Waves, Wave Behavior, & Sound Quiz Review KEY

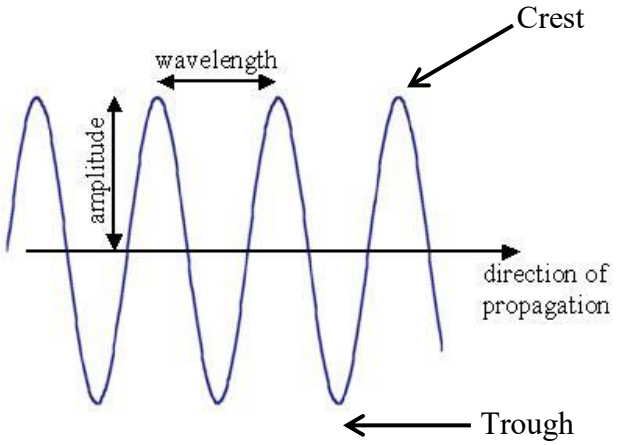
***Instructions**: Show all of your work completely in your journal, including the equations used in variable form. Pay attention to sig figs and units; use complete sentences if applicable.*

1. Define and provided examples for the following types of waves:
   a. Transverse: ***waves with particle motion perpendicular to wave propagation (i.e. – guitar strings)***
   b. Longitudinal: ***waves with particle motion parallel to wave propagation (i.e. – sound waves)***
   c. Surface: ***waves with particle motion perpendicular AND parallel to wave propagation, resulting in a circular motion (i.e. – water waves)***

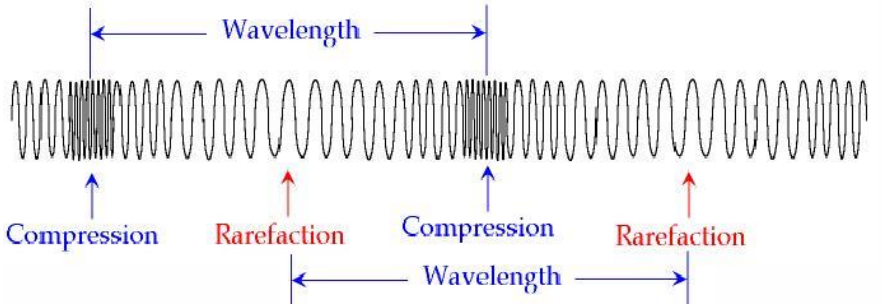
2. What is the only factor that affects the speed of a mechanical wave?
   Wave speed is a property of <u>the medium</u> through which the wave is travelling.

3. Define and list the variables for the following terms:
   a. Frequency: ***The number of complete cycles that pass a fixed point every second; units: Hertz (Hz)***
   b. Period: ***The amount of time required to complete on full cycle; units: seconds (s)***
   c. Wave Speed: ***The speed with which energy propagates through a medium; units: $^{m}/_{s}$***
   d. Amplitude: ***For transverse waves: amplitude is a measure of maximum displacement from equilibrium. In longitudinal waves: it is the difference in pressure between the compressions and rarefactions (perceived as volume in sound waves).***
   e. Wavelength: ***The distance from one point on a wave to the same point on the next wave (i.e.- crest to crest); units: meters (m)***
   f. Sound Intensity: ***power of sound per unit areas; units: decibels (dB)***

4. Sketch and label the following diagrams:
   a. Transverse Wave:

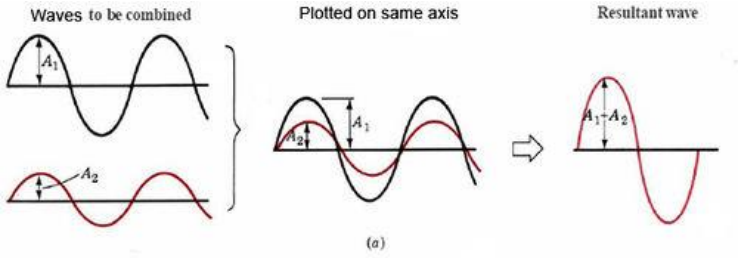


b. Longitudinal Wave:

