

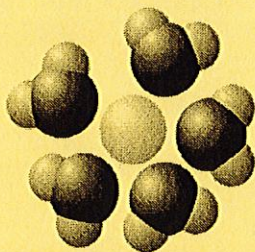
Unit 2 - Organic Chemistry and Enzymes

Multiple Choice

Identify the choice that best completes the statement or answers the question.

- B 1) DNAase is an enzyme that catalyzes the hydrolysis of the covalent bonds that join nucleotides together. What would first happen to DNA molecules treated with DNAase?
- A) The two strands of the double helix would separate.
 - B) The phosphodiester bonds between deoxyribose sugars would be broken.
 - C) The purines would be separated from the deoxyribose sugars.
 - D) The pyrimidines would be separated from the deoxyribose sugars.
 - E) All bases would be separated from the deoxyribose sugars.
- E 2) The nucleus of a nitrogen atom contains 7 neutrons and 7 protons. Which of the following is a correct statement concerning nitrogen?
- A) The nitrogen atom has a mass number of approximately 7 daltons and an atomic mass of 14.
 - B) The nitrogen atom has a mass number of approximately 14 daltons and an atomic mass of 7.
 - C) The nitrogen atom has a mass number of 14 and an atomic mass of 7 grams.
 - D) The nitrogen atom has a mass number of 7 and an atomic number of 14.
 - E) The nitrogen atom has a mass number of 14 and an atomic mass of approximately 14 daltons.
- D 3) Which of the following explains most specifically the attraction of water molecules to one another?
- A) nonpolar covalent bond
 - B) polar covalent bond
 - C) ionic bond
 - D) hydrogen bond
 - E) hydrophobic interaction
- C 4) A group of molecular biologists is trying to synthesize a new artificial compound to mimic the effects of a known hormone that influences sexual behavior. They have turned to you for advice. Which of the following compounds is most likely to mimic the effects of the hormone?
- A) a compound with the same number of carbon atoms as the hormone
 - B) a compound with the same molecular mass (measured in daltons) as the hormone
 - C) a compound with the same three-dimensional shape as part of the hormone
 - D) a compound with the same number of orbital electrons as the hormone
 - E) a compound with the same number of hydrogen and nitrogen atoms as the hormone

- A 5) Water molecules are able to form hydrogen bonds with
- A) compounds that have polar covalent bonds.
 - B) oils.
 - C) oxygen gas (O_2) molecules.
 - D) chloride ions.
 - E) any compound that is not soluble in water.
- D 6) Why does ice float in liquid water?
- A) The high surface tension of liquid water keeps the ice on top.
 - B) The ionic bonds between the molecules in ice prevent the ice from sinking.
 - C) Ice always has air bubbles that keep it afloat.
 - D) Hydrogen bonds stabilize and keep the molecules of ice farther apart than the water molecules of liquid water.
 - E) The crystalline lattice of ice causes it to be denser than liquid water.
- D 7) One liter of a solution of pH 2 has how many more hydrogen ions (H^+) than 1 L of a solution of pH 6?
- A) 4 times more
 - B) 16 times more
 - C) 40,000 times more
 - D) 10,000 times more
 - E) 100,000 times more
- E 8) Buffers are substances that help resist shifts in pH by
- A) releasing H^+ to a solution when acids are added.
 - B) donating H^+ to a solution when bases are added.
 - C) releasing OH^- to a solution when bases are added.
 - D) accepting H^+ from a solution when acids are added.
 - E) both donating H^+ to a solution when bases are added, and accepting H^+ when acids are added.
- A 9) If the cytoplasm of a cell is at pH 7, and the mitochondrial matrix is at pH 8, this means that
- A) the concentration of H^+ ions is tenfold higher in the cytoplasm than in the mitochondrial matrix.
 - B) the concentration of H^+ ions is tenfold higher in the mitochondrial matrix than in the cytoplasm.
 - C) the concentration of H^+ ions in the cytoplasm is $7/8$ the concentration in the mitochondrial matrix.
 - D) the mitochondrial matrix is more acidic than the cytoplasm.
 - E) the concentration of H^+ ions in the cytoplasm is $8/7$ the concentration in the mitochondrial matrix.

A 10)

Based on your knowledge of the polarity of water molecules, the solute molecule depicted here is most likely

- A) positively charged.
- B) negatively charged.
- C) without charge.
- D) hydrophobic.
- E) nonpolar.

