Biophysics seminar 1: Thermodynamics

Questions regarding the Stirling engine:

1. What is the role of entropy in the functioning of an Stirling engine?
2. Do you think this engine can run forever from the heat of a cup of hot water? Why?
3. If we put the engine in a very hot room, do you think it will be able to run using the heat of a cup of hot water? Why?
4. Do you think this engine can run using a source of cold instead of a source of heat? Why?

Questions regarding dice probabilities and entropy:

1. What number is the most likely when rolling two dice? Why?
2. How many microstates are available for that number?
3. What number is the most unlikely when rolling two dice? Why?
4. How many microstates are available for that number?

Questions regarding enthalpy:

1. The combustion of hydrogen is an exothermic process. Assume that this process takes place at constant pressure.
    - Write the corresponding balanced equation.
    - Say if $\Delta H > 0$ or $\Delta H < 0$.
    - Say what bonds contain more energy, the ones of products or the ones of the reactants.
2. Consider two complementary molecules of single stranded DNA inside the cell nucleus. If they hybridize, will this process increase or decrease the enthalpy of the DNA molecules?
3. The hydrolysis of ATP in our cells is an exothermic process:
    - Say if for this process $\Delta H > 0$ or $\Delta H < 0$.
    - Can you deduce if the ΔH for ATP synthesis will be > 0 or < 0? Why?

Questions regarding the Gibbs free energy equation:

1. Consider a block of ice and a glass of liquid water:
    - What is the ΔH for going from solid ice to liquid water?
    - What is the ΔS for going from solid ice to liquid water?
    - Under what conditions becomes spontaneous going from solid ice to liquid water?
2. Consider two water molecules floating in vaccum, if they create a hydrogen bond between themselves:
    - What is the ΔH of the process?
    - What is the ΔS of the process?
    - What value is larger in absolut values? $|\Delta H|$ or $|T \cdot \Delta S|$?