turn λ/8 = 0.125 λ

load on WTL Scale = 0.04λ + 0.125λ = 0.165λ ← point B

point B.

reading: −j1.7

$$Z_L = z_L \cdot Z_0 = -j1.7 \cdot 100 = -j170\,\Omega$$



WAVELENGTHS TOWARD GENERATOR →
← WAVELENGTHS TOWARD LOAD ←
INDUCTIVE REACTANCE COMPONENT (+jX/Zo), OR CAPACITIVE SUSCEPTANCE (+jB/Yo)
CAPACITIVE REACTANCE COMPONENT (-jX/Zo), OR INDUCTIVE SUSCEPTANCE (-jB/Yo)
RESISTANCE COMPONENT (R/Zo), OR CONDUCTANCE COMPONENT (G/Yo)
ANGLE OF REFLECTION COEFFICIENT IN DEGREES
ANGLE OF TRANSMISSION COEFFICIENT IN DEGREES
A
y_{in}
B
Z Load
0.125λ
RADIALLY SCALED PARAMETERS
TOWARD LOAD →
← TOWARD GENERATOR
SWR
dBS
RTN. LOSS [dB]
RFL. COEFF, P
RFL. COEFF, E or I
ATTEN. [dB]
S.W. LOSS COEFF
RFL. LOSS [dB]
S.W. PEAK (CONST. P)
TRANSM. COEFF, P
TRANSM. COEFF, E or I
CENTER
ORIGIN

2. (35%) On a lossless transmission line terminated with a $Z_L = 50+j100\ \Omega$. The characteristic impedance is 100-Ω. If this transmission line is be matched to the load using a shorted load stub. Determine the stub length and distance between the load and stub. Two possible answers. You only need to show one of them.

Solution:

① $z_L = \frac{Z_L}{Z_0} = \frac{50+j100\ \Omega}{100\ \Omega} = 0.5+j1$

② point A on Smith Chart

③ y_L @ point B on Smith Chart

④ destination @ point C

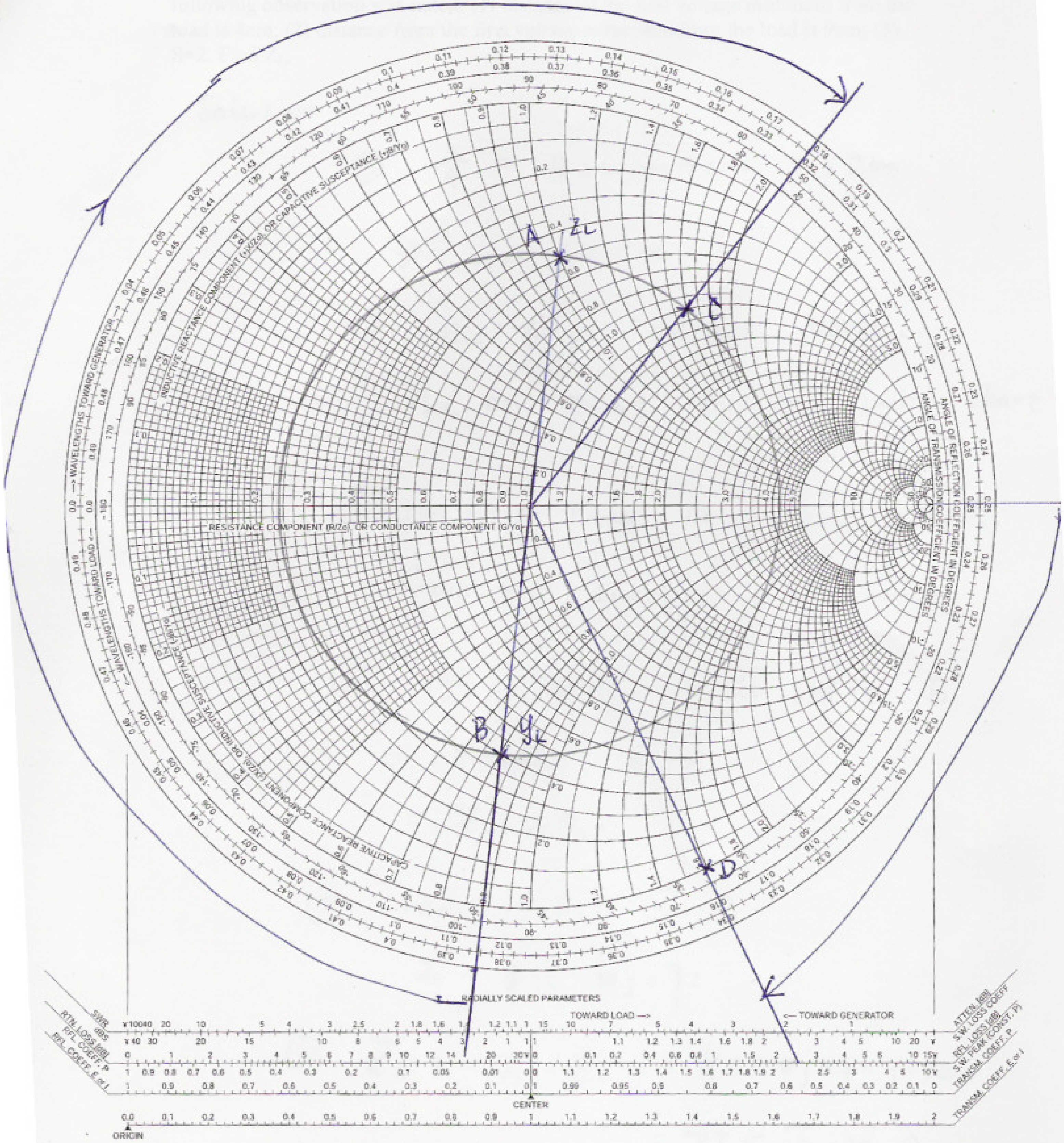
⑤ distance of $d = -0.385\lambda + 0.5\lambda + 0.178\lambda$

