Physics 122-01
Test 2
March 31, 2004

Name:_____

Start all problems with a fundamental principle or with an equation from the equation sheet. Be sure to show your work **clearly** and **draw a box around your answer**. If any question is unclear, please ask immediately.

1. (20 pts.) A long tube of length $0.8\,\text{m}$ is filled with Argon gas ($\gamma = 5/3$, $M = 0.040\,\text{kg/mole}$, $T = 295.6\,\text{K}$). One end of the tube is open. At the other end is a speaker driven at a frequency f, where f can be varied with a function generator. The end with the speaker should be treated as a closed end.

   a. (5 pts.) Sketch the three lowest-frequency modes.

   b. (5 pts.) What are the wavelengths for those three lowest modes?
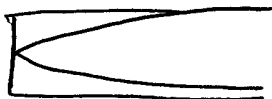
   c. (10 pts.) What are the frequencies for those three lowest modes?

Name: $\mathsf{SOLUTIONS}$

Start all problems with a fundamental principle or with an equation from the equation sheet. Be sure to show your work **clearly** and **draw a box around your answer**. If any question is unclear, please ask immediately.
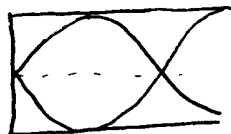
1. (20 pts.) A long tube of length $0.8\,m$ is filled with Argon gas ($\gamma = 5/3$, $M = 0.040\,kg/mole$, $T = 295.6\,K$). One end of the tube is open. At the other end is a speaker driven at a frequency f, where f can be varied with a function generator. The end with the speaker should be treated as a closed end.

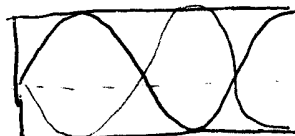   a. (5 pts.) Sketch the three lowest-frequency modes.

$$L = 0.8\,m$$

$$v = \sqrt{\frac{\gamma R T}{M}} = \sqrt{\frac{\left(\frac{5}{3}\right)(8.3145)(295.6)}{0.040}}$$

$$v = 320\,m/s$$

   b. (5 pts.) What are the wavelengths for those three lowest modes?

1 : $L = \frac{1}{4}\lambda_1 \Rightarrow \lambda_1 = 4L = \boxed{3.2\,m}$

2 : $L = \frac{3}{4}\lambda_2 \Rightarrow \lambda_2 = \frac{4L}{3} = \boxed{1.07\,m}$

3 : $L = \frac{5}{4}\lambda_3 \Rightarrow \lambda_3 = \frac{4L}{5} = \boxed{0.64\,m}$

   c. (10 pts.) What are the frequencies for those three lowest modes?

$f_1 = v/\lambda_1 = \boxed{100\,Hz}$

$f_2 = v/\lambda_2 = 3f_1 = \boxed{300\,Hz}$

$f_3 = v/\lambda_3 = 5f_1 = \boxed{500\,Hz}$