Campbell's Biology, 9e **(Reece et al.)**
Chapter 4 Carbon and the Molecular Diversity of Life

This chapter focuses on the chemistry of carbon and organic compounds. Students should be able to identify the nature of the bonds between carbon and other elements (nonpolar versus polar), the different types of weak bonds and interactions, the various types of isomers, the basic functional groups of organic molecules, and their relative solubility in water. The abiotic formation of organic molecules from inorganic molecules is important in the origin of life.

Multiple-Choice Questions

1) The element present in all organic molecules is
A) hydrogen.
B) oxygen.
C) carbon.
D) nitrogen.
E) phosphorus.
Answer: C
Topic: Concept 4.1
Skill: Knowledge/Comprehension

2) The complexity and variety of organic molecules is due to
A) the chemical versatility of carbon atoms.
B) the variety of rare elements in organic molecules.
C) the fact that they can be synthesized only in living organisms.
D) their interaction with water.
E) their tremendously large sizes.
Answer: A
Topic: Concept 4.1
Skill: Knowledge/Comprehension

3) The experimental approach taken in current biological investigations presumes that
A) simple organic compounds can be synthesized in the laboratory from inorganic precursors, but complex organic compounds like carbohydrates and proteins can only be synthesized by living organisms.
B) a life force ultimately controls the activities of living organisms and this life force cannot be studied by physical or chemical methods.
C) although a life force, or vitalism, exists in living organisms, this life force cannot be studied by physical or chemical methods.
D) living organisms are composed of the same elements present in nonliving things, plus a few special trace elements found only in living organisms or their products.
E) living organisms can be understood in terms of the same physical and chemical laws that can be used to explain all natural phenomena.
Answer: E
Topic: Concept 4.1
Skill: Knowledge/Comprehension

4) Differences among organisms are caused by
A) large differences in elemental composition from organism to organism.
B) differences in the types and relative amounts of organic molecules synthesized by each organism.
C) differences in the elements that bond with carbon in each organism.
D) differences in the sizes of the organic molecules in each organism.
E) differences in inorganic compounds present in each organism.
Answer: B
Topic: Concept 4.1
Skill: Application/Analysis

5) Which of the following people was the first to synthesize an organic compound, urea, from inorganic starting materials?
A) Stanley Miller
B) Jakob Berzelius
C) Friedrich Wohler
D) Hermann Kolbe
E) August Kekulé
Answer: C
Topic: Concept 4.1
Skill: Knowledge/Comprehension

6) 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.
Answer: B
Topic: Concept 4.1
Skill: Synthesis/Evaluation

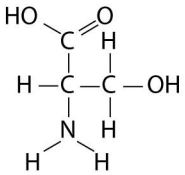
7) Hermann Kolbe's synthesis of an organic compound, acetic acid, from inorganic substances that had been prepared directly from pure elements was a significant milestone for what reason?
A) It solved an industrial shortage of acetic acid.
B) It proved that organic compounds could be synthesized from inorganic compounds.
C) It disproved the concept of vitalism.
D) It showed that life originated from simple inorganic chemicals.
E) It proved that organic compounds could be synthesized from inorganic compounds and disproved the concept of vitalism.
Answer: E
Topic: Concept 4.1
Skill: Synthesis/Evaluation

End-of-Chapter Questions

The following questions are from the end-of-chapter "Test Your Understanding" section in Chapter 4 of the textbook.

65) 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.
Answer: B
Topic: End-of-Chapter Questions
Skill: Knowledge/Comprehension

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

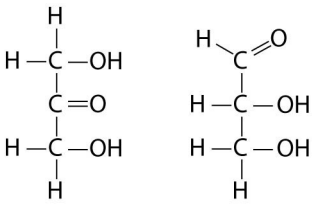


A) carboxyl
B) sulfhydryl
C) hydroxyl
D) amino
Answer: B
Topic: End-of-Chapter Questions
Skill: Knowledge/Comprehension

67) Which chemical group is most likely to be responsible for an organic molecule behaving as a base?
A) hydroxyl
B) carbonyl
C) carboxyl
D) amino
E) phosphate
Answer: D
Topic: End-of-Chapter Questions
Skill: Knowledge/Comprehension

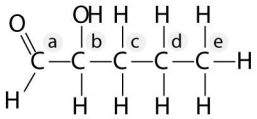
68) Which of the following hydrocarbons has a double bond in its carbon skeleton?
A) C_3H_8
B) C_2H_6
C) CH_4
D) C_2H_4
E) C_2H_2
Answer: D
Topic: End-of-Chapter Questions
Skill: Application/Analysis

69) Choose the term that correctly describes the relationship between these two sugar molecules:



A) structural isomers
B) *cis-trans* isomers
C) enantiomers
D) isotopes
Answer: A
Topic: End-of-Chapter Questions
Skill: Application/Analysis

Answer the following questions based on the figure below.



70) Identify the asymmetric carbon in this molecule.
A) A
B) B
C) C
D) D
E) E
Answer: B
Topic: End-of-Chapter Questions
Skill: Application/Analysis

71) Which action could produce a carbonyl group?
A) the replacement of the –OH of a carboxyl group with hydrogen
B) the addition of a thiol to a hydroxyl
C) the addition of a hydroxyl to a phosphate
D) the replacement of the nitrogen of an amine with oxygen
E) the addition of a sulfhydryl to a carboxyl
Answer: A
Topic: End-of-Chapter Questions
Skill: Application/Analysis