(10) A rocket moves at a speed of 242 m/s directly toward a stationary pole (through stationary air) while emitting sound waves at frequency \( f = 1250 \, \text{Hz} \).

(a) What frequency \( f' \) is measured by a detector that is attached to the pole?
(b) Some of the sound reaching the pole reflects back to the rocket as an echo. What frequency \( f'' \) does a detector on the rocket detect for the echo?

(c) If the air in this problem is moving toward the pole at speed 20 m/s (i) what value for the source speed \( V_s \) should be used in the solution of part (a), and what value for the detector speed \( V_d \) should be used in the solution of part (b)?

(11) Two sinusoidal waves, identical except for phase, travel in the same direction along the string and interfere to produce a resultant wave given by; \( y'(x,t) = (3.0 \, \text{mm}) \sin (20x - 4.0t + 0.820 \, \text{rad}) \) with \( x \) in metres and \( t \) in seconds. What are (a) the wavelength \( \lambda \) of the two waves, (b) the phase difference between them, and (c) their amplitude \( y_m \)?

(12) The wavefunctions for two transverse waves on a string are

\[ y_1 = 0.03 \cos (6.0x - 18t + 1.5) \]
\[ y_2 = 0.02 \cos (6.0x - 18t - 2.3) \]

where \( y \) and \( x \) are measured in metres and \( t \) in seconds.

(a) What is the phase difference between these waves?

[Hint: if \( y(x,t) = y_0 \cos (kx - \omega t + \phi) \) then \( \theta = (kx - \omega t + \phi) \) is the phase of the wave at position \( x \) & time \( t \) ]
(b) What is the amplitude and the phase constant of the resultant wave?

(c) What is the transverse displacement of the string at \( x = 0 \) at \( t = 0 \)?

(13) A string has a length of 3.0 m and a mass of 12 g. If this string is subjected to a tension of 250 N, what is the speed of transverse waves?

(14) A string of length \( L \) is plucked at a distance \( d \) from one end. Find the smallest value of \( d \) in terms of \( L \) if the string vibrates only at the second harmonic.

If the string has a mass \( m \) and a tension \( T \), what is the frequency of the second harmonic?