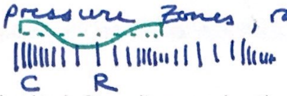
1. What is the difference between a transverse and a longitudinal traveling wave?

Transverse Wave – particles move ⊥ to wave velocity

Longitudinal Wave – particles move ∥ to wave velocity

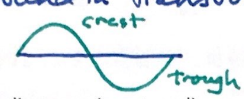
2. Explain what compressions and rarefactions are, and what type of traveling wave has these characteristics.

Longitudinal Waves have compressions and rarefactions.
compressions are high pressure zones, rarefactions are low pressure zones




3. Explain what crests and troughs are, and what kind of traveling wave has these characteristics.

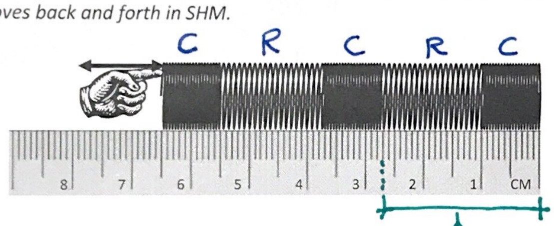
Crests and troughs are found in transverse waves.
(high points) (low points)

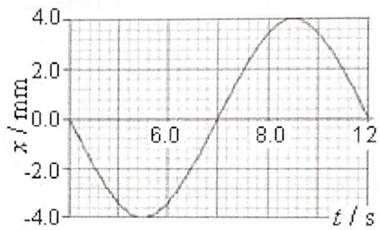



4. What kind of oscillation are the particles of a medium carrying a traveling wave undergoing?

Periodic – particles are displaced, then return to original position.

*Consider the wave train being transmitted through the spring as shown. The accompanying graph shoes the motion of a single loop of the spring as it moves back and forth in SHM.*



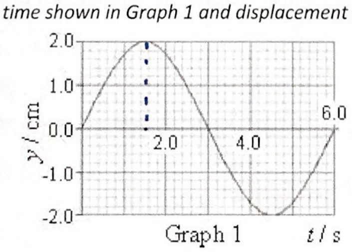

5. In the spring picture place a C at <u>each</u> *center* of a **compression**. In the picture place an R at <u>each</u> *center* of a rarefaction.

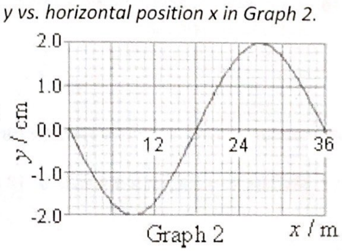
6. What is the frequency of the wave train? one cycle in 12 secs → $f = \frac{1\text{ cyc}}{12\text{ sec}}$ $f = 0.083\text{ Hz}$
period = 12 secs

7. What is the wavelength (in cm) of the wave train? $\lambda = 2.7\text{ cm}$

8. What is the wave speed (in cm $s^{-1}$)? $V = f \cdot \lambda$ $V = (2.7)(\frac{1}{12})$
$V = 0.225\text{ cm/s}$ OR $0.00225\text{ m/s}$

*A traveling wave has displacement y vs. time shown in Graph 1 and displacement y vs. horizontal position x in Graph 2.*



