Problem 1.1  A 2-kHz sound wave traveling in the x-direction in air was observed to have a differential pressure \( p(x,t) = 10 \text{ N/m}^2 \) at \( x = 0 \) and \( t = 50 \mu \text{s} \). If the reference phase of \( p(x,t) \) is 36°, find a complete expression for \( p(x,t) \). The velocity of sound in air is 330 m/s.

Problem 1.8  Two waves on a string are given by the following functions:

\[
y_1(x,t) = 4 \cos(20t - 30x) \quad \text{cm} \\
y_2(x,t) = -4 \cos(20t + 30x) \quad \text{cm}
\]

where \( x \) is in centimeters. The waves are said to interfere constructively when their superposition \( |y_s| = |y_1 + y_2| \) is a maximum, and they interfere destructively when \( |y_s| \) is a minimum.

(a) What are the directions of propagation of waves \( y_1(x,t) \) and \( y_2(x,t) \)?

(b) At \( t = (\pi/50) \text{ s} \), at what location \( x \) do the two waves interfere constructively, and what is the corresponding value of \( |y_s| \)?

(c) At \( t = (\pi/50) \text{ s} \), at what location \( x \) do the two waves interfere destructively, and what is the corresponding value of \( |y_s| \)?

Problem 1.9  Give expressions for \( y(x,t) \) for a sinusoidal wave traveling along a string in the negative \( x \)-direction, given that \( y_{\text{max}} = 40 \text{ cm} \), \( \lambda = 30 \text{ cm} \), \( f = 10 \text{ Hz} \), and

(a) \( y(x,0) = 0 \) at \( x = 0 \),

(b) \( y(x,0) = 0 \) at \( x = 3.75 \text{ cm} \).

Problem 1.13  The voltage of an electromagnetic wave traveling on a transmission line is given by \( v(z,t) = 5e^{-az} \sin(4\pi \times 10^9 t - 20\pi z) \) (V), where \( z \) is the distance in meters from the generator.

(a) Find the frequency, wavelength, and phase velocity of the wave.

(b) At \( z = 2 \text{ m} \), the amplitude of the wave was measured to be 2 V. Find \( \alpha \).
Problem 1.16  Evaluate each of the following complex numbers and express the result in rectangular form:

(a) \( z_1 = 8e^{i\pi/3} \)
(b) \( z_2 = \sqrt{3} \ e^{i3\pi/4} \)
(c) \( z_3 = 2e^{-j\pi/2} \)
(d) \( z_4 = j^3 \)
(e) \( z_5 = j^{-4} \)
(f) \( z_6 = (1 - j)^3 \)
(g) \( z_7 = (1 - j)^{1/2} \)

Problem 1.19  If \( z = -2 + j4 \), determine the following quantities in polar form:

(a) \( 1/z \),
(b) \( z^3 \),
(c) \( |z|^2 \),
(d) \( \text{Im}\{z\} \),
(e) \( \text{Im}\{z^*\} \).

Problem 1.21  Complex numbers \( z_1 \) and \( z_2 \) are given by

\[
\begin{align*}
    z_1 &= 5 \angle -60^\circ \\
    z_2 &= 4 \angle 45^\circ 
\end{align*}
\]

(a) Determine the product \( z_1z_2 \) in polar form.
(b) Determine the product \( z_1z_2^* \) in polar form.
(c) Determine the ratio \( z_1/z_2 \) in polar form.
(d) Determine the ratio \( z_1^*/z_2^* \) in polar form.
(e) Determine \( \sqrt{z_1} \) in polar form.
Problem 1.26  Find the phasors of the following time functions:
(a) \( v(t) = 9 \cos(\omega t - \pi/3) \) (V)
(b) \( v(t) = 12 \sin(\omega t + \pi/4) \) (V)
(c) \( i(x, t) = 5 e^{-3x} \sin(\omega t + \pi/6) \) (A)
(d) \( i(t) = -2 \cos(\omega t + 3\pi/4) \) (A)
(e) \( i(t) = 4 \sin(\omega t + \pi/3) + 3 \cos(\omega t - \pi/6) \) (A)

Problem 1.27  Find the instantaneous time sinusoidal functions corresponding to the following phasors:
(a) \( \overrightarrow{V} = -5 e^{j\pi/3} \) (V)
(b) \( \overrightarrow{V} = j6 e^{-j\pi/4} \) (V)
(c) \( \overrightarrow{I} = (6 + j8) \) (A)
(d) \( \overrightarrow{I} = -3 + j2 \) (A)
(e) \( \overrightarrow{I} = j \) (A)
(f) \( \overrightarrow{I} = 2 e^{j\pi/6} \) (A)

Problem 1.28  A series RLC circuit is connected to a generator with a voltage \( v_5(t) = V_0 \cos(\omega t + \pi/3) \) (V).

(a) Write the voltage loop equation in terms of the current \( i(t) \), \( R \), \( L \), \( C \), and \( v_5(t) \).
(b) Obtain the corresponding phasor-domain equation.
(c) Solve the equation to obtain an expression for the phasor current \( \overrightarrow{I} \).