Assignment 6

1. In class, I indicated that the TdS equations were general, applying to a solid, liquid or gas. If that is the case, then they must apply to an ideal gas as well.
(a) Start with an appropriate TdS equation and show that it reduces to Eqn. 1.38 in the text for the case of adiabatic expansion or compression of an ideal gas.
(b) Repeat part (a) but now show that the result is Eqn. 1.40.

2. One gram of water at 30° C is compressed isothermally from an initial pressure of 1 atm to a final pressure of 10,000 atms. For water, $\beta = 3.03 \times 10^{-4}$/K, $\kappa_T = 50 \times 10^{-6}$/atm, and 1 gram has a volume of 1.00 cm^3. Express your results in SI units.
(a) Calculate the work done on the water. [Hint: Start with the definition of expansive/compressive work and see whether a change of variables will help.]
(b) Calculate the heat extracted in the process.
(c) What is the increase in internal energy, ΔU, of the water?
(d) Compare the amount of heat extracted to the amount of work that was done. Is isothermal compression of water a good way of creating a source of heat? Explain.

3. In order to improve the efficiency of a heat engine, we would like to increase the temperature difference between T_h and T_c. Is it better to increase T_h or to decrease T_c? Show this mathematically.

4. Do problem 4.1 in the text. [Hint: Think about which segments have heat going in. The sum of these Q will give you Q_h.]

5. Do problem 4.18 in the text.