

Biology: How Life Works 2e, Chapter 2 Assessment

1. An atom with three electrons has:

- A. one occupied orbital with three electrons.
- B. two occupied orbitals, one of which has two electrons and the other has one.
- C. three occupied orbitals, each of which contains one electron.
- D. three energy shells, each of which contains one electron.

ANSWER: B

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1, 2.2, 2.3, 2.4

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question assesses the ability to use the periodic table to discern structural differences between the elements.

2. If an atom has three electrons, how many occupied orbitals will the atom have, and how many electrons will be in each?

ANSWER: The atom will have two orbitals. One will have two paired electrons, and the other will have one unpaired electron.

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.4, 2.1, 2.2, 2.3

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements.

3. For an atom that is **not** an ion, which of the following must be true?

- A. The number of electrons equals the number of protons.
- B. The number of electrons equals the number of neutrons.
- C. The number of protons equals the number of neutrons.

ANSWER: A

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1, 2.9

Cognitive level: LOC

Bloom's level: Understanding
Level of difficulty: Medium
Setting: Exam

4. Explain why an atom that is **not** an ion is electrically neutral.

ANSWER: In an atom that is not an ion, the number of positively charged protons always equals the number of negatively charged electrons.

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1, 2.9

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

5. Which of the following correctly pairs the particles of an atom with their physical properties?

- A. proton—positively charged; neutron—uncharged; electron—negatively charged
- B. proton—negatively charged; neutron—uncharged; electron—positively charged
- C. proton—positively charged; neutron—negatively charged; electron—uncharged
- D. proton—negatively charged; neutron—uncharged; electron—positively charged

ANSWER: A

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question tests basic knowledge.

6. List the particles in an atom, and indicate whether each is positively charged, negatively charged, or uncharged.

ANSWER: proton—positively charged; neutron—uncharged; electron—negatively charged

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question tests basic knowledge.

7. Sometimes, atoms gain or lose particles. The loss of which of the following results in a change of atomic mass?

- A. a neutron
- B. a proton
- C. an electron
- D. a neutron and a proton
- E. a proton and an electron

ANSWER: D

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question could be used as a standard K-type MCQ, or remove D and E and use as an MTFQ.

8. Sometimes, atoms gain or lose particles. The loss of which of the following would result in a change of overall electrical charge?

- A. protons only
- B. electrons only
- C. neutrons only
- D. protons or neutrons
- E. protons or electrons
- F. neutrons or electrons

ANSWER: E

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1, 2.9

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question could be used as an MTFQ.

9. The most common isotope of oxygen has 8 protons and an atomic mass of 16. How many neutrons are present in the oxygen nucleus?

- A. 2
- B. 4
- C. 6

- D. 8
- E. 10

ANSWER: D

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Exam

10. The most common isotope of oxygen has 8 protons and an atomic mass of 16. How many electrons are present in the orbitals around an atom of oxygen?

- A. 2
- B. 4
- C. 6
- D. 8
- E. 10

ANSWER: D

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Exam

11. The most common isotope of oxygen has an atomic mass of 16 (^{16}O). An isotope with an atomic mass of 18 (^{18}O) is also stable. How many valence electrons are present in ^{18}O ?

- A. fewer than in ^{16}O
- B. more than in ^{16}O
- C. the same as in ^{16}O
- D. None of the other answer options is correct.

ANSWER: C

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

12. ^{14}C is an isotope of carbon that possesses:

- A. 6 protons, 6 neutrons, and 2 electrons.
- B. 6 protons, 8 neutrons, and 6 electrons.
- C. 8 protons, 6 neutrons, and 2 electrons.
- D. 6 protons, 2 neutrons, and 6 electrons.
- E. 6 protons, 8 neutrons, and 2 electrons.

