Q1.
For a given medium, the wavelength of a wave is:

A) inversely proportional to the frequency
B) independent of the frequency
C) proportional to the frequency
D) proportional to the amplitude
E) inversely proportional to the amplitude

$$v = f\lambda \rightarrow \lambda = \frac{v}{f} \rightarrow \lambda \propto \frac{1}{f} \; ; \; v = \text{const.}$$

Q2.
A stretched string has a length of 2.0 m and a mass of 2.5 g. A sinusoidal transverse wave traveling on the string is described by the equation: $y(x,t) = 0.010 \sin(3.0x - 75t)$, where x and y are in meters and t is in seconds. What is the tension in the string?

A) 0.78 N
B) 0.31 N
C) 0.39 N
D) 0.47 N
E) 0.53 N

$$Y(x,t) = 0.01 \sin(3.0x - 75t)$$

$$v = \frac{\omega}{k} = \frac{75}{3} = 25 \text{ m/s} = \sqrt{\frac{T}{\mu}}$$

$$T = (25)^2 * \frac{2.5 * 10^{-3}}{2} = 0.78 \text{ N}.$$

Q3.
A transverse sinusoidal wave with amplitude of 2.5 cm is traveling on a stretched string. The speed of the wave on the string is 35 cm/s, and the maximum transverse speed of a particle on the sting is 7.5 cm/s. What is the wavelength of the wave?

A) 73 cm
B) 54 cm
C) 66 cm
D) 47 cm
E) 31 cm

$$v_{max} = \omega Y = 7.5 \text{ cm/s} \rightarrow \omega = \frac{7.5}{2.5} = 3 \text{ rad/s}.$$

$$= 2\pi f.$$

$$v_{ph} = f\lambda \rightarrow \lambda = \frac{35}{f} = \frac{35 * 2\pi}{3} = 73 \text{ Cm}.$$

Q4.
The displacement of a string carrying a traveling sinusoidal wave is given by: $y(x,t) = y_m \sin(kx - \omega t - \phi)$.
At time $t = 0$ the point at $x = 0$ has a displacement of 0 and is moving in the positive y direction.
The phase constant ϕ is:

$Y = Y_m \sin(kx - \omega t - \phi)$.

$Y(0,0) = 0 = Y_m \sin(0 - 0 - \phi)$.

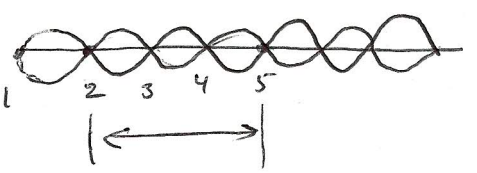
$\rightarrow \phi = 0$ Since ~~disp~~motion in +Y.

A) 180°
B) zero
C) 45°
D) 90°
E) 135°

Q5.
Standing waves are produced by the interference of two traveling sinusoidal waves, each of frequency 100 Hz. The distance from the second node to the fifth node is 60 cm. The wavelength of each of the two original waves is:

$60 = 3\frac{\lambda}{2}$.

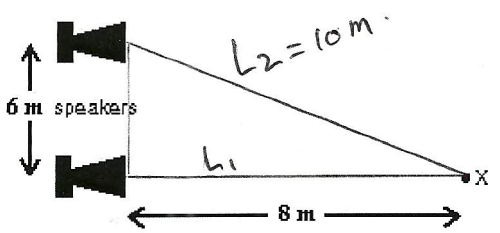
$\lambda = 30$ Cm.



A) 40 cm
B) 50 cm
C) 30 cm
D) 20 cm
E) 15 cm

Q6.
Two small identical speakers are connected (in phase) to the same source. The speakers are 6 m apart and are at ear level. An observer stands at X=8 m in front of one speaker as shown in Fig. 1. The sound he hears will be least intense if the wavelength is: (First minema).

Fig#



#:

$L_2 - L_1 = \frac{\lambda}{2} \rightarrow \lambda = 4$ m.

A) 4 m
B) 9 m
C) 3 m
D) 2 m
E) 5 m

Q7.
The intensity of sound wave A is 100 times that of sound wave B. By how many decibels is the sound level of A higher than that of B?

A) 20 dB
B) 100 dB
C) 40 dB
D) 2 dB
E) 10 dB

$I_A = 100\, I_B$

$\beta_A = 10 \log I_A/I_0 = 10 \log 100\, I_B/I_0$

$\beta_B = 10 \log I_B/I_0 = 10 \log I_B/I_0$

$\frac{\beta_A}{\beta_B} = \frac{\log 100\, I_B/I_0}{\log I_B/I_0}$ $\quad \beta_A = 10\left(\log 100 + \log \frac{I_B}{I_0}\right)$

$= 20 + 10 \log \frac{I_B}{I_0}$.

$\beta_A = 20 + \beta_B$

Q8.
A tuning fork with a frequency of 510 Hz is placed at the open end of an air column that is closed at the other end. What is the shortest length of the air column that will resonate with the tuning fork? The speed of sound in air is 345 m/s.

A) 17 cm
B) 4.2 cm
C) 9.4 cm
D) 33 cm
E) 66 cm

$L = \frac{\lambda}{4}$.

$345 = 510 * \lambda$.

$\lambda = \frac{345}{510} = 68$ cm.

$L = \frac{68}{4} = 17$ cm.

Q9.
A source emits sound with a frequency of 1000 Hz. The source and an observer are moving toward each other, each with a speed of 100 m/s. If the speed of sound is 340 m/s, the observer hears sound with a frequency of:

A) 1833 Hz
B) 1000 Hz
C) 294 Hz
D) 545 Hz
E) 3400 Hz

S 100 m/s → ← 100 m/s observer.

$f' = f \frac{v \pm v_D}{v \pm v_S}$.

both Towards each other:

$f' = 1000 \frac{340 + 100}{340 - 100} = 1000 \frac{440}{240}$

$= 1833$ Hz.