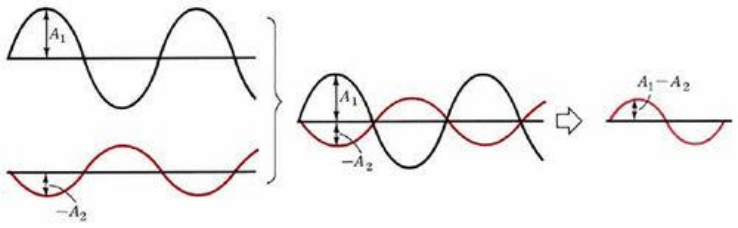


5. Define and sketch a diagram for each of the following wave behaviors:

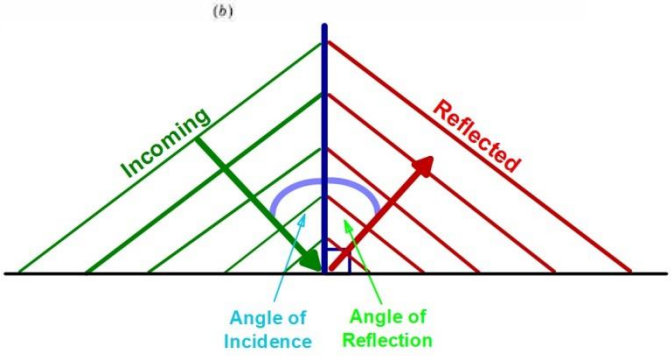
a. Constructive Interference



b. Destructive Interference



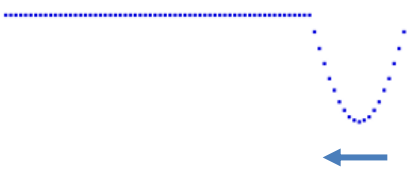
c. Reflection: ***a change in direction when a wave reaches a barrier. Angle incidence =Angle reflection***



d. Fixed vs. Free End:

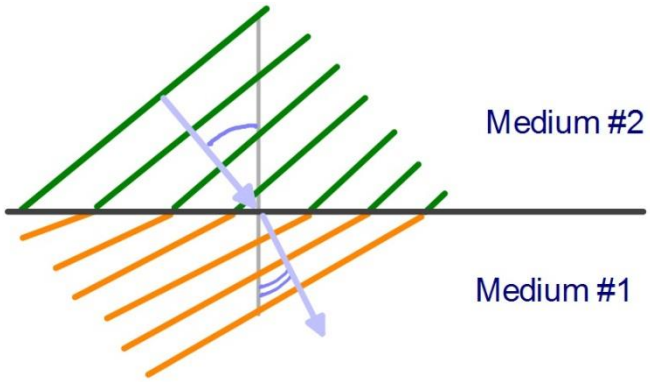
Incoming Wave:

Fixed:

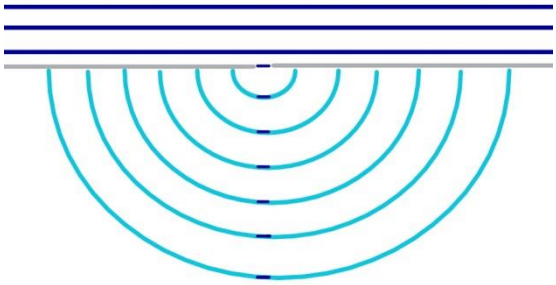


Free:

e. Refraction: ***change in direction at the boundary between two different mediums.***



f. Diffraction ***the spreading of waves around the edge of a barrier***



6. What is the superposition principle? What does it mean for mechanical waves?
   The superposition principle states that waves can be in the same place at the same time. To find the resultant wave's amplitude, we simply add the two waves point by point.

7. Define pitch; what wave property is it most closely related to?
   Pitch is the tone of a sound (how high or low something sounds). It is most closely associated with frequency.

8. Define loudness; what wave property is it most closely related to?
   Loudness is the brain's interpretation of pressure differences in sound waves. This is related to the amplitude of the sound wave.

9. If frequency changes, what other wave properties are changed? Are they directly or indirectly related?
   If frequency changes (and the medium is not), the period changes inversely (i.e. – if frequency increases, period decreases), as does the wavelength (also inversely).

10. How does air temperature affect the speed of sound? List an equation to support your reasoning.
    Yes! Sound travels faster in warmer air because the molecules have more kinetic energy and are thus easier to propagate through.

$$v_{sound} = 331 + 0.6T$$

11. Define the following terms:
    a. Infrasonic frequencies: ***frequencies LOWER than 20 Hz***
    b. Ultrasonic frequencies: ***frequencies HIGHER than 20,000 Hz***
    c. Subsonic speeds: ***speeds SLOWER than the speed of sound (~343 $^{m}/_{s}$)***
    d. Supersonic speeds: ***speeds FASTER than the speed of sound***

12. Define the Doppler Effect. How does the apparent frequency shift for an observer based on the motion of the source?
    The Doppler Shift is the APPARENT shift in frequency due to the relative motion of a sound source to an observer. When the source is moving TOWARDS the observer, the pitch the observer hears will be HIGHER than the source frequency and vice versa!

13. A tuning fork with a frequency of 480 Hz is played in a room with a temperature of 25°C.
    a. What is the period of the sound wave?

$$f = \frac{1}{T} \rightsquigarrow T = \frac{1}{f} = \frac{1}{480\ \text{Hz}}$$

$$\boxed{T = 0.00208\ \text{s} = 2.08 \times 10^{-3}\text{s}}$$

    b. What is the velocity of the sound wave produced?

$$v_{sound} = 331 + 0.6T = 331 + 0.6(25℃)$$

$$\boxed{v_{sound} = 346\ {}^{\text{m}}/_{\text{s}}}$$

    c. What is the wavelength of the resulting sound wave?

$$v = f\lambda \rightsquigarrow \lambda = \frac{v}{f} = \frac{346\ {}^{\text{m}}/_{\text{s}}}{480\ \text{Hz}}$$

$$\boxed{\lambda = 0.721\ \text{m} = 721\ \text{mm}}$$