**Quiz 8**

Name: _____ Student Number: _____

**CALCULATORS ALLOWED.**

**5 x 2 = 10 marks**

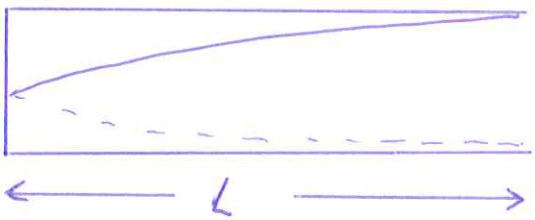
1. Estimate the work done when 5 moles of $N_2$ expands at a constant temperature of 293 K from 1 $cm^3$ to 1 liter.

Work $W = nRT \ln(V_f/V_i)$

$= 5 \times 8.314 \times 293 \ln(1000/1)$

$= 8.41 \times 10^4$ J

2. Consider an organ pipe of length 2 meters, closed at one end. Find its lowest resonant frequency.




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

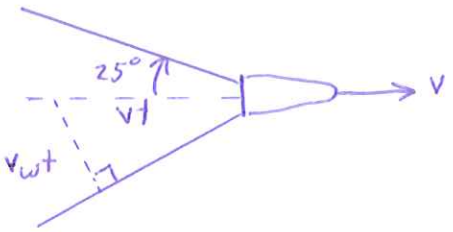
$\Rightarrow \lambda = 4L = 8$ m.

$\therefore \nu = \frac{c}{\lambda}$

$= \frac{330 \text{ m/sec}}{8 \text{ m}}$

$= 41$ Hz.

3. Consider a boat travelling in water. If the angle of its wake is 25° as measured from the line parallel to the boat's travel, estimate the boat's speed if the speed of water waves in this lake is 4 m/sec.




$$\sin 25^\circ = \frac{V_w}{V}$$

$$V = \frac{4\ m/sec}{\sin 25^\circ}$$

$$= 9.5\ m/sec$$

4. A piano is loaded into a pickup truck.
   a) How fast would the truck need to travel for note B(248 Hz) to sound like the next higher note C (262 Hz) for an observer at rest.
   b) Would the truck need to travel toward or away from the observer?

$$\Delta\nu_{Dop} = \frac{V}{c}\nu_o$$

$$V = \frac{\Delta\nu_{Dop} \cdot c}{\nu_o}$$

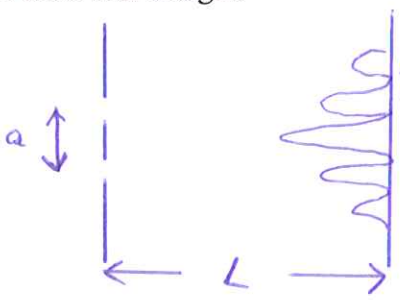
$$= \frac{262-248}{255} \cdot 330\ m/sec$$

$$= 18.1\ m/sec.$$

$$= 65.2\ km/hr$$

Truck moves toward observer since frequency of C > frequency of B.

5. Consider a laser incident on a pair of slits separated by 2 mm. A screen 2 meters away shows an interference pattern with the distance between adjacent maxima of 1 mm. Find the laser wavelength.




$$\Delta x = \frac{L}{a} \cdot \lambda$$

$$\Rightarrow \lambda = \frac{a\,\Delta x}{L}$$

$$= \frac{2\ mm \times 1\ mm}{2\ m}$$

$$= 10^{-6}\ m$$

$$\lambda = 1\ \mu m$$