Biological Thermodynamics and Kinetics

Unit I: Principles of Thermodynamics and Applications in Biology

1. Define the importance and scope of thermodynamics in biological systems.
2. Classify different types of systems (closed, isolated, and open) and explain their significance in biological processes.
3. Differentiate between extensive and intensive properties and provide examples related to biological systems.
4. Distinguish between state functions and path functions in thermodynamics and their relevance to biological processes.
5. Analyze the concepts of steady state and equilibrium state in biological systems.
6. Describe the first law of thermodynamics and its application in determining internal energy changes in biological reactions.
7. Compare reversible and irreversible processes in biological systems and calculate the work done during these processes.
8. Interpret the significance of isothermal and adiabatic processes in biological systems.
9. Calculate enthalpy changes in physicochemical and biochemical reactions and apply Kirchoff's law to determine heat capacities.
10. Explore the second law of thermodynamics and its implications on the spontaneity and equilibrium of biological reactions.
11. Analyze the Carnot cycle and its application in refrigeration processes related to biological systems.
12. Evaluate entropy changes during various processes in biological systems and explain the concept of unavailable work.
13. Apply the Helmholtz free energy and Gibbs free energy equations to determine spontaneity and equilibrium in biological reactions.
14. Utilize the Gibbs-Helmholtz equation in calculating thermodynamic parameters for biological processes.
15. Interpret the Clausius-Clapeyron equation in the context of phase transitions in biological systems.
16. Determine the equilibrium constant and standard free energy change for coupled reactions in biological systems.
17. Analyze the concept of chemical potential and its role in driving biochemical reactions.
18. Calculate partial molar quantities and apply them in understanding Donnan equilibrium in biological systems.
19. Define activity and activity coefficient in the context of thermodynamics of biological reactions.
20. Analyze fugacity and its importance in predicting the behavior of gases in biological systems.