3. A Vector Network Analyzer (VNA) is attached to the end of a 15m transmission line (50Ω, $\epsilon_r = 2.3$) operating at 220Mhz. The VNA shows an input impedance of $Z_{in} = 75 - j35$. Answer the following questions or do the work requested below on the attached Smith Charts.

a) Using Smith Chart #1, find the SWR on the line as it is presently.

$SWR =$ 2.0

$Z_{in} = 75 - j35$

$\overline{Z}_{in} = 1.5 - j0.7$

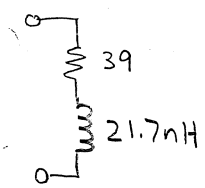
b) Using Smith Chart #1, find the normalized, denormalized, and and equivalent circuit of the load impedance Z_L at the far end of the line? Your equivalent circuit should show the correct schematic symbol and the value(s) of the symbol.(s)

$\overline{Z}_L =$ 0.78 + j0.6 $\quad Z_L =$ 39 + j30

need λ; $v_p = \frac{c}{\sqrt{2.3}} = 1.978 \times 10^8$ m/s

$\lambda = \frac{1.978 \times 10^8 \text{ m/s}}{220 \times 10^6 \frac{1}{s}} = 0.8992$ m

Equivalent Circuit:



$X_L = 2\pi f L$

$30 = 2\pi(220 \times 10^6) L$

$L = \frac{30}{2\pi(220 \times 10^6)} = 21.7$ nH

15 meters is = 16.68λ long equivalent to rotation of 0.68 − 0.5 = 0.1815 λ

c) Using Smith Chart #1, find the normalized load admittance Y_L at the far end of the line.

$\overline{Y}_L =$ 0.81 − j0.61

d) Using Smith Chart #1, find the distance in both λ and meters from the load to the first matching point.

Distance (λ) = .281 $\quad$ Distance (m) = 0.253 meters

e) What is the normalized addmittance at the first match point?

$\overline{Y}_m =$ 1.0 + j0.72

f) Using Smith Chart #2, find the shortest stub to match the susceptance found at the first match point. Give the length of the stub in both λ and meters.

Length (λ) = 0.151 λ $\quad$ Length (m) = 0.136 meters

open or short stub?

g) If fabrication of a coaxial stub was not feasible but a lumped matching element was necessary, determine the component and its value.

Matching element and value:

matching element is $B = -j0.72$ or $X = +j1.4$

denormalize $X_L = 70\Omega$

$70 = 2\pi f L$; $L = \frac{70}{2\pi(220\times10^6)} = 50.6\,nH$ } inductor

h) Where do standing waves exist in this system? Where do they not?

