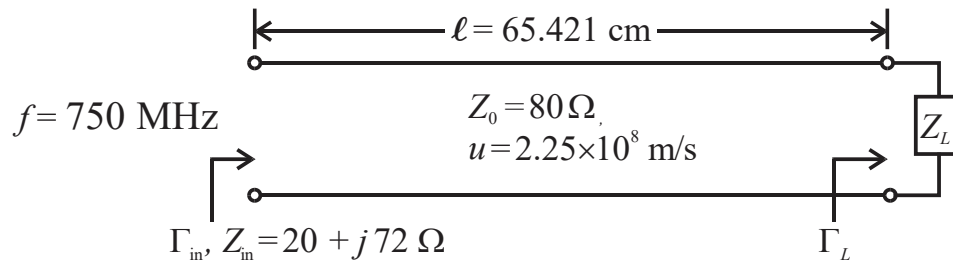


EE 381 Electric and Magnetic Fields Quiz #3 (Fall 2026)

Name KEY A

Instructions: Closed book & notes. Place answers in indicated spaces and show all work for credit.

A lossless transmission line ($80\ \Omega$, $2.25 \times 10^8\ \text{m/s}$) of length $65.421\ \text{cm}$ has a measured input impedance of $20 + j72\ \Omega$ at $750\ \text{MHz}$. Calculate the wavelength. Then, using a Smith chart, find the input reflection coefficient, load reflection coefficient, load impedance, and standing wave ratio (SWR) along the transmission line. **Show and clearly label** all points/work on the Smith chart (this will be graded).



➤ Wavelength $\lambda = u / f = 2.25 \times 10^8 / 750 \times 10^6 \Rightarrow \underline{\lambda = 0.3\ \text{m} = 30\ \text{cm}}$.

Steps

- 1) Compute normalized input impedance $z_{\text{in}} = Z_{\text{in}} / Z_0 = (20 + j72) / 80 = \underline{0.25 + j0.9\ \Omega/\Omega}$ and plot on Smith chart.
- 2) Set compass to radius corresponding to z_{in} . Draw circle, centered on Smith chart, through z_{in} . Also, draw arcs on the “REFL. COEFF, V or I” and “SWR (VSWR)” scales at bottom of Smith chart. Read $\underline{|\Gamma| = 0.76}$ and $\underline{\text{SWR} = 7.3}$.
- 3) Draw radial line from center of Smith chart through z_{in} . Read $\underline{\angle \Gamma_{\text{in}} = 94.1^\circ}$ on “ANGLE OF REFLECTION COEFFICIENT” scale.
- 4) Put magnitude and phase together to get $\Rightarrow \underline{\Gamma_{\text{in}} = 0.76 \angle 94.1^\circ}$.
- 5) To get to the load point, we must go $\ell / \lambda = 65.421 / 30 = 2.1807 \Rightarrow 0.1807 = 0.119 + 0.0617$ in “WAVELENGTHS TOWARD LOAD” direction along the $|\Gamma| = 0.76$ circle from $z_{\text{in}} / \Gamma_{\text{in}}$ point. Draw radial line from center of Smith chart through z_L / Γ_L point.
- 6) Read the normalized load impedance $z_L = 0.16 - j0.4\ \Omega/\Omega$. Compute the load impedance $Z_L = Z_0 z_{\text{in}} = 80 (0.16 - j0.4) \Rightarrow \underline{Z_L = 12.8 - j32\ \Omega}$.
- 7) Read $\underline{\angle \Gamma_L = -135.8^\circ}$ using “ANGLE OF REFLECTION COEFFICIENT” scale. We already know that $|\Gamma| = 0.76$ on a lossless transmission line. $\Rightarrow \underline{\Gamma_L = 0.76 \angle -135.8^\circ}$.