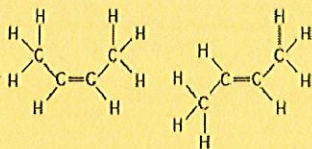
- B 11) Stanley Miller's 1953 experiments proved that
- A) life arose on Earth from simple inorganic molecules.
 - B) organic molecules can be synthesized abiotically under conditions that may have existed on early Earth.
 - C) life arose on Earth from simple organic molecules, with energy from lightning and volcanoes.
 - D) the conditions on early Earth were conducive to the origin of life.
 - E) the conditions on early Earth were conducive to the abiotic synthesis of organic molecules.

- B 12) Why are hydrocarbons insoluble in water?
- A) The majority of their bonds are polar covalent carbon-to-hydrogen linkages.
 - B) The majority of their bonds are nonpolar covalent carbon-to-hydrogen linkages.
 - C) They are hydrophilic.
 - D) They exhibit considerable molecular complexity and diversity.
 - E) They are lighter than water.

- B 13) Organic chemistry is currently defined as
- A) the study of compounds made only by living cells.
 - B) the study of carbon compounds.
 - C) the study of vital forces.
 - D) the study of natural (as opposed to synthetic) compounds.
 - E) the study of hydrocarbons.

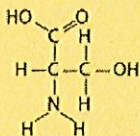
E

14)



The two molecules shown in the figure above are best described as

- A) enantiomers.
- B) radioactive isotopes.
- C) structural isomers.
- D) nonisotopic isomers.
- E) *cis-trans* isomers.

B15) Which functional group is *not* present in this molecule?

- A) carboxyl
- B) sulfhydryl
- C) hydroxyl
- D) amino

B

16) Which of the following statements concerning saturated fats is not true?

- A) They are more common in animals than in plants.
- B) They have multiple double bonds in the carbon chains of their fatty acids.
- C) They generally solidify at room temperature.
- D) They contain more hydrogen than unsaturated fats having the same number of carbon atoms.
- E) They are one of several factors that contribute to atherosclerosis.

E

17) What aspects of protein structure are stabilized or assisted by hydrogen bonds?

- A) primary structure
- B) secondary structure
- C) tertiary structure
- D) quaternary structure
- E) secondary, tertiary, and quaternary structures, but not primary structure

B

- 18) The R group or side chain of the amino acid serine is $-\text{CH}_2-\text{OH}$. The R group or side chain of the amino acid leucine is $-\text{CH}_2-\text{CH}-(\text{CH}_3)_2$. Where would you expect to find these amino acids in a globular protein in aqueous solution?
- Serine would be in the interior, and leucine would be on the exterior of the globular protein.
 - Leucine would be in the interior, and serine would be on the exterior of the globular protein.
 - Both serine and leucine would be in the interior of the globular protein.
 - Both serine and leucine would be on the exterior of the globular protein.
 - Both serine and leucine would be in the interior and on the exterior of the globular protein.

B

- 19) A new organism is discovered in the forests of Costa Rica. Scientists there determine that the polypeptide sequence of hemoglobin from the new organism has 72 amino acid differences from humans, 65 differences from a gibbon, 49 differences from a rat, and 5 differences from a frog. These data suggest that the new organism
- is more closely related to humans than to frogs.
 - is more closely related to frogs than to humans.
 - evolved at about the same time as frogs, which is much earlier than primates and mammals.
 - is more closely related to humans than to rats.
 - is more closely related to frogs than to humans and also evolved at about the same time as frogs, which is much earlier than primates and mammals.

B

20)

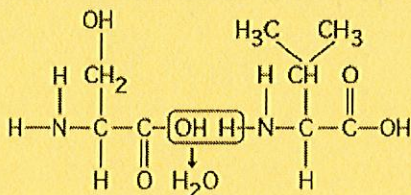


Figure 5.5

Which of the following statements is/are true regarding the chemical reaction illustrated in Figure 5.5?

- It is a hydrolysis reaction.
- It results in a peptide bond.
- It joins two fatty acids together.
- It is a hydrolysis reaction and it results in a peptide bond.
- It is a hydrolysis reaction, it results in a peptide bond, and it joins two fatty acids together.

The following questions are based on the 15 molecules illustrated in Figure 5.8. Each molecule may be used once, more than once, or not at all.