Between the matching stub & load

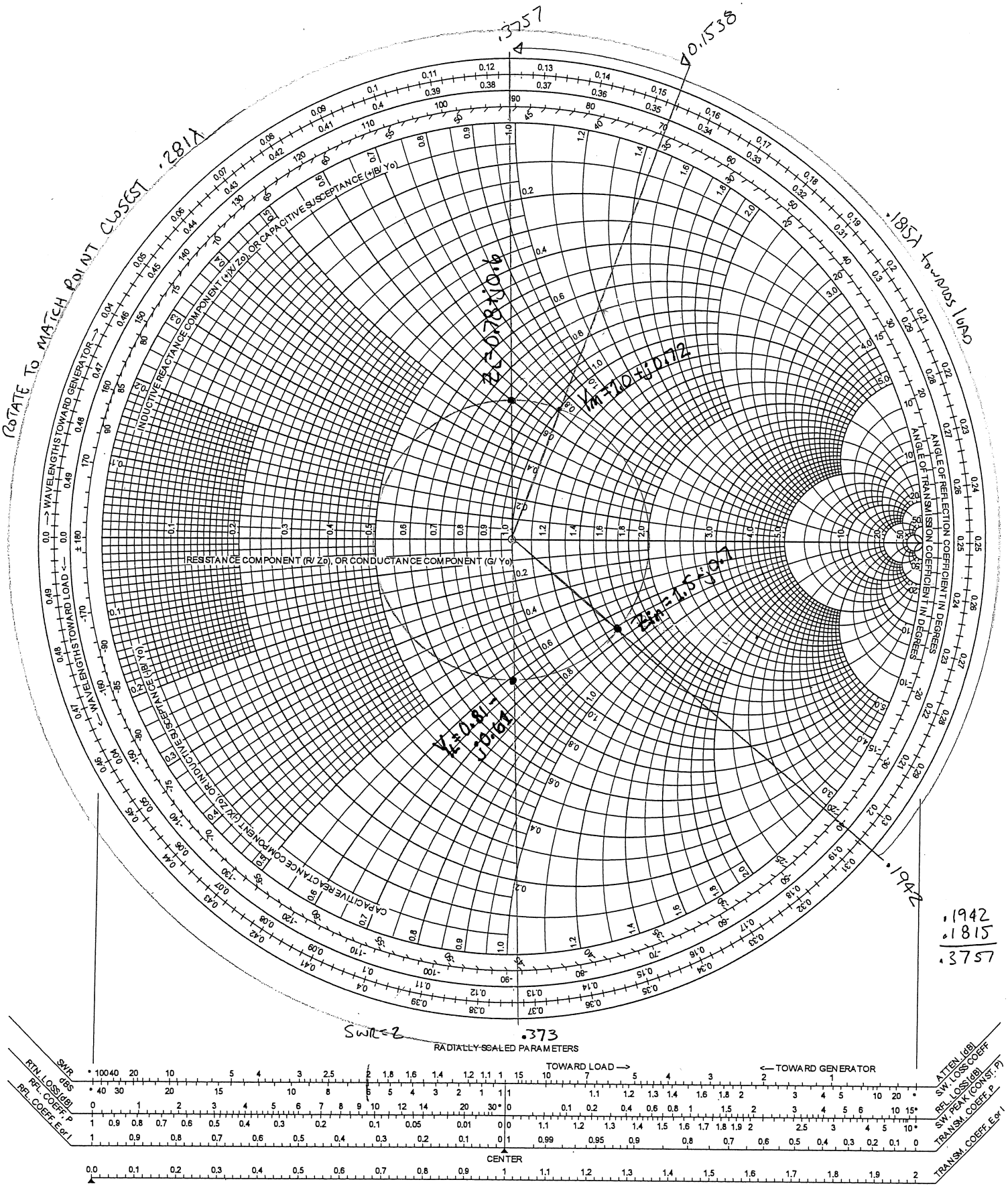
On the matching stub

i) After applying the matching network, what is the SWR at the input to the line?

1.

smith chart #1

Smith Chart



.1942
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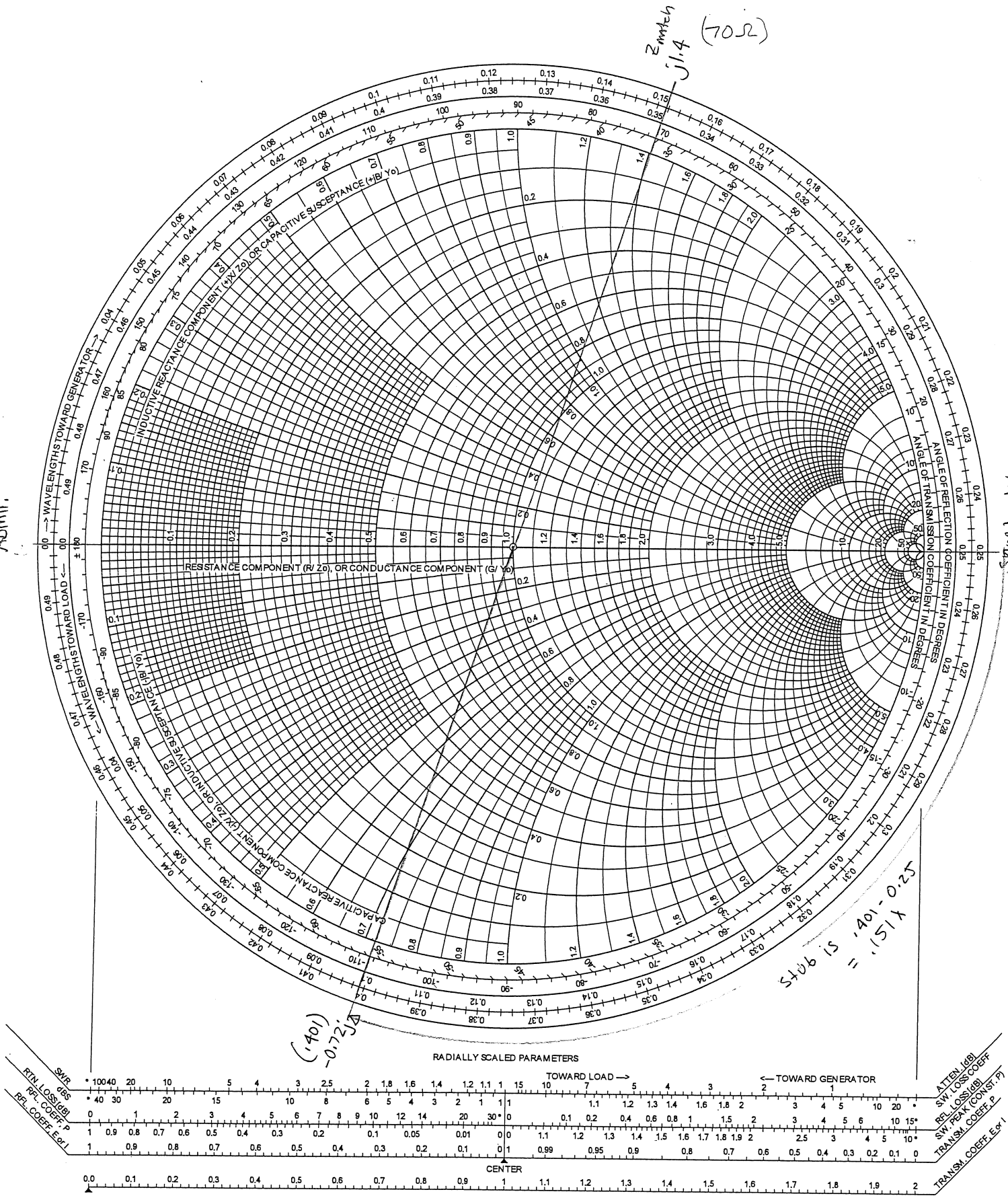
Smith chart #2

Smith Chart



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