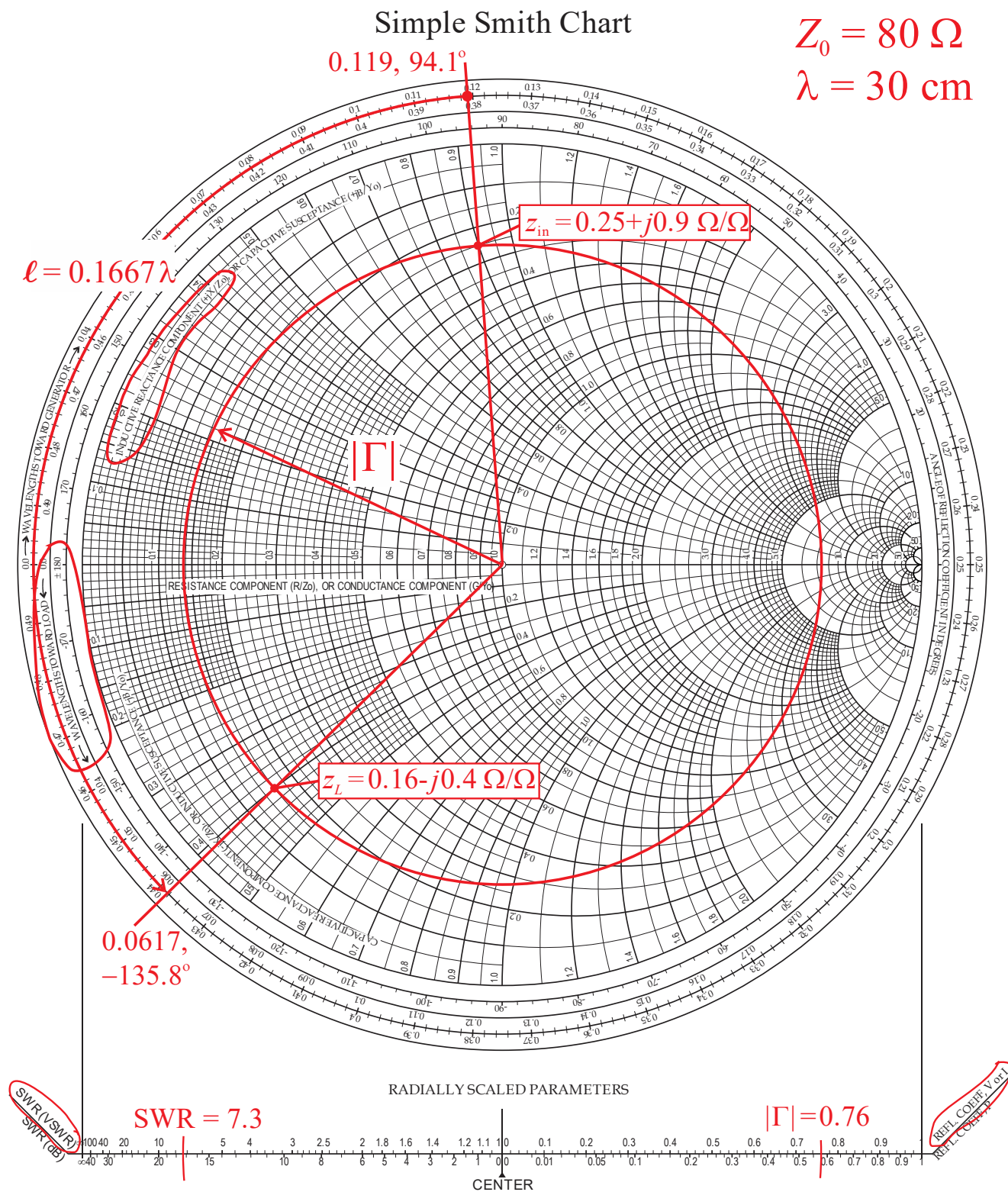
wavelength = $\underline{\lambda = 0.3\ \text{m} = 30\ \text{cm}}$

