Practice Questions for Midterm 2, Physics 142H

1) Provide short answers to questions (a)—(h). For full credit, you must justify your answers.

a) Explain why the column of mercury first descends and then rises when a mercury-in-glass thermometer is put in a flame.

b) Two equal-size rooms are connected by an open doorway. However, the average temperatures in the two rooms are maintained at different values. In which room are there more air molecules?

c) Explain why the temperature decreases with height in the lower atmosphere.

d) Give an example of a process in which no heat is transferred to or from a system but the temperature of the system changes.

e) Can a given amount of mechanical energy be converted entirely into heat? If so, give an example.

f) Why do you get poorer gasoline mileage from your car in winter than in summer?

g) An inventor suggested that a house might be heated in the following manner: A system resembling a refrigerator draws heat from the Earth and rejects heat to the house. The inventor claimed that the heat supplied to the house can exceed the work done by the engine of the system. What is your commment?

h) What is the change in entropy when N molecules of a monatomic ideal gas undergo an (irreversible) adiabatic free expansion from an initial volume V to a final volume $3V$? Does the result differ if the molecules are diatomic?

2) Consider a heat engine in which n mol of an ideal diatomic gas is taken through a cycle that consists of two isothermal processes at temperatures T_i and $3T_i$ and two isovolumetric processes (see Fig. P22.53). For each cycle, determine: a) the heat added to the gas in each step; b) the net work done; c) the efficiency; and d) the entropy change of the gas during each step.