1.(a) (15%) For a wave with frequency f = 1MHz, the amplitude phasor at different position z can be written as: $\tilde{A}(z) = 5e^{-j100z}$, what is the instantaneous value of the amplitude $A(z,t)$ at different position z? What's the direct direction the wave travels?

$$A(z,t) = Re\left[\hat{A}(z)\, e^{j\omega t}\right] = Re\left[5e^{-j100z} \cdot e^{j2\pi ft}\right]$$

$$= Re\left[e^{j(2\pi ft - 100z)}\right]$$

$$= \cos(2\pi ft - 100z)$$

it Travels along the z direction.

1.(b) (30%) A 10GHz voltage source is connected to a lossless transmission line is terminated with $Z_L = j25\text{-}\Omega$. The characteristic impedance of the transmission line is 50-Ω. Assuming the phase velocity of the transmission line is 0.8*c*, where *c* is the speed of light. (1) Find out the location of the first $|V|_{max}$ from the load, (2) What's the standing wave ratio S? (3) how long the transmission line will make it equivalent to a short circuit?

(1). $0.8c = f \cdot \lambda \Rightarrow \lambda = \frac{0.8c}{f} = \frac{0.8 \times 3 \times 10^8}{10 \times 10^9}$

$\lambda = 2.4$ cm.

normalized load $z_L = \frac{Z_L}{Z_0} = 0.5j$

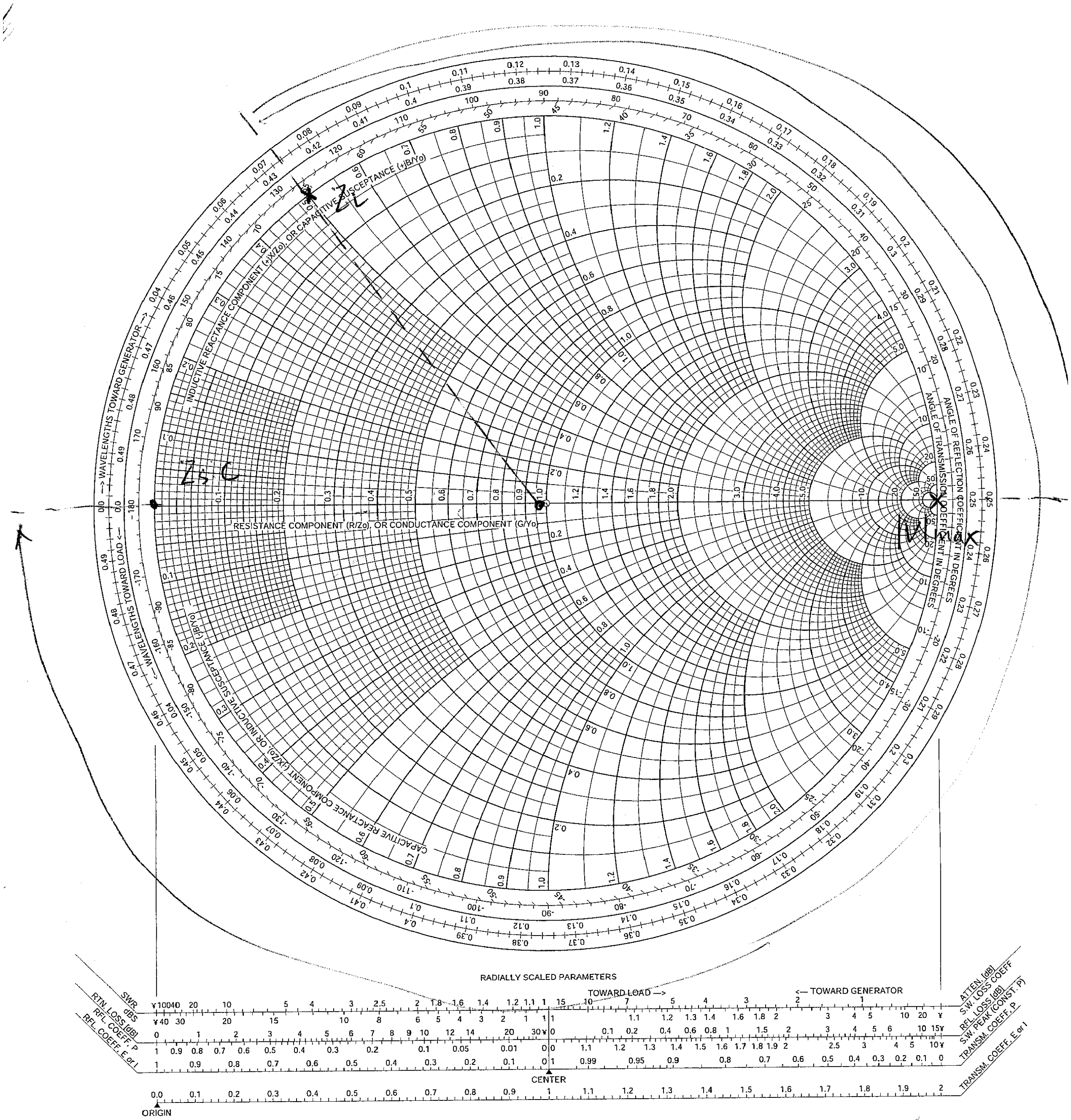
distance between $|V|_{max}$ and the Z_L is:

$0.25\lambda - 0.072\lambda = 0.178\lambda = 0.427$ cm

(2) $S = \infty$

(3) length of the transmission line is:

$0.5\lambda - 0.072\lambda = 0.428\lambda = 1.027$ cm.


