1.(a) (10%) If a voltage $V(t)=10\sin(100\pi t+\pi/4)$, what is the phasor of the voltage?

$$\tilde{V} = 10\, e^{j\left(\frac{\pi}{4}-\frac{\pi}{2}\right)} \quad \text{or}$$

$$\tilde{V} = 10\, e^{-j\left(\frac{\pi}{4}-\frac{\pi}{2}\right)}$$

1.(b) (30%) A voltage source $V(t)=10\sin(6\times10^{9}\pi t)$ (V) with a resistance of 10-Ω is connected to 12-cm long lossless transmission line. The characteristic impedance of the transmission line is 50-Ω. If the transmission line is terminated with Z_L = j25-Ω. Find out the location of the first $|V|_{max}$ from the load, and the value of $|V|_{max}$, assuming the phase velocity of the transmission line equals the speed of light.

(a) $f = 3\times10^{9}$ (Hz), $\lambda = \frac{c}{f} = \frac{3\times10^{8}}{3\times10^{9}} = 0.1$ m $= 10$ cm

For $|V|_{max}$, $2\beta L + \theta_r = 2n\pi$. $\Gamma = \frac{Z_L - Z_0}{Z_L + Z_0} = \frac{j25-50}{j25+50}$

$= 1\angle 126^\circ$

$\Rightarrow 2\beta L = -126^\circ$

$\Rightarrow L = 0.0175$ m $= 1.75$ cm.

(b). $|V|_{max} = (1+|\Gamma|)|V_0^+|$, $|V_0^+| = |V_g|\cdot\frac{Z_0}{Z_g+Z_0}$

$= 10\cdot\frac{5}{6} = 8.3$ (V)

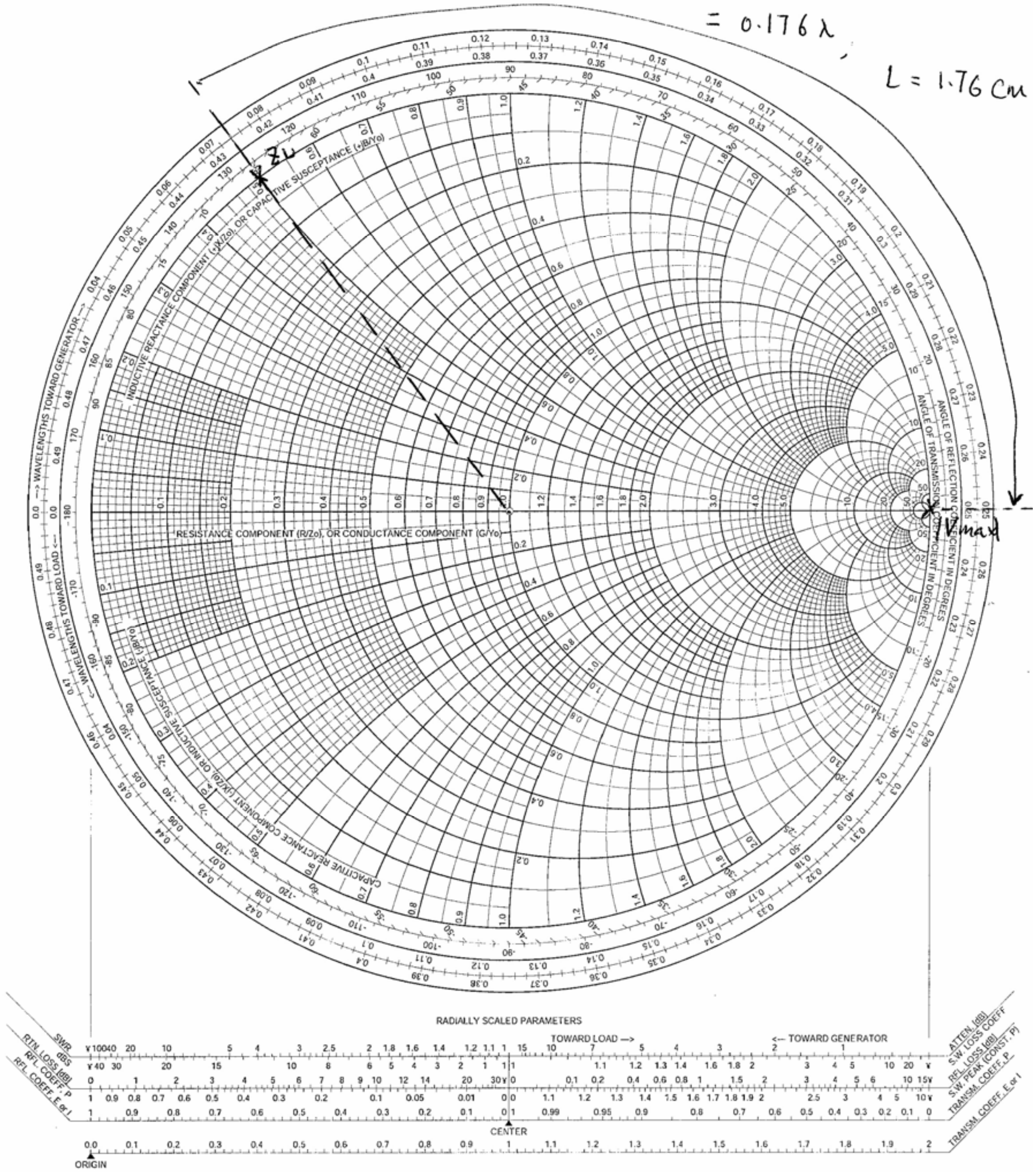
$\therefore |V|_{max} = 2\cdot 8.3$ (V)