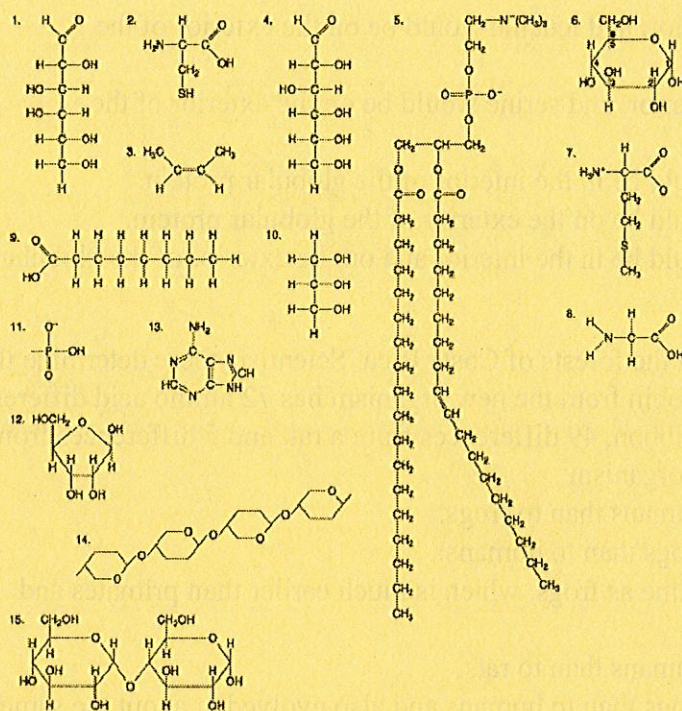


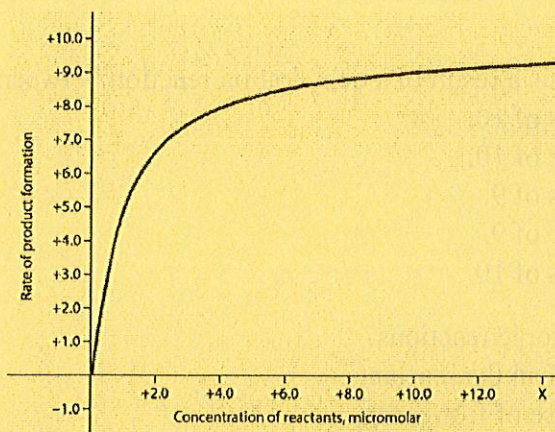
Figure 5.8

- B 21) Which molecule has both hydrophilic and hydrophobic properties and would be found in plasma membranes?
- A) 1
 B) 5
 C) ~~6~~
 D) 12
 E) 14
- D 22) Which of the following combinations could be linked together to form a nucleotide?
- A) 1, 2, and 11
 B) 3, 7, and 8
 C) 5, 9, and 10
 D) 11, 12, and 13
 E) 12, 14, and 15

- E 23) Which molecule is a saturated fatty acid?
A) 1
B) 5
C) 6
D) 8
E) 9
- B 24) Which of the following molecules act as building blocks (monomers) of polypeptides?
A) 1, 4, and 6
B) 2, 7, and 8
C) 7, 8, and 13
D) 11, 12, and 13
E) 12, 13, and 15
- B 25) A fat (or triacylglycerol) would be formed as a result of a dehydration reaction between
A) one molecule of 9 and three molecules of 10.
B) three molecules of 9 and one molecule of 10.
C) one molecule of 5 and three molecules of 9.
D) three molecules of 5 and one molecule of 9.
E) one molecule of 5 and three molecules of 10.
- B 26) Which of the following 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.
E) The reactions are rapid.
- B 27) Which of the following statements regarding enzymes is true?
A) Enzymes increase the rate of a reaction by making the reaction more exergonic.
B) Enzymes increase the rate of a reaction by lowering the activation energy barrier.
C) Enzymes increase the rate of a reaction by reducing the rate of reverse reactions.
D) Enzymes change the equilibrium point of the reactions they catalyze.
E) Enzymes make the rate of a reaction independent of substrate concentrations.
- C 28) When you have a severe fever, what grave consequence may occur if the fever is not controlled?
A) destruction of your enzymes' primary structure
B) removal of amine groups from your proteins
C) change in the tertiary structure of your enzymes
D) removal of the amino acids in active sites of your enzymes
E) binding of your enzymes to inappropriate substrates

B

- 29) Protein kinases are enzymes that transfer the terminal phosphate from ATP to an amino acid residue on the target protein. Many are located on the plasma membrane as integral membrane proteins or peripheral membrane proteins. What purpose may be served by their plasma membrane localization?
- ATP is more abundant near the plasma membrane.
 - They can more readily encounter and phosphorylate other membrane proteins.
 - Membrane localization lowers the activation energy of the phosphorylation reaction.
 - They flip back and forth across the membrane to access target proteins on either side.
 - They require phospholipids as a cofactor.