ZL
|V|max
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

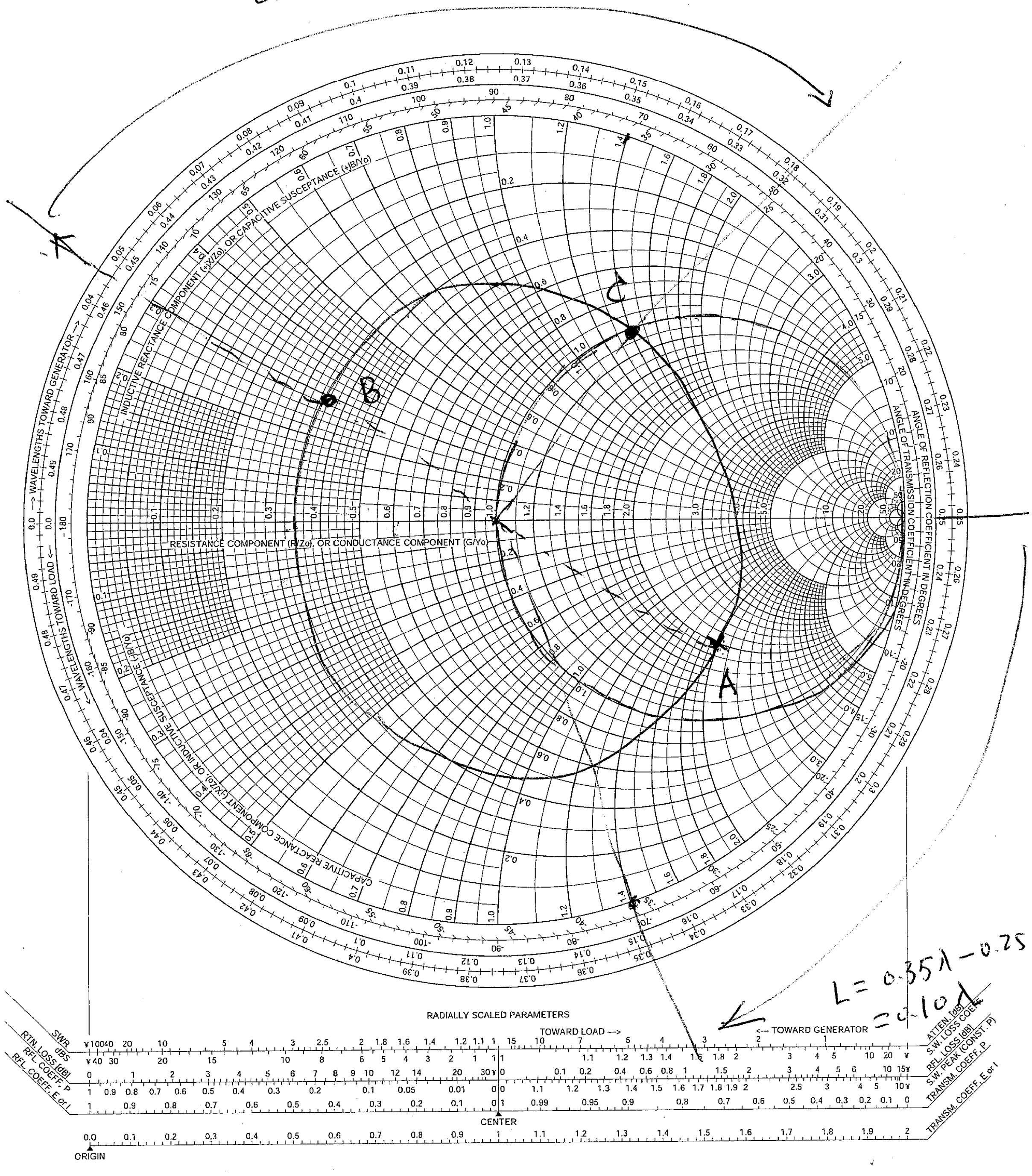
2. (30%) On a lossless 50-Ω transmission line terminated with a $Z_L = 100\text{-}j100\ \Omega$. If this transmission line is be matched to the load using a shorted load stub. Determine the stub length and distance between the load and stub. Two possible answers. You only need to show one of them.

1. normalized load $z_L = \dfrac{Z_L}{Z_0} = 2 - j2$

point A on the Smith chart.

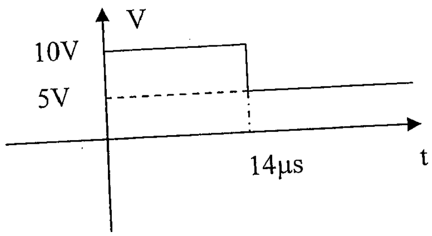
the admitance is at point B

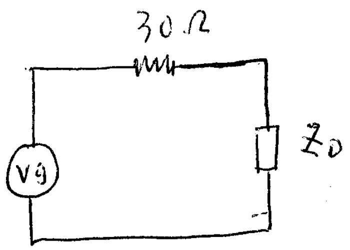
$d = 0.18\lambda - 0.043\lambda = 0.136\lambda$



$L = 0.35\lambda - 0.25 = 0.10\lambda$

3. (25%)A time domain reflector is an instrument to locate faults on a transmission line. A voltage meter is connected to beginning of a 50-Ω lossless matched transmission line, and the measured voltage waveform is shown in following figure. The line insulating material is Teflon with $\varepsilon_r = 2.0$. If we know that the resistance of the generator is 30-Ω, determine: (a) the magnitude of the generator voltage, and (b) the location of the fault.





(a) $10\,V = V_g \frac{Z_o}{30+Z_o}$

$\Rightarrow V_g = 16\,(V)$

(b) $\frac{2L}{v} = 14\,\mu s$

$\Rightarrow L = 7\mu s \cdot v = 7\times10^{-6} \times \frac{c}{\sqrt{\ }}$

$= 1.5\times10^{3}\,(m)$