Physics 2C 1/10

1. Quick Buoyancy Prob Review
2. Waves on strings
3. Change in v, λ, f upon change in media
4. Practice Problems

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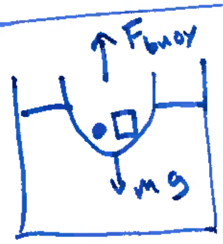
1 

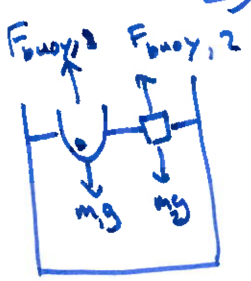
(scenario A)

what is V_{disp}? (neglecting mass of boat)

$$F_{buoy} - m_{\substack{everything\\ in\ boat}}\, g = 0$$

$$\Rightarrow \rho_{water} V_{disp} \cancel{g} = (m_{rock} + m_{\substack{ice\\ cube}}) \cancel{g}$$

$$\Rightarrow V_{disp} = \frac{m_{rock} + m_{\substack{ice\\ cube}}}{\rho_{water}}$$

(scenario B) 

$$F_{buoy,1} - m_{rock}\, g = 0$$

$$F_{buoy,2} - m_{\substack{ice\\ cube}}\, g = 0$$

$$\Rightarrow \boxed{V_{\substack{tot\\ disp}} = V_{disp,1} + V_{disp,2} = \frac{m_{rock} + m_{\substack{ice\\ cube}}}{\rho_{water}}}$$

Same water displace $\Rightarrow$ same water level

(Scenario C) 

rock sinks because buoyant force is not enough to balance weight

$$F_{buoy,1} - m_{\substack{ice\\ cube}}\, g = 0$$

$$F_{buoy,2} - m_{rock}\, g = m_{rock}\, a < 0$$

water ~~rises~~ falls $\quad V_{\substack{tot\\ disp}} < \frac{m_{rock} + m_{\substack{ice\\ cube}}}{\rho_{water}}$

② Waves on Strings: $v = f\lambda$

can't chang v by changing f or λ

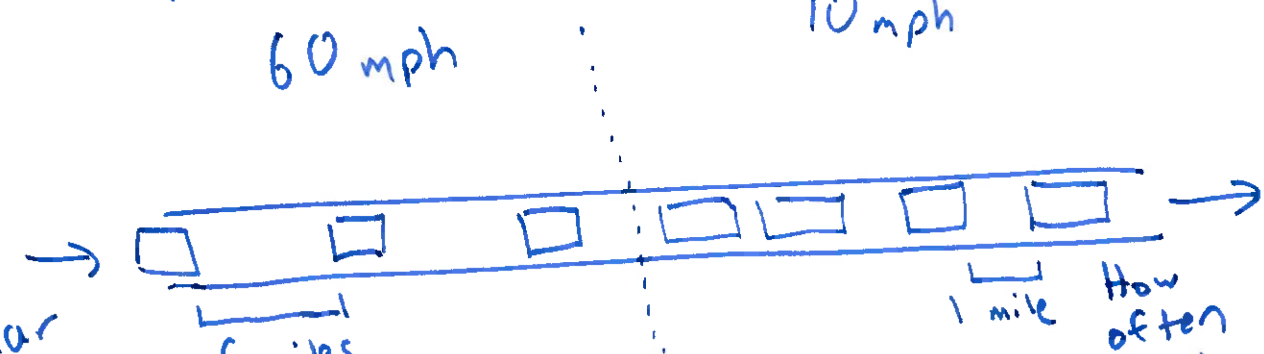
$$v = \sqrt{\frac{T}{\mu}} \quad \begin{matrix} \cdots \text{ tension} \\ \cdots \ \dfrac{\text{mass}}{\text{length}} \end{matrix}$$

v is a property of medium

(or nature)

③

what about f?



car enters every 6 minutes

How often would you observe a car exit?

$\boxed{\text{every 6 minutes}}$

☆ key: frequency is a property of the source

wavelength adjusts

$v = f\lambda$

(3 clickers)

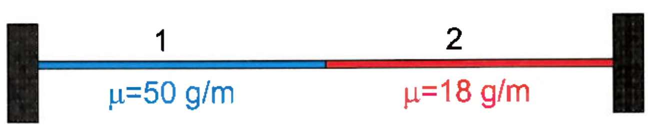
Two strings with different unit mass are tied in the center and attached with a tension of 1000N to two walls, as shown. What is the ratio of the wave's speed in the two strings?

The wave speed in a wire is $v = \sqrt{\frac{T}{\mu}}$

$$\frac{V_1}{V_2} = \frac{\sqrt{\frac{T}{\mu_1}}}{\sqrt{\frac{T}{\mu_2}}} = \sqrt{\frac{\mu_2}{\mu_1}} = \frac{3}{5}$$

1. $v_1/ v_2=9/25$
2. $v_1/ v_2=3/5$
3. $v_1/ v_2=5/3$
4. $v_1/ v_2=25/9$
5. $v_1/ v_2=1$

