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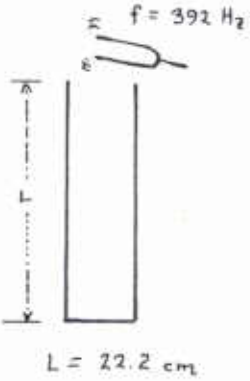
Phys 221 (Section 8)
Quiz #6



1. A pipe which is closed at one end is excited at a frequency of 392 Hz and gives its first resonance (the fundamental) when its length is 22.2 cm. From *this data*, what is the speed of sound in the air column of the tube?

For the first harmonic in a tube closed at one end, we have

$L = \frac{\lambda}{4} \rightarrow \lambda = 4L$

Then

$f = \frac{v}{\lambda} = \frac{v}{4L}$ So $v = 4Lf$ = speed of sound

Substitute values given:

$v = 4(0.222\ m)(392\ s^{-1}) = \boxed{348\ \frac{m}{s}}$

2. An ideal gas at a pressure of 0.5 atm, temperature 27.0° C and volume 2.0 L is compressed to a final volume of 0.6 L and pressure of 3.0 atm. What is the final temperature of the gas?

Ideal gas law: $PV = nRT$. If n remains constant, then

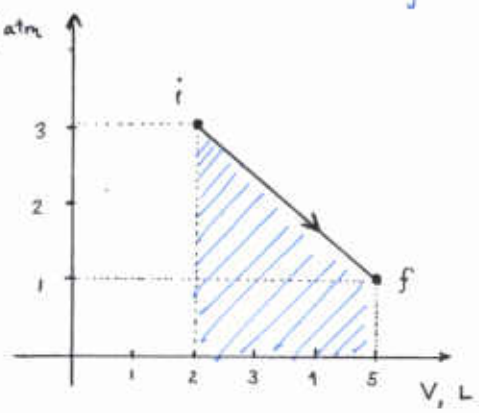
$\frac{PV}{T}$ = constant So $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ for any two sets of thermo. variables.

Then, with $T_1 = (27.0 + 273.15)\,K = 300\,K$,

$T_2 = \frac{P_2}{P_1}\frac{V_2}{V_1}T_1 = \frac{(3.0\ atm)}{(0.5\ L)}\frac{(0.6\ L)}{(2.0\ L)}(300\,K) = \boxed{540\ K}$

[In Celsius, $T_2 = (540 - 273.15)\,°C = 267\,°C$]

3. A gas expands from i to f along the path indicated in this $P-V$ diagram. Calculate the work done by the gas; express the answer in Joules.



Work done by the gas is $W = \int P\,dV$. This is the "area under the curve" for the P vs. V plot of the gas expansion.

Simple geometry gives the area shown:

$W = \int P\,dV = (1\ atm)(3\ L) + \frac{1}{2}(2\ atm)(3\ L)$

$= 6.0\ L\cdot atm$

$= (6.0\ L\cdot atm)\left(\frac{101.3\ J}{1\ L\cdot atm}\right) = \boxed{608\ J}$

$1.00\,L\cdot atm = 101.3\,J$ $\quad R = 0.0821\,\frac{L\cdot atm}{mol\cdot K}$

$N_A = 6.022 \times 10^{23}\ mol^{-1}$ $\quad T_C = T - 273.15$