$= 0.293\lambda$

⑥ ~~the~~ length of the short circuit st

$= 0.34\lambda - 0.25\lambda$

$= 0.09\lambda$


A
Z_L
B
Y_L
C
D
WAVELENGTHS TOWARD GENERATOR →
← WAVELENGTHS TOWARD LOAD ←
INDUCTIVE REACTANCE COMPONENT (+jX/Zo), OR CAPACITIVE SUSCEPTANCE (+jB/Yo)
CAPACITIVE REACTANCE COMPONENT (-jX/Zo), OR INDUCTIVE SUSCEPTANCE (-jB/Yo)
RESISTANCE COMPONENT (R/Zo), OR CONDUCTANCE COMPONENT (G/Yo)
ANGLE OF REFLECTION COEFFICIENT IN DEGREES
ANGLE OF TRANSMISSION COEFFICIENT IN DEGREES
RADIALLY SCALED PARAMETERS
TOWARD LOAD →
← TOWARD GENERATOR
SWR
dBS
RTN. LOSS [dB]
RFL. COEFF, P
RFL. COEFF, E or I
ATTEN. [dB]
S.W. LOSS COEFF
RFL. LOSS [dB]
S.W. PEAK (CONST. P)
TRANSM. COEFF, P
TRANSM. COEFF, E or I
CENTER
ORIGIN

3. (35%) On a lossless transmission line with characteristic impedance $Z_0 = 50\text{-}\Omega$, the following observation was noted: (1) distance of the first voltage minimum from the load is 4cm; (2) distance from the first voltage maximum from the load is 9cm; (3) S=2. Find Z_L.

Solution:

① $\frac{\lambda}{4} = 9\text{ cm} - 4\text{ cm} = 5\text{ cm}$

$\Rightarrow \lambda = 20\text{ cm}$

② the first Voltage minimum is at point A on Smith Chart

③ the first V_{min} is $4/20 = 0.2\lambda$ from the Load

④ the Load is @ point B

$= 0.25\lambda - 0.2\lambda$

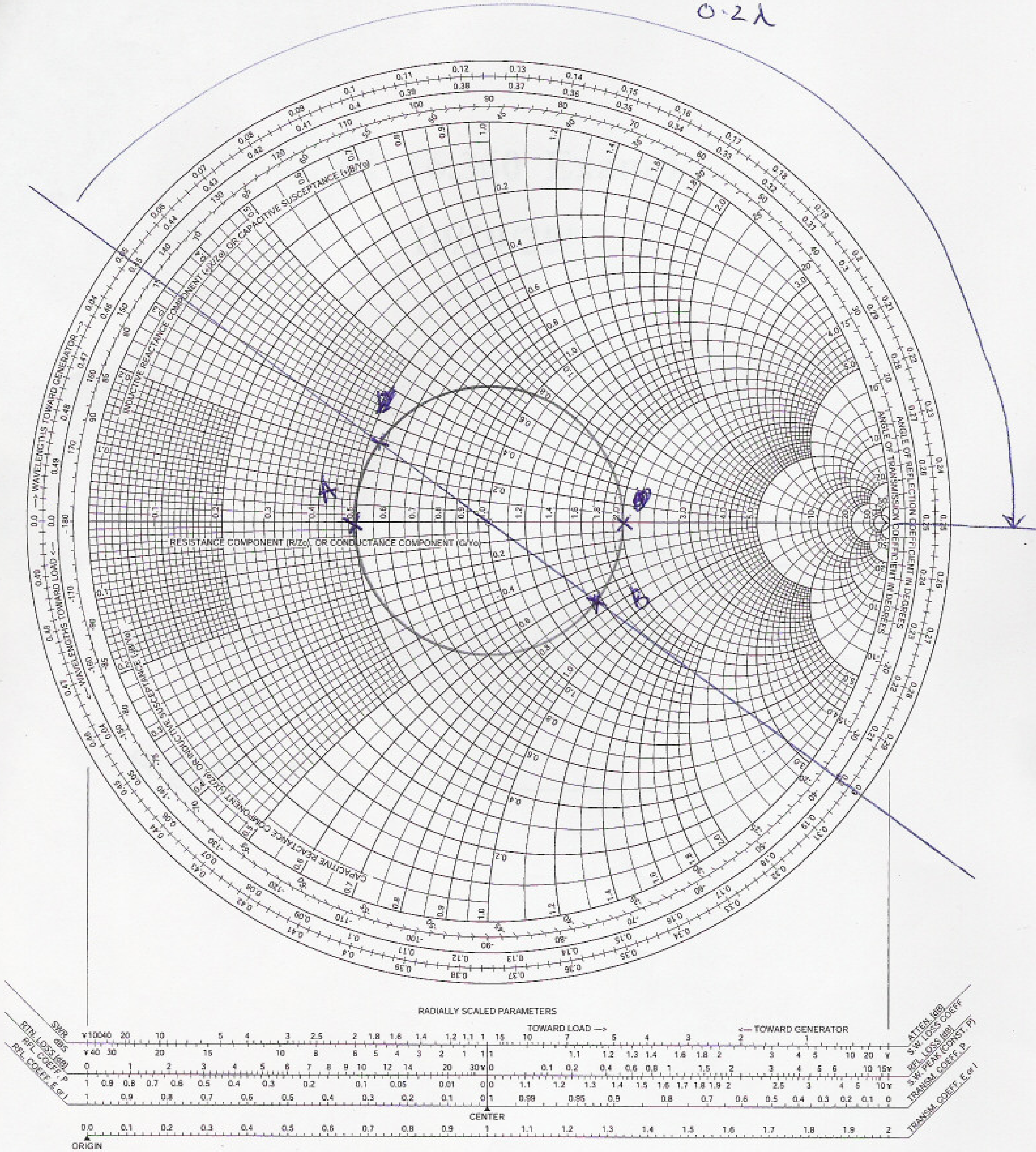
$= 0.05\lambda$

⑤ read z_L @ B

$z_L = 1.55 \mp j0.72$

⑥ $Z_L = z_L \cdot Z_0 = (1.55 \mp j0.72) \cdot 50$

$= 77.5 \mp j36\ \Omega$



0.2λ
A
B
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)
WAVELENGTHS TOWARD GENERATOR
WAVELENGTHS TOWARD LOAD
ANGLE OF REFLECTION COEFFICIENT IN DEGREES
ANGLE OF TRANSMISSION COEFFICIENT IN DEGREES
RADIALLY SCALED PARAMETERS
TOWARD LOAD
TOWARD GENERATOR
SWR
dBS
RTN. LOSS [dB]
RFL. COEFF, P
RFL. COEFF, E or I
ATTEN. [dB]
S.W. LOSS COEFF
RFL. LOSS [dB]
S.W. PEAK (CONST. P)
TRANSM. COEFF, P
TRANSM. COEFF, E or I
CENTER
ORIGIN