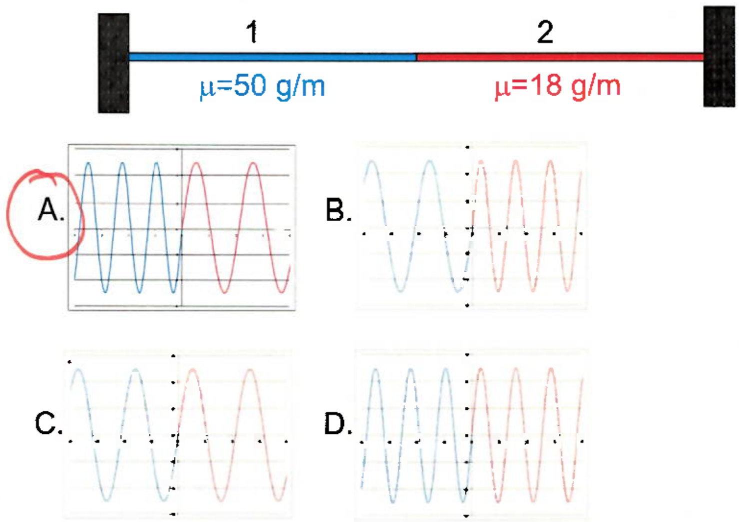
Two strings with different unit mass are tied in the center and attached with a tension of 1000N to two walls, as shown. What is the ratio of the wave's frequencies in the two strings?



1. $f_1/ f_2=9/25$
2. $f_1/ f_2=3/5$
3. $f_1/ f_2=5/3$
4. $f_1/ f_2=25/9$
5. $f_1/ f_2=1$

frequency is a property of the source!

Two strings with different unit mass are tied together as shown.
What will the waves look like in the two strings?



$$\frac{v_1}{v_2} = \frac{3}{5}$$

$$v_1 = \lambda_1 f$$

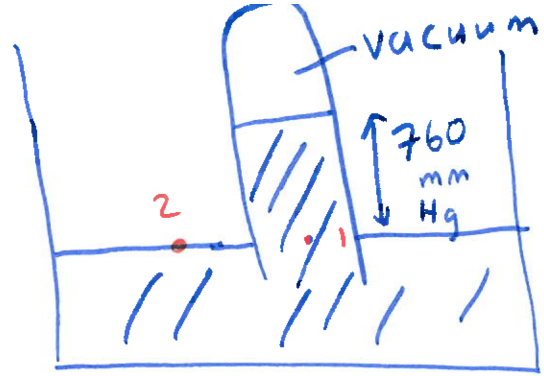
$$v_2 = \lambda_2 f$$

$$\frac{5}{3} v_1 = \lambda_2 f$$

$$\frac{5}{3} \lambda_1 \cancel{f} = \lambda_2 \cancel{f}$$

④ Practice Problems

① Given this picture, what is the density of mercury?



④

$1\ atm = 1.01 \times 10^5\ Pa$

$P_2 = P_{atmos}$

$P_1 = \rho_{Hg}\, g h + \cancelto{0}{P_{vacuum}}$

$P_1 = P_2 \Rightarrow \rho_{Hg}\, g h = 1.01 \times 10^5\ Pa$

$$\rho_{Hg} = \frac{1.01 \times 10^5\ Pa}{(10\ m/s^2)(0.76\ m)}$$

$$= 13600\ kg/m^3$$

Phase:

③

$$D(x,t) = A \sin[\underbrace{kx \mp \omega t + \phi_0}_{\text{phase } \phi}]$$

"where you are in the wave cycle"

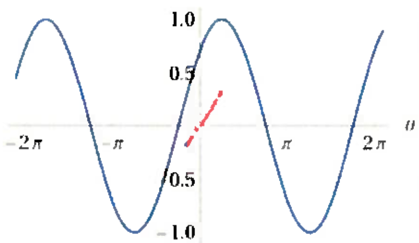
If I look @ Δx (const t) or Δt (const x), I get

$$\Delta\phi = k\Delta x = 2\pi\left(\frac{\Delta x}{\lambda}\right)$$

$$\Delta\phi = \omega\Delta t = 2\pi\left(\frac{\Delta t}{T}\right)$$

Which of the following best describes $f(\theta)$?

Hint: take $\sin\theta$ & shift it left/right by some angle



(A) $\sin(\theta + \pi/4)$
(B) $\sin(\theta - \pi/4)$
(C) $\sin(\theta + 3\pi/4)$
(D) $\sin(\theta - 3\pi/4)$
(E) None of the above

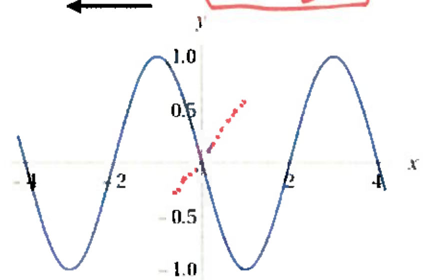
This is a snapshot of a wave @ $t = T/2$, where T is the period. Find an equation for

$$y(x,t) = A\sin[kx \pm \omega t + \phi_0] \quad (A > 0)$$

with $\phi_0 \in [0, 2\pi)$

what is sign and ϕ_0?

2 m/s ← $\boxed{t = \frac{1}{2}T}$



← left $\quad y(x,t) = A\sin[kx + \omega t + \phi_0]$

$y(x, \tfrac{1}{2}T) = A\sin[kx + \pi + \phi_0]$

$\Rightarrow \phi_0 = 0$

$$\boxed{y(x,t) = A\sin[kx + \omega t]}$$