S4.1. Consider the two-port network given below:

\[
\begin{array}{c}
\text{Port 1} \\
5 \text{ ohms} \\
\end{array}
\begin{array}{c}
\text{40 ohms} \\
\text{Port 2}
\end{array}
\]

(a) Find $S_{11}$ for $Z_0 = 50 \, \Omega$.
(b) Find $S_{21}$ for $Z_0 = 50 \, \Omega$.

S4.2. Consider the two-port network given below:

\[
\begin{array}{c}
\text{Port 1} \\
10 \, \Omega \\
\end{array}
\begin{array}{c}
80 \, \Omega \\
80 \, \Omega \\
\text{Port 2}
\end{array}
\]

(a) Find $S_{11}$ for $Z_0 = 50 \, \Omega$.
(b) Find $S_{21}$ for $Z_0 = 50 \, \Omega$.

S4.3. Consider the following two-port network:

\[
\begin{array}{c}
\text{Port 1} \\
1 = 0.25\lambda, Z_0 = 30 \, \Omega \\
\end{array}
\begin{array}{c}
\text{Port 2}
\end{array}
\]

(a) Find $S_{11}$, referenced to $Z_0 = 50 \, \Omega$.
(b) Find $S_{21}$, referenced to $Z_0 = 50 \, \Omega$. 
S4.4. Consider a two-port network with S-parameters (taken with respect to $Z_0 = 50 \, \Omega$) given as follows:

$$[S] = \begin{bmatrix} 0.3 \angle 0^\circ & 0.6 \angle 50^\circ \\ 0.6 \angle 50^\circ & 0.3 \angle 0^\circ \end{bmatrix}$$

(a) Is the network reciprocal? Why or why not?
(b) Is the network lossless? Show that your answer is correct based on the mathematical equation identities regarding S-parameters for lossless networks.
(c) What is the input reflection coefficient looking into port 1 if a 100 $\Omega$ resistor is connected as the load to port 2?

S4.5. Consider a two-port network with S-parameters (taken with respect to $Z_0 = 50 \, \Omega$) given as follows:

$$[S] = \begin{bmatrix} 0.2 \angle 90^\circ & 0.2 \angle 0^\circ \\ 0.9 \angle 100^\circ & 0.2 \angle -90^\circ \end{bmatrix}$$

(a) Is the network reciprocal? Why or why not?
(b) Is the network lossless? Show that your answer is correct based on the mathematical equation identities regarding S-parameters for lossless networks.
(c) What is the input reflection coefficient looking into port 1 if a 20 $\Omega$ resistor is connected as the load to port 2?

S4.6. Consider a problem in which two two-port networks, each possessing the given S-parameters, are placed in cascade:

The S-Parameters for each individual network (with $Z_0 = 50 \, \Omega$) are:

- $S_{11} = 0.1$
- $S_{12} = 0.9$
- $S_{21} = 0.9$
- $S_{22} = 0.1$

Find the ABCD matrix for the cascade combination of the networks.