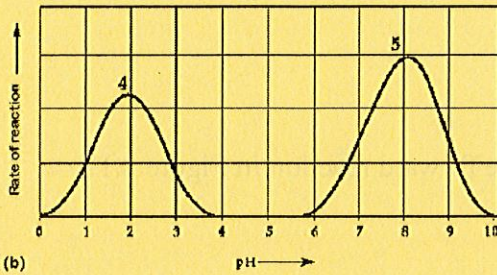
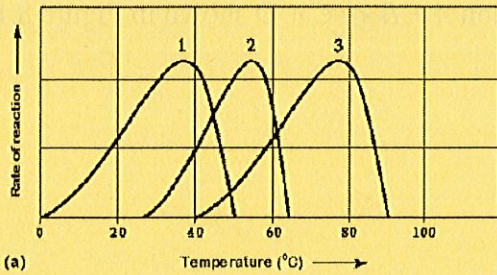
Rate of an enzyme-catalyzed reaction as a function of varying reactant concentration, with the concentration of enzyme constant.

D

- 30) For the enzyme-catalyzed reaction shown in the figure, which of these treatments will cause the greatest increase in the rate of the reaction, if the initial reactant concentration is 1.0 micromolar?
- doubling the activation energy needed
 - cooling the reaction by 10°C
 - doubling the concentration of the reactants to 2.0 micromolar
 - doubling the enzyme concentration
 - increasing the concentration of reactants to 10.0 micromolar, while reducing the concentration of enzyme by $1/2$

B

- 31) In the figure, why does the reaction rate plateau at higher reactant concentrations?
- Feedback inhibition by product occurs at high reactant concentrations.
 - Most enzyme molecules are occupied by substrate at high reactant concentrations.
 - The reaction nears equilibrium at high reactant concentrations.
 - The activation energy for the reaction increases with reactant concentration.
 - The rate of the reverse reaction increases with reactant concentration.



Activity of various enzymes at various temperatures (a) and at various pH (b).

- E
- 32) Which curve(s) on the graphs may represent the temperature and pH profiles of an enzyme taken from a bacterium that lives in a mildly alkaline (basic) hot springs at temperatures of 70°C or higher?
- A) curves 1 and 5
 B) curves 2 and 4
 C) curves 2 and 5
 D) curves 3 and 4
 E) curves 3 and 5
- A
- 33) Which temperature and pH profile curves on the graphs were most likely generated from analysis of an enzyme from a human stomach where conditions are strongly acid?
- A) curves 1 and 4
 B) curves 1 and 5
 C) curves 2 and 4
 D) curves 2 and 5
 E) curves 3 and 4

The following questions are based on the reaction $A + B \leftrightarrow C + D$ shown in Figure 8.1.

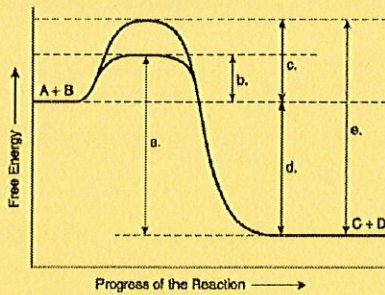


Figure 8.1

- B 34) Which of the following terms best describes the forward reaction in Figure 8.1?
- A) endergonic, $\Delta G > 0$
 - B) exergonic, $\Delta G < 0$
 - C) endergonic, $\Delta G < 0$
 - D) exergonic, $\Delta G > 0$
 - E) chemical equilibrium, $\Delta G = 0$

- B 35) Which of the following represents the activation energy required for the enzyme-catalyzed reaction in Figure 8.1?
- A) a
 - B) b
 - C) c
 - D) d
 - E) e

A series of enzymes catalyze the reaction $X \rightarrow Y \rightarrow Z \rightarrow A$. Product A binds to the enzyme that converts X to Y at a position remote from its active site. This binding decreases the activity of the enzyme.

- C 36) What is substance X?
- A) a coenzyme
 - B) an allosteric inhibitor
 - C) a substrate
 - D) an intermediate
 - E) the product
- B 37) With respect to the enzyme that converts X to Y, substance A functions as
- A) a coenzyme.
 - B) an allosteric inhibitor.
 - C) the substrate.
 - D) an intermediate.
 - E) a competitive inhibitor.