$\Gamma_{\text{in}} = \underline{0.76 \angle 94.1^\circ}$

$\Gamma_L = \underline{0.76 \angle -135.8^\circ}$

$Z_L = \underline{12.8 - j32\ \Omega}$

SWR = $\underline{7.3}$

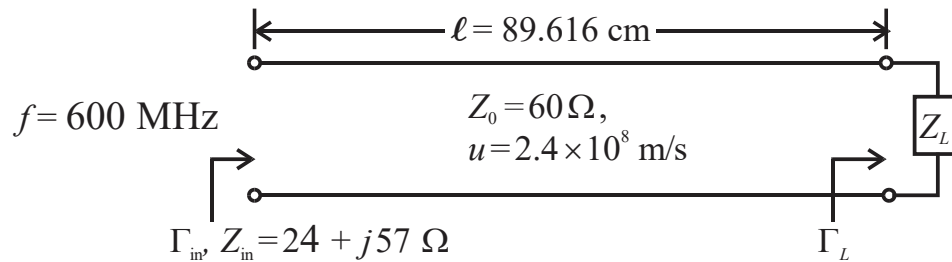


EE 381 Electric and Magnetic Fields Quiz #3 (Fall 2026)

Name KEY B

Instructions: Closed book & notes. Place answers in indicated spaces and show all work for credit.

A lossless transmission line ($60\ \Omega$, $2.4 \times 10^8\ \text{m/s}$) of length $89.616\ \text{cm}$ has a measured input impedance of $24 + j57\ \Omega$ at $600\ \text{MHz}$. Calculate the wavelength. Then, using a Smith chart, find the input reflection coefficient, load reflection coefficient, load impedance, and standing wave ratio (SWR) along the transmission line. **Show and clearly label** all points/work on the Smith chart (this will be graded).



➤ Wavelength $\lambda = u / f = 2.4 \times 10^8 / 600 \times 10^6 \Rightarrow \underline{\lambda = 0.4\ \text{m} = 40\ \text{cm}}$.

Steps

- 1) Compute normalized input impedance $z_{\text{in}} = Z_{\text{in}} / Z_0 = (24 + j57) / 60 = \underline{0.4 + j0.95\ \Omega/\Omega}$ and plot on Smith chart.
- 2) Set compass to radius corresponding to z_{in} . Draw circle, centered on Smith chart, through z_{in} . Also, draw arcs on the “REFL. COEFF, V or I” and “SWR (VSWR)” scales at bottom of Smith chart. Read $\underline{|\Gamma| = 0.66}$ and $\underline{\text{SWR} = 4.9}$.
- 3) Draw radial line from center of Smith chart through z_{in} . Read $\underline{\angle \Gamma_{\text{in}} = 88.1^\circ}$ on “ANGLE OF REFLECTION COEFFICIENT” scale.
- 4) Put magnitude and phase together to get $\Rightarrow \underline{\Gamma_{\text{in}} = 0.66 \angle 88.1^\circ}$.
- 5) To get to the load point, we must go $\ell / \lambda = 89.616 / 40 = 2.2404 \Rightarrow 0.2404 = 0.1274 + 0.113$ in “WAVELENGTHS TOWARD LOAD” direction along the $|\Gamma| = 0.66$ circle from $z_{\text{in}} / \Gamma_{\text{in}}$ point. Draw radial line from center of Smith chart through z_L / Γ_L point.
- 6) Read the normalized load impedance $z_L = 0.35 - j0.8\ \Omega/\Omega$. Compute the load impedance $Z_L = Z_0 z_{\text{in}} = 60 (0.35 - j0.8) \Rightarrow \underline{Z_L = 21 - j48\ \Omega}$.
- 7) Read $\underline{\angle \Gamma_L = -98.6^\circ}$ using “ANGLE OF REFLECTION COEFFICIENT” scale. We already know that $|\Gamma| = 0.76$ on a lossless transmission line. $\Rightarrow \underline{\Gamma_L = 0.66 \angle -98.6^\circ}$.

wavelength = $\underline{\lambda = 0.4\ \text{m} = 40\ \text{cm}}$

$\Gamma_{\text{in}} = \underline{0.66 \angle 88.1^\circ}$

$\Gamma_L = \underline{0.66 \angle -98.6^\circ}$

$Z_L = \underline{21 - j48\ \Omega}$

SWR = $\underline{4.9}$

