Physics of Waves

Use this key to check answers and read the explanations.

1. Which word describes the lowest point of a transverse wave drawn above and below a horizontal resting line?

A. Trough
B. Crest
C. Compression
D. Medium

Correct answer: A. Trough
The trough is the lowest point on the profile. The crest is the highest point.

2. A pulse travels to the right on a rope while a marked section of rope moves up and down. What kind of wave motion is this?

A. Rotational
B. Longitudinal
C. Transverse
D. Static

Correct answer: C. Transverse
The rope’s local motion is perpendicular to the direction in which the disturbance travels. That is transverse motion.

3. In a sound wave traveling through still air, what moves parallel to the direction the wave travels?

A. Air particles move steadily with the wave to the listener
B. Air particles oscillate back and forth
C. Air particles oscillate only up and down
D. Air particles remain completely still

Correct answer: B. Air particles oscillate back and forth
Sound in air is longitudinal. The local air motion is back and forth along the direction of propagation.

4. On a wave drawing, the crest is 3.5 cm above the resting line and the trough is 3.5 cm below it. What is the amplitude?

A. 0 cm
B. 7.0 cm
C. 1.75 cm
D. 3.5 cm

Correct answer: D. 3.5 cm
Amplitude is the maximum distance from the resting position. The crest-to-trough height is twice the amplitude.

5. Which of these can travel from a spacecraft through the near-vacuum of space to a distant receiver?

A. A sound wave made by a bell
B. A radio wave
C. A seismic P wave
D. A wave on a steel string

Correct answer: B. A radio wave
Radio waves are electromagnetic and can travel through a vacuum. Sound and waves in ropes or water need matter to carry the disturbance.

6. A marker on a spring makes 18 complete oscillations in 6 seconds. What is the frequency?

A. 3 Hz
B. 24 Hz
C. 108 Hz
D. One-third Hz

Correct answer: A. 3 Hz
Frequency is cycles per unit time. Divide 18 cycles by 6 seconds to get 3 cycles per second.

7. The interval from one crest passing a buoy to the next crest passing it is 0.25 seconds. What is the wave’s frequency?

A. 25 Hz
B. 0.25 Hz
C. 2 Hz
D. 4 Hz

Correct answer: D. 4 Hz
The crest-to-crest time at a fixed position is the period. Its reciprocal is 1 ÷ 0.25 = 4 Hz.

8. A periodic wave has frequency 8 Hz and wavelength 0.75 m. What is its speed?

A. 8.75 m/s
B. 0.094 m/s
C. 6 m/s
D. 10.7 m/s

Correct answer: C. 6 m/s
Wave speed is frequency multiplied by wavelength. The product is 8 × 0.75 = 6 m/s.

9. A pulse travels down a stretched rope. After the pulse passes, a small marker tied to the rope returns to its starting position. What did the pulse carry along the rope?

A. Energy without carrying the marker along with it
B. The marker all the way to the far end
C. A new length of rope
D. The tied section of rope permanently upward

Correct answer: A. Energy without carrying the marker along with it
The disturbance transfers energy. Parts of the rope move locally and can return to their resting positions after the pulse.

10. Two small pulses overlap on a linear rope. Their individual displacements at a point are 6 mm upward and 2 mm downward. What is the total displacement there?

A. 2 mm downward
B. 8 mm upward
C. 4 mm downward
D. 4 mm upward

Correct answer: D. 4 mm upward
Superposition adds signed displacements. Taking upward as positive gives $6 - 2 = 4$ mm.

11. On the same ideal string at unchanged tension, the source frequency is tripled. How does the wavelength change?

A. It stays the same
B. It becomes three times as long
C. It becomes one-third as long
D. It becomes nine times as long

Correct answer: C. It becomes one-third as long
The string sets the wave speed under these conditions. Since wavelength equals speed divided by frequency, tripling frequency divides wavelength by three.

12. Adjacent nodes in a standing wave on a string are 0.45 m apart. What is the wavelength of the component waves?

A. 0.225 m
B. 0.90 m
C. 0.45 m
D. 1.80 m

Correct answer: B. 0.90 m
Adjacent nodes in a standing wave are separated by half a wavelength. Double 0.45 m to get the wavelength.

13. An observer tracks a point halfway between neighboring antinodes of a standing wave. What is true about that point?

A. It alternates between being a node and an antinode every cycle
B. It oscillates with the largest amplitude
C. It travels along the string at the wave speed
D. It is a node and remains at rest

Correct answer: D. It is a node and remains at rest
A node lies midway between adjacent antinodes. At a node the component waves cancel at all times.

14. Wave A has a wavelength of 3 m and period 0.5 s. Wave B has a wavelength of 5 m and period 1.25 s. How do their speeds compare?

A. Wave A is 2 m/s faster
B. Wave B is 2 m/s faster
C. Both travel at 6 m/s
D. Wave B is three times as fast

Correct answer: A. Wave A is 2 m/s faster
Divide wavelength by period. Wave A travels at 6 m/s and wave B at 4 m/s, a difference of 2 m/s.

15. Two waves of equal frequency reach one point half a cycle apart, but their amplitudes at that point are 7 mm and 4 mm. What is the amplitude of their sum there?

A. 11 mm
B. 0 mm
C. 3 mm
D. 7 mm

Correct answer: C. 3 mm
With opposite phase, the waves subtract rather than reinforce. Equal amplitudes would cancel completely, but these leave an amplitude of $7 - 4 = 3$ mm.