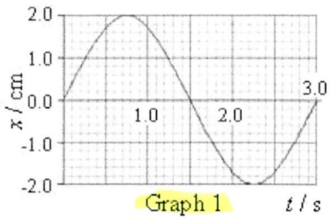

9. What are the amplitude and the period of the traveling wave?

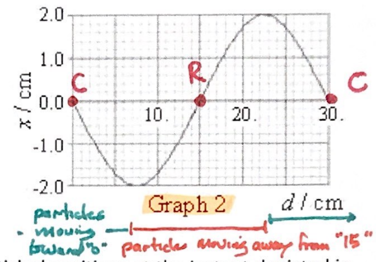
amp = 2 cm period = 6 sec

10. What are the wavelength and the wave speed of the traveling wave?

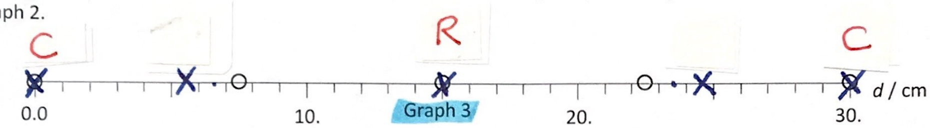
$\lambda = 36\text{ m}$ $V = f \cdot \lambda$
$= (\frac{1}{6})(36)$
$V = 6\text{ m/s}$

*A longitudinal wave has displacement x vs. time shown for a single particle in Graph 1 and displacement x vs. horizontal position d for a particular instant in Graph 2. Graph 3 shows 5 particles in the longitudinal wave at their equilibrium position.*




11. For each of the 5 particles, in Graph 3 (below) place an x reflecting the particles' positions at the instant depicted in Graph 2.




12. In Graph 3 place an R at the *center* of a rarefaction. Place a C at the *center* of a compression.

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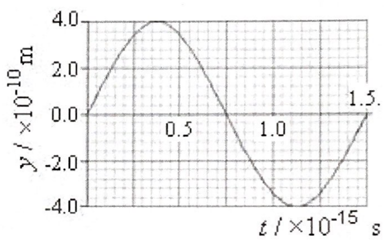
*The displacement y vs. time t graph of a light wave is shown.*




13. Find the frequency of the light. What portion of the electromagnetic spectrum does this place this light?

$T = 1.5 \times 10^{-15}$ sec

$f = 6.67 \times 10^{14}$ Hz

14. Find the wavelength of the light.

$c = f \cdot \lambda$

$3 \times 10^{8} = 6.67 \times 10^{14} \lambda$

$450 \times 10^{-9} = \lambda$

$\lambda = 450$ nm

∴ visible spectrum, (close to the violet and blue intersection)

15. Explain why you don't need a displacement vs. distance graph for light, but you do for other traveling waves.

Velocity is constant - ($3 \times 10^{8}$ m/s) for light; other wave graphs would need the $\lambda$ to find wave speed.

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16. A 350 watt speaker projects sound in a spherical wave. Find the intensity of the sound at a distance of 3.0 m and 9.0 m from the speaker.

$I = \frac{350}{4\pi(3)^2}$ $\quad I = \frac{350}{4\pi(9)^2}$

$I = 3.1$ W/m² $\quad = 0.34$ W/m²

*At a distance of 45 m from a speaker the sound intensity is $5.0 \times 10^{-1}$ W m$^{-2}$.* (I)

17. Find its intensity at a distance of 18 m.

$\frac{I_2}{I_1} \propto \frac{18^{-2}}{45^{-2}}$ $\quad I_2 = (5 \times 10^{-1}) \frac{(18^{-2})}{(45^{-2})}$ $\quad$ watch negative exponents

$I_2 = 3.125$ W/m² $\quad$ greater intensity because it is closer.

18. Compare the amplitudes of the sound at 45 m and 18 m.

$\frac{I_2}{I_1} = \frac{A_2^2}{A_1^2}$

$\frac{0.5}{3.125} = \frac{A_2^2}{A_1^2}$

$\sqrt{\frac{0.5}{3.125}} = \frac{A_2}{A_1}$

$\rightarrow 0.40 = \frac{A_2}{A_1}$

$0.40 A_1 = A_2$

∴ 40% of Amplitude 1 is Amplitude 2.

Alternative Solution #17

$I_1 = \frac{P}{A}$ $\quad 5 \times 10^{-1} = \frac{P}{4\pi(45)^2}$

$12700$ W $= P$

$I_2 = \frac{P}{A}$ $\quad I_2 = \frac{12700}{4\pi(18)^2}$

$I_2 = 3.125$ W/m²