HW2, PHYS 3113

P1 (4.1) Consider an ideal diatomic gas taken around a rectangular circle on a PV diagram. Suppose that this system is used as a heat engine, to convert the heat added into mechanical work.

(a) Evaluate the efficiency of this engine for the case $V_2 = 3V_1$, $P_2 = 2P_1$.

(b) Calculate the efficiency of an ideal engine operating between the same temperature extremes.

P2 (2.8) Consider a system of two Einstein solids, A and B, each containing 10 oscillators, sharing a total of 20 units of energy. Assume that the solids are weakly coupled, and that the total energy is fixed.

(a) How many different macrostates are available to this system?

(b) How many different microstates are available to this system?

(c) Assuming that this system is in thermal equilibrium, what is the probability of finding all the energy in solid A?

(d) What is the probability of finding exactly half of the energy in solid A?

(e) Under what circumstances would this system exhibit irreversible behavior?

P3 (2.29) Consider a system two Einstein solids, with $N_A = 300$, $N_B = 200$, and $q_{\text{total}} = 100$. Compute the entropy of the most likely macrostate and of the least likely macrostate. Also compute the entropy over long time scales, assuming that all microstates are accessible.