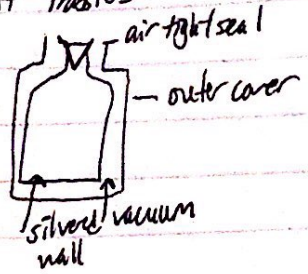
PH202

Final Exam Review: Recitation 10 solutions

Question 1:

Explain how thermos design addresses all 3 heat transfers

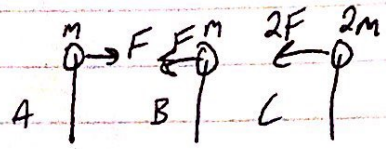


1: Air tight seal prevents convection
2: Vacuum prevents conduction between layers
3: Silvered wall reflects radiation.

Question 2: Rank α from - to +

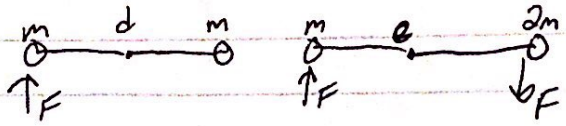
$\Sigma\tau = I\alpha$

$\Rightarrow \alpha = \frac{\Sigma\tau}{\alpha}$



massless rod and point mass $\Rightarrow mr^2$

$\Rightarrow \alpha = \frac{F \cdot r}{mr^2}$ in general



$\alpha_A = \frac{-F \cdot r}{mr^2} = \frac{-F}{mr}$ $\alpha_B = \frac{+F \cdot r}{mr^2} = \frac{F}{mr}$ $\alpha_L = \frac{2F \cdot r}{2mr^2} = \frac{F}{mr}$

$\alpha_D = \frac{-F \cdot r}{2mr^2} = -\frac{F}{2mr}$ $\alpha_E = \frac{-2F \cdot r}{3mr^2} = \frac{-2F}{3mr}$

$\alpha_A < \alpha_E < \alpha_D < \alpha_B = \alpha_C$

Question 3: tire of car leaks, Pressure does ___ Surface area ___ force ___

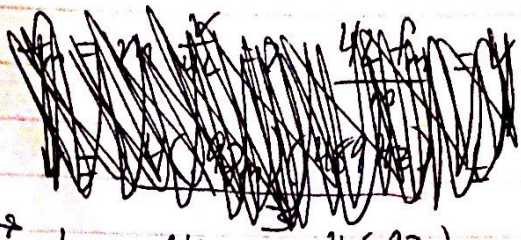
well, pressure will slowly decrease, and force is constant at mg, so the surface area increases to make up for pressure loss ↓

$P = \frac{F}{A}$ if $P\downarrow$ and F constant $A\uparrow$

Question 4: .92m long pipe, one end closed, 3rd harmonic with $f = 489\,Hz$
Speed of sound of air?

well, 1 end closed $\Rightarrow$ antisymmetric boundary conditions
$\Rightarrow \lambda_m = \frac{4L}{m}$ and $f_m = m\frac{V}{4L}$

$f_m = m\frac{V}{4L}$
or $V = \frac{4Lf_m}{m}$



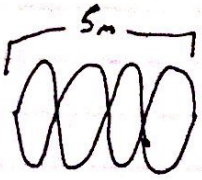
$V = 600\,Hz$ ← check here $\lambda_m = \frac{4L}{m} = \frac{4(.92m)}{3} = 1.23m$

$V = \lambda f = 600\,m/s$
which is closest to $360\,m/s$ so answer E)

Question 5: characteristics of sound affect "pitch"
wavelength and frequency affect "pitch"
amplitude and intensity affects loudness
phase isn't important now
so answers B) and C)

PH202 Recitation 10 Solutions

Problem 1:



string is 5m long at 4th harmonic
vibrates up and down 48 cycles in 20s
frequency, period, wavelength, velocity?

well the string is closed closed => symmetric boundary conditions

$$\Rightarrow \lambda_m = \frac{2L}{m} \qquad f_m = m\frac{V}{2L}$$

48 cycles for 20s $\Rightarrow$ $\frac{48 \text{ cycles}}{20 s} = 2.4 \frac{\text{cycles}}{s} = 2.4 \text{ Hz} = \text{frequency}$

$\lambda_m = \frac{2L}{m}$ → 4th harmonic $\Rightarrow m = 4$

$\lambda_4 = \frac{2L}{4} = \frac{L}{2} = \frac{5m}{2} = 2.5m$ wavelength

velocity $\Rightarrow$ $V = \lambda f = 2.5m \cdot 2.4 \text{ Hz} = 6 m/s$

period $\Rightarrow$ $T = \frac{1}{f} = \frac{1}{2.4 \frac{\text{cycles}}{s}} = .417 \frac{s}{\text{cycle}}$

String has a mass of 10g, what is tension?

$$V_{wave} = \sqrt{\frac{FT}{\mu}}$$

$$V_{wave}^2 = \frac{FT}{\mu}$$

$$\Rightarrow FT = \mu V_{wave}^2$$

$$= \frac{m}{L} V_{wave}^2$$

$$= \frac{.010 kg}{5m} \cdot (6 m/s)^2$$

$$= .072 N$$

Problem 2: train traveling at 35 m/s on still air day
150 Hz horn, what does stationary person hear as train approaches and leaves?

doppler shift question => $f_{obs} = f_s \left(\frac{V \pm V_o}{V \mp V_s}\right)$

$V_s = 35 m/s$ V_o = person = 0 $V = V_{air} = 343 m/s$

as train approaches => $\Delta r \downarrow$ => $-V_s$

=> $f_{obs} = 150 Hz \left(\frac{343 m/s + 0}{343 m/s - 35 m/s}\right)$

=> $f_{obs} = 167 Hz$ which is greater than f_s

which is good, as it approaches we hear a higher pitch

as train leaves => $\Delta r \uparrow$ => $+V_s$

=> $f_{obs} = 150 Hz \left(\frac{343 m/s + 0}{343 m/s + 35 m/s}\right)$

=> $f_{obs} = 136 Hz$ ✓

train engineer on train => $V_o = 35 m/s$ as well as V_s

=> $f_{obs} = f_s = 150 Hz$