$= 16.6$ (V)

For Graphic solution, See Smith Chart.

$l = 0.074\lambda - 0.25\lambda$

$= 0.176\lambda$, $l = 1.76$ cm



2. (30%) On a lossless 50-Ω transmission line terminated with a $Z_L = 50 + j80\ \Omega$. 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.

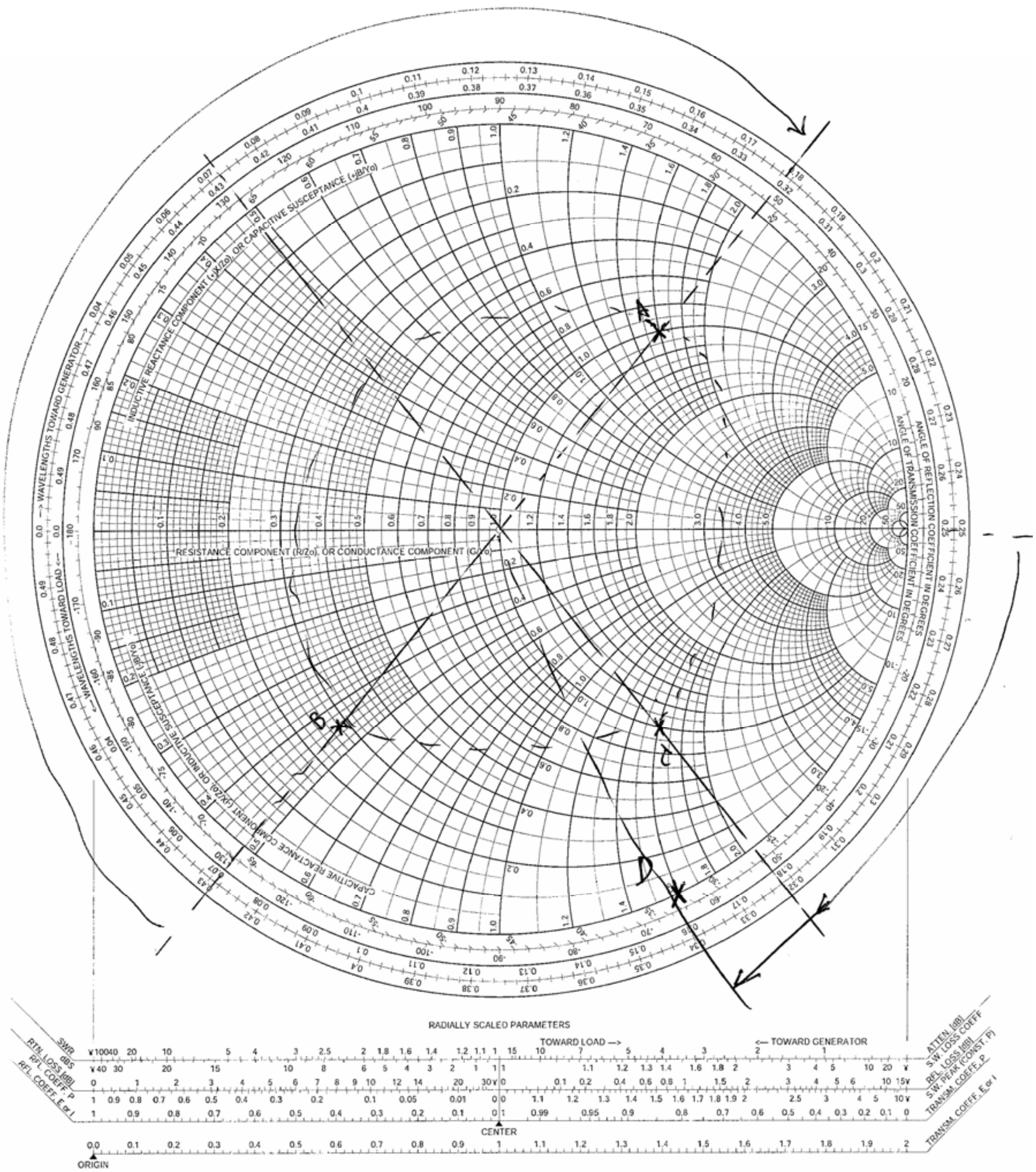
$z_L = \dfrac{Z_L}{Z_0} = 1 + j1.6$, point A

$y_L = 0.28 - j0.44$. point B

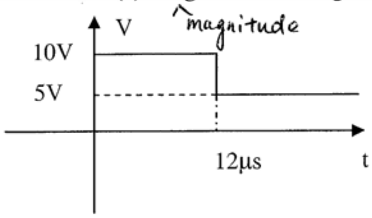
$d = 0.25\lambda$. $L = 0.338 - 0.25 = 0.084\lambda$

or $d = 0.25 + 0.338 - 0.18\lambda = 0.31\lambda$

$l = 0.18 + 0.5 - 0.25\lambda = 0.43\lambda$


RADIALLY SCALED PARAMETERS
TOWARD LOAD —>
<— TOWARD GENERATOR
SWR
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. E or I
CENTER
ORIGIN
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
—> WAVELENGTHS TOWARD GENERATOR —>
<— WAVELENGTHS TOWARD LOAD <—
A
B
C
D

3. (30%) 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 25-Ω, determine: (a) the generator voltage, and (b) the location of the fault.



(a) $|V_0^+| = |V_g| \cdot \frac{Z_0}{Z_0 + Z_g} = |V_g| \cdot \frac{50}{25+50}$

$\Rightarrow |V_g| = \frac{75}{50} \cdot |V_0^+| = 1.5 \cdot 10\ (V) = 15\ (V)$

(b). $V_p = \frac{c}{\sqrt{\varepsilon_r}} = \frac{c}{\sqrt{2}} = 2.1 \times 10^8\ m/s$

$\frac{2 \cdot l}{V_p} = t_d = 12\ \mu s$

$\Rightarrow l = V_p \cdot \frac{t_d}{2} = 2.1 \times 10^8\ m/s \cdot \frac{12}{2} \times 10^{-6}$

$= 1.26 \times 10^3\ m$

$\sim 1.3 \times 10^3\ m$