ANSWER: B

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Homework

13. Using the periodic table in Fig. 2.3, select the element that would be found in least abundance in a living cell.

1 H																	2 He															
3 Li	4 Be																	5 B	6 C	7 N	8 O	9 F	10 Ne									
11 Na	12 Mg																	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar									
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr															
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe															
55 Cs	56 Ba	57-71 La-Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn															
87 Fr	88 Ra	89-103 Ac-Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo															
																		57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
																		89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

- A. hydrogen (H)
- B. sodium (Na)
- C. phosphorous (P)
- D. zinc (Zn)
- E. silicon (Si)

ANSWER: E

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.3, 2.12

Cognitive level: HOC

Bloom's level: Applying

Level of difficulty: Medium

Setting: Homework

14. How many electron orbitals does a carbon atom possess?

- A. 2
- B. 4
- C. 5
- D. 6
- E. 12

ANSWER: C

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.3, 2.6

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Homework

15. What differentiates isotopes of the same element?

- A. protons
- B. neutrons
- C. electrons
- D. charge

ANSWER: B

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: In-class

16. You discover an isotope of an element that has 6 electrons in its second and outermost shell, 8 protons, and 6 neutrons. What element is it?

- A. fluorine (F)
- B. carbon (C)
- C. nitrogen (N)
- D. oxygen (O)

ANSWER: D

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.3, 2.4

Cognitive level: LOC

Bloom's level: Applying

Level of difficulty: Medium

Setting: In-class

17. What would happen to an atom's atomic mass and electric charge if it gained or lost a proton, a neutron, or an electron?

ANSWER: If an atom:

gained a proton, its atomic mass would increase and its electrical charge would become more positive.

lost a proton, its atomic mass would decrease and its electrical charge would become more negative.

gained a neutron, its atomic mass would increase and its electrical charge would remain the same.

lost a neutron, its atomic mass would decrease and its electrical charge would remain the same.

gained an electron, its atomic mass would remain essentially the same and its electrical charge would become more negative.

lost an electron, its atomic mass would remain essentially the same and its electrical charge would become more positive.

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: In-class

18. The atom:

- A. is the basic unit of matter.
- B. is the unit of composition for elements.
- C. contains protons, neutrons, and electrons.
- D. has negatively charged particles circling around a positively charged nucleus.
- E. All of these choices are correct.

ANSWER: E

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

19. The designation of a magnesium ion as Mg^{2+} indicates an atom that has:

- A. two more protons than neutrons. .
- B. lost two electrons and is negatively charged.
- C. lost two electrons and is positively charged.
- D. gained two protons and is positively charged.
- E. gained two protons and is negatively charged.

ANSWER: C

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

20. The basic unit of matter is referred to as a(n) _____.

ANSWER: atom

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

21. The negatively charged components of atoms are referred to as:

- A. protons.
- B. electrons.
- C. anions.
- D. neutrons.
- E. cations.

ANSWER: B

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

22. For the first three rows of the periodic table, elements in the same row have the same number and type of electron orbitals.

- A. true
- B. false

ANSWER: A

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.3

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

23. Which one of the following pairs would be classified as isotopes of each other?

- A. H and H^+
- B. Na^+ and Cl^-
- C. C and Si
- D. ^{12}C and ^{13}C
- E. H and H^+ , Na^+ and Cl^- , C and Si, ^{12}C and ^{13}C

ANSWER: D

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.2, 2.3

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Pre-class

24. Nitrogen and phosphorus are in the same column of the periodic table. They have similar properties in bonding with other molecules because they have the same number of:

- A. electrons.
- B. paired electrons.
- C. valence electrons.
- D. electron shells.

