Thermodynamics

(20) 1. Fresh turkey must be cooled below 4°C to eliminate the risk of food poisoning. What is the minimum amount of work that must be supplied to a refrigerator employing a cyclic process in order to cool a 10kg turkey from 20°C to 4°C. You should assume that a turkey is composed of essentially 100% water, and that its heat capacity is constant.

(15) 2. Derive a Maxwell relation.

(40) 3. An monoatomic ideal gas is allowed to expand reversibly from pressure p_1 to p_2, but during this process the product p^2T^3 is kept constant. If the initial temperature is T_1, calculate:

a) The work done on the gas.
b) The entropy change of the gas.
c) The entropy change of the universe.

(25) 4. A ideal black body has fundamental relation $S = \frac{4}{3}(bU^3V)^{1/4}$ where b is a constant.

a) derive the p-v equation of state for an ideal black body.
b) what is, expressed in terms of the proper variables, the Helmholtz free energy of an ideal black body?