

Review Sheet Metabolism and Energy

Prof. Lester BIOL 150

General things to do to prepare for the exam:

- study the PowerPoints
- write out the answers to the learning objectives found with each PowerPoint
- listen to my lecture recordings
- **STUDY the ENERGY SUMMARY SHEET**

Chapter 8

Define metabolism, catabolism, and anabolism. How are catabolism and anabolism related to each other?

Define energy and the following types of energy: kinetic, potential, chemical, and thermal.

Explain the first and second laws of thermodynamics.

Define entropy and enthalpy.

How does energy flow thru an ecosystem?

Define "free energy".

In terms of energy, define equilibrium.

Compare and contrast endergonic reactions with exergonic reactions. Which one is usually spontaneous and nonspontaneous? What does spontaneous and nonspontaneous mean here? Which reaction needs energy and which one releases energy? What is the ΔG for each type of reaction?

What are the three main types of work in a cell?

How can a cell enable an endergonic reaction occur?

Define phosphorylation. How do compounds often get phosphorylated?

Define: catalyst, apoenzyme, holoenzyme, cofactor, and coenzyme.

What is activation energy and how do enzymes affect the activation energy?

Define: substrate, enzyme-substrate complex, and induced fit.

How can the enzyme active site lower the energy of activation?

Define optimal/optimum pH and temperature for an enzyme.

Explain the effect of temperature on the rate of reaction for an enzyme and on the enzyme itself.

Explain the effect of pH on the rate of reaction for an enzyme and on the enzyme itself.

Compare and contrast competitive inhibition with noncompetitive inhibition.

Which type of inhibition is typically a normal cell function and why do cells do this on purpose?

Explain how cooperativity can amplify enzyme activity.

Sample Test Problems

Which of the following is an example of potential rather than kinetic energy?

- A) water rushing over Niagara Falls
- B) light flashes emitted by a firefly
- C) a molecule of glucose
- D) a crawling beetle foraging for food

A decrease in entropy is associated with which type of reaction?

- A) dehydration
- B) catabolic
- C) depolymerization
- D) hydrolysis

Which of the following statements about anabolic pathways is true?

- A) They are usually spontaneous chemical reactions.
- B) They consume energy to build up polymers from monomers.
- C) They release energy by degrading polymers to monomers.
- D) They decrease the entropy of the organism and its environment.

Which of the following statements is an important consequence of the first law of thermodynamics for a living organism?

- A) The energy content of an organism is constant.
- B) An organism ultimately must obtain all of the necessary energy for life from its environment.
- C) The entropy of an organism decreases with time as the organism grows in complexity.
- D) Organisms grow by converting energy into organic matter.

Which of the following statements is a logical consequence of the second law of thermodynamics?

- A) If the entropy of a system increases, there must be a corresponding decrease in the entropy of the universe.
- B) If the entropy of a system decreases, there must be a corresponding decrease in the entropy of the universe.
- C) If there is an increase in the energy of a system, there must be a corresponding decrease in the energy of the rest of the universe.
- D) Each chemical reaction in an organism must increase the total entropy of the universe.

Which of the following statements about the evolution of life on Earth, from simple prokaryote-like cells to multicellular eukaryotic organisms, is true?

- A) By resulting in such diversity and complexity of life, it is an exception to the second law of thermodynamics.
- B) It has occurred in accordance with the laws of thermodynamics and resulted in a substantial increase in the entropy of the planet.
- C) It has occurred in accordance with the laws of thermodynamics and resulted in a substantial increase in the total energy in the universe.
- D) It has occurred in accordance with the laws of thermodynamics and resulted in a substantial decrease in the entropy of the planet.

Which of the following statements is true for all exergonic reactions?

- A) The products have more total energy than the reactants.
- B) The reaction proceeds with a net release of free energy.
- C) The reaction goes only in a forward direction: all reactants will be converted to products, but no products will be converted to reactants.
- D) A net input of energy from the surroundings is required for the reactions to proceed.

A chemical reaction that has a positive ΔG is best described as _____.

- A) endergonic
- B) enthalpic
- C) spontaneous
- D) exergonic

Which of the following molecules is most similar in structure to ATP?

- A) a pentose sugar
- B) a DNA nucleotide
- C) an RNA nucleotide
- D) an amino acid with three phosphate groups attached

When chemical, transport, or mechanical work is done by an organism, what happens to the heat generated?

- A) It is used to power yet more cellular work.
- B) It is captured to store energy as more ATP.
- C) It is used to generate ADP from nucleotide precursors.
- D) It is lost to the environment.



Which of the following is the most correct interpretation of the figure?

- A) Energy from catabolism can be used directly for performing cellular work.
- B) ADP + Pi are a set of molecules that store energy for catabolism.
- C) ATP is a molecule that acts as an intermediary to store energy for cellular work.
- D) Pi acts as a shuttle molecule to move energy from ATP to ADP.

Which of the following is true when comparing an uncatalyzed reaction to the same reaction with a catalyst?

- A) The catalyzed reaction will be slower.
- B) The catalyzed reaction will have the same ΔG .
- C) The catalyzed reaction will have higher activation energy.
- D) The catalyzed reaction will consume all of the catalyst.

What is the name of the thermodynamic barrier that must be overcome before products are formed in a spontaneous reaction?

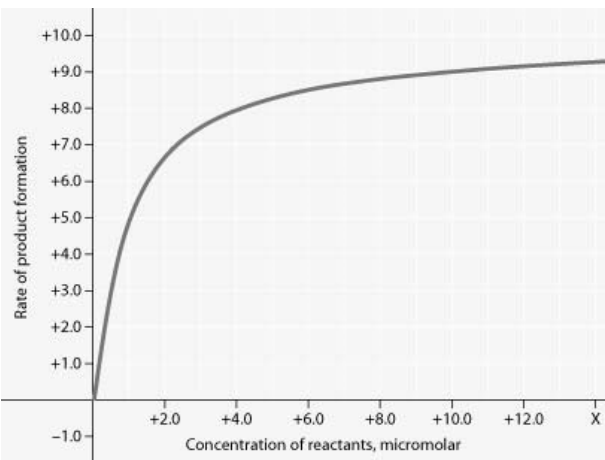
- A) entropy
- B) activation energy
- C) the equilibrium point
- D) free energy

Which of the following conditions may be overcome by increasing the substrate concentration in an enzymatic reaction with a fixed amount of enzyme?

- A) the need for a coenzyme
- B) allosteric inhibition
- C) noncompetitive inhibition
- D) competitive inhibition

Zinc, an essential trace element for most organisms, is present in the active site of the enzyme carboxypeptidase. The zinc most likely functions as:

- A) a noncompetitive inhibitor of the enzyme
- B) an allosteric activator of the enzyme
- C) a cofactor necessary for enzyme activity
- D) a coenzyme derived from a vitamin



In the figure, why does the reaction rate plateau at higher reactant concentrations?

- A) Feedback inhibition by product occurs at high reactant concentrations.
- B) Most enzyme molecules are occupied by substrate at high reactant concentrations.
- C) The reaction nears equilibrium at high reactant concentrations.
- D) The rate of the reverse reaction increases at high reactant concentrations.