Physics 31A Final (260pts MAX)
Fall 2002

4. P.607 #88

5. P.606 #67

6. P.550 Example 13.8

7. In adiabatic process ($\Delta Q = 0$), P drops more quickly with increasing V, please prove that PV^r = constant

8. P.533 #68

9. P.531 #38

10. P.533 #66

III. P.452 Example 11.1

II. P.497 #26

I. P.417 Example #103

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<I>. The human thigh bone, the femur, at its narrowest point resembles a hollow cylinder with an outer radius of roughly 1.1 cm and inner radius of just about half of that. Taking the compressive strength of the bone to be 170 MPa, how much force will be required to rupture it?

<II>. A wire having a mass of 60.0 g is 6.00 m long. If transverse waves travel along it at 200 m/s, what is the tension in the wire?

<III>. A youngster in a boat watches waves on a lake that seem to be an endless succession of identical crests passing, with a half-second between them. If one wave takes 1.5 s to sweep straight down the length of her 4.5-m-long boat, what are the frequency, period, and wavelength of the waves?

<IV>. An ideal gas expands isothermally from V_i to V_f. Prove that the associated entropy change is given by

<V>. A Carnot engine operates at an efficiency of 42.2% with a high-temperature reservoir at 473 K. If the efficiency is to be raised to 50% using a new high-temperature reservoir, what will its temperature have to be?

<VI>. How much heat must be added to a 1.0 kg mass of water ice at –10 °C and atmospheric pressure, in order to transform it into superheated steam at 110 °C? (L_f = 334 kJ/kg, Lv = 2.26 x 10^3 kJ/kg, Cw = 4.2 kJ/kgK, Ci = 2.1 kJ/kgK, Cs = 2.0kJ/kgK)

<VII>. In adiabatic process ($\Delta Q = 0$), P drops more quickly with increasing V, please prove that PV^r = constant.

<VIII>. An automobile tire is pumped up to an absolute pressure of 33 lb / $in.^2$, with air at a temperature of 40.0 °F. After driving for several hours, the temperature in the tire reaches 120 °F. Find the pressure in the tire at that point in SI units.

<IX>. The coefficient of expansion of a typical material is not constant. For example, a metal like copper behaves, over a limited range of temperature, such that: $\beta(T) = C_1 + C_2T$, where C_1 and C_2 are rather small constants (of the order of 10^{-5} and 10^{-8}, respectively). If a sample is raised from some initial to some final temperature (in the range of applicability of the above expression), write a formula for the final volume in terms of the initial volume

<X>. Determine the density of hydrogen gas at STP. What is its density at 1.00 atm and at a temperature of 273 °C?