

Homework # 5

Problem #1 (3 points)

Estimate at what temperature rotational degrees of freedom of CO molecule become active. We made similar estimate in the lecture # 3 for H₂ molecule.

Problem #2 (4 points)

System #1 is a thermally isolated system of N_s spins with spin excess S_0 positioned in magnetic field B . System #2 is a thermally isolated container with monoatomic ideal gas that has N_m atoms and has total energy U_1 . System #1 and #2 are brought in thermal contact. Find the spin excess of the system #1 when thermal equilibrium is established. Volume of the gas does not change. Magnetic field is always turned on. Specific heat of container is negligible.

Hints: Look at Problems#1 and #4 in HW#4. Assume that the constant C in the expression for the multiplicity of the gas is known. Find in lecture notes how the energy of the spin system in magnetic field depends on the spin excess.

Problem #3 (2 points)

A cyclic thermal engine operates according to the cycle described in the problem #HW2-2. What is the efficiency of this engine? What is the efficiency of an ideal engine that operates between the highest and lowest temperatures of the cycle? Use all needed results from the problem #2-2.

Problem#4 (1 point)

Problem 4-7 from the textbook

Problem #4 (4 points)

Problem #4-13 from the textbook.