PHYSICS 126 – Midterm 2

Name: _____

Student ID: _____

Answer the questions in spaces provided on each sheet. If you run out of room for an answer, continue on the back.

Question	Points	Score
1	20	
2	30	
3	40	
4	25	
5	35	
Total	150	

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1. A wire that is 3.4 m long and under a tension of 70 N is found to have consecutive harmonics at 330 Hz and 440 Hz.

[5] (a) What is the fundamental frequency of the wire (hint: use the ratio of the harmonic frequencies)?

[5] (b) What is the wave velocity on the wire?

[10] (c) † What is the linear density of the wire?

2. A violin string which is 30 cm long is tuned using a 440 Hz reference tone.

[5] (a) What is the wavelength fundamental mode of the string?

[5] (b) When the string has a tension of 34 N a violinist hears 5.7 beats per second. What are the frequencies at which the string might be vibrating?

[10] (c) The tension is increased and the violinist hears 3.8 beats per second. What is the original frequency of the string?

[10] (d) † What should the tension of the string be so that the fundamental frequency is 440 Hz

3. A hot-air balloon has a volume of 2000 m^3 and generates a lift of 2720 N (assume the outside temperature is 20 °C with an air density of 1.2 kg/m^3).

10 (a) What is the density of the air inside the balloon?

10 (b) How many moles of air are inside of the balloon (the molecular mass of air is 28 g/mol)?

10 (c) What is the temperature of the air in the balloon ?

5 (d) What is the mean kinetic energy of the air in the balloon?

5 (e) † What is the mean velocity (not v_{rms}, and not speed) of the air in the balloon?

4. A glass cup with a mass of 0.1 kg and an initial temperature of 23 °C is filled with 0.3 kg of water at 80 °C.

10 (a) What is the final temperature of the water and cup?

10 (b) How much heat must be added to raise the temperature to 90 °C?

5 (c) † What is the change in the internal energy of the water?

5. An aluminum cup (of negligible mass) is filled with 0.5 kg of water with a temperature of 15 °C and 1.3 kg of ice (at -8 celsius) is added.

10 (a) What is the final phase or phases of the mixture?

10 (b) What is the final temperature of the mixture?

15 (c) † How much heat is required to raise the mixture to 15 °C.

Formulas

$\rho = m/V$ | $\mu = m/L$

$E_{kin} = \frac{1}{2}mv^2$ | $\bar{K} = \frac{3}{2}kT$

$PV = nRT$ | $PV = NkT$

$k = 1.38 \times 10^{-23}$ J/K | $R = 8.32$ J/molK

$N_A = 6.02 \times 10^{23}$ mol^{-1} | $v = \lambda f$

$v = \sqrt{\frac{F_T}{\mu}}$ | $v_{air} = 343$ m/s

$P_{atm} = 100$ kPa $= 1 \times 10^5$ N/m^2 | g $= 9.8$ m/s^2

$\Delta U = Q - W$ | $Q = mc\Delta T$

$Q = mL$

Material	Specific Heat
Water	4186 J/kgK
Ice	2100 J/kgK
Glass	840 J/kgK

Material	Melting Point	Heat of Fusion	Boiling Point	Heat of Vap.
Water	0 °C	3.33×10^4 J/kg	100 °C	2.26×10^6 J/kg