Winter Midterm Examination Physics 100

February 6, 2012

Name/Student #:

Instructions: Summary sheets with formulas on a separate booklet. My formulas are on this sheet. Questions are on both sides of the exam sheet. Calculator permitted. Put your name and student number at the top of the question sheet and complete all questions on the question sheet. Point values are shown with the questions. Complete the questions in any order. Total exam is worth 50 points.

1. Matching question. 16 points. You may give your answer by the standard connecting lines method or give the letter from the match item in second column behind the first column item e.g. (1) viscous flow B. One item in the first column has no match and one item has two matches. I am looking for *direct* matches.

(1) viscous flow	A. linear restoring force
(2) $\Delta S \geq 0$ in closed system	B. $Q = 0$
(3) buoyancy	C. Bernouilli's principle
(4) abiabatic process	D. forced oscillations
(5) simple harmonic motion	E. $\rho_f V_{\text{disp}} g$
(6) manometer	F. Poiseuille's equation
(7) resonance	G. $Q = 0$
(8) sails on a boat	H. pendulum

2. (a) You have a monatomic ideal gas with pressure 1.01×10^5 Pa and volume of 1.85×10^{-4} m^3 at a temperature of 285 K. Calculate the number of particles. (2)

   (b) The pressure is held constant and volume decreases to 0.925×10^{-4} m^3. Calculate the new temperature and calculate ΔE_{th}. (3)

   (c) Calculate the work that was done on the gas and the heat. (hint: it is a compression so work done on the gas is positive, you might also find a pV diagram useful). (3)

3. Suppose that you have liquid with density of 950 kg/m^3. You insert a tube and you want to raise the level of the liquid in the tube. Also suppose you have some way of lowering the pressure at the top of the tube (i.e. like drinking through a straw).

(a) How much lower does the pressure have to be in the tube to raise the liquid by 0.05 m? (3)

(b) Further suppose that you want to create this pressure difference by having air (density 1.2 kg/m^3) flow over the top of the tube (in the same way I blew across the paper strip in glass). How fast would the air have to travel to create this pressure difference? (use 250 Pa as a dummy answer if you like) (3)

4. A $m = 0.454$ kg mass is suspended from a spring. You pull down the mass and it begins to oscillate with a period of 0.750 s.

   (a) What is the value of the spring constant k? (3)

   (b) If the amplitude of oscillation is 0.062 m what is the maximum velocity of the mass? (3)

   (c) If the amplitude decays to 37% of its original value in 7.5 s what is the quality factor? (2)

5. You have heat engine placed between a hot reservoir with temperature of 730 K and a cold reservoir of 310 K. 100 J of energy are taken from the hot reservoir. If the engine runs at maximum possible efficiency what is the total work extracted by the engine? How much entropy is transfered to the cold reservoir? (4)

6. A transverse wave is described by the following expression

$$y(x,t) = 0.5\cos\left(\frac{2\pi x}{3.0} - \frac{2\pi t}{1.5}\right) \tag{1}$$

(a) Draw a snapshot graph with $t = 0$ over a range of x from 0 to 9. Use quantitative scales for x and y. (4)

(b) Suppose that this represents a water wave. If an object was floating on the water how long would it take to go from maximum positive y (a crest) to maximum negative y (a trough). (2)

(c) How fast is the water moving in the x-direction because of the wave? (2)

———extra formulas———