ANSWER: C

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.3, 2.4

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Pre-class

25. What percentage of carbon's orbitals is spherical in conformation?

- A. 0%
- B. 20%
- C. 40%
- D. 80%
- E. 100%

ANSWER: C

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.2

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Settings: Pre-class

26. Which one of the following contributes to the measurement referred to as atomic mass?

- A. protons and electrons
- B. electrons and neutrons
- C. protons, electrons, and neutrons
- D. protons and neutrons
- E. neutrons only

ANSWER: D

Chapter: 2

Core concept: 2.1
Connections: Fig. 2.1
Cognitive level: LOC
Bloom's level: Remembering
Level of difficulty: Easy
Setting: Pre-class

27. Which component of an atom has the smallest mass?

- A. proton
- B. neutron
- C. electron
- D. isotope
- E. isomer

ANSWER: C
Chapter: 2
Core concept: 2.1
Connections: Fig. 2.1
Cognitive level: LOC
Bloom's level: Remembering
Level of difficulty: Easy
Setting: Pre-class

28. Two elements within the same group:

- A. occupy the same row on the periodic table of elements.
- B. occupy the same column on the periodic table of elements.
- C. have the same number of electrons in their outermost shell.
- D. have different numbers of electrons in their outermost shell.
- E. occupy the same column on the periodic table and have the same number of electrons in their outermost shell.

ANSWER: E
Chapter: 2
Core concept: 2.1
Connections: Fig. 2.3, 2.4
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Medium
Setting: Pre-class

29. Consider two carbon atoms, one represented as ^{14}C and the other as ^{12}C . Which of the following statements is true regarding these two atoms?

- A. These carbon atoms have the same number of protons.

- B. These carbon atoms have the same number of neutrons.
- C. These carbon atoms have different numbers of electrons.
- D. These carbon atoms have different numbers of protons.

ANSWER: A

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

30. Which of the following statements is true regarding elements?

- A. Elements are composed of several different types of atoms.
- B. Elements are only found in nature and cannot be created by humans.
- C. Elements are still categorized according to Aristotle's early classifications.
- D. Elements are composed of only one type of atom.
- E. Elements are only found in inorganic substances and not in living organisms.

ANSWER: D

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1, 2.3

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

31. Which of the following statements is true regarding atomic mass?

- A. The atomic mass is defined as the sum of electrons and neutrons in an atom.
- B. The atomic mass can be used to differentiate between different isotopes of the same element.
- C. The atomic mass is synonymous with the atomic number.
- D. The atomic mass is calculated by adding the total number of electrons, protons, and neutrons in an atom.

ANSWER: B

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

32. Imagine that you have two different carbon atoms, one identified as ^{14}C and the other as ^{13}C . These two carbon atoms:

- A. are two different carbon isotopes.
- B. have a different number of neutrons.
- C. have a different number of protons.
- D. are two different carbon isotopes and have a different number of protons.
- E. are two different carbon isotopes and have a different number of neutrons.

ANSWER:E

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

33. Where is the highest-energy electron found in an atom of hydrogen?

- A. in the spherical orbital closest to the nucleus
- B. in the second spherical orbital, a little farther from the nucleus
- C. in the dumbbell-shaped orbital of the y-axis
- D. in the dumbbell-shaped orbital of the x-axis
- E. in the dumbbell-shaped orbital of the z-axis

ANSWER:A

Chapter: 2

Core concept: 2.1

Connections: Fig. 2.1

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

34. Consider the two elements, sodium (Na) and magnesium (Mg), which occupy the same row in the periodic table of elements. Sodium and magnesium atoms have:

- A. a different number of orbitals.
- B. the same atomic number.
- C. different atomic masses.
- D. the same number of electrons in their outermost orbitals.
- E. different atomic masses and the same number of electrons in their outermost orbitals.

ANSWER: C

Chapter: 2
Core concept: 2.1
Connections: Fig. 2.3
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Medium
Setting: Pre-class

35. Which of the following bonds rely on the attraction of positive and negative charges?

- A. ionic bonds
- B. covalent bonds
- C. hydrogen bonds
- D. ionic bonds and hydrogen bonds
- E. ionic bonds and covalent bonds

ANSWER: D

Chapter: 2
Core concept: 2.2
Connections: Fig. 2.8, 2.9
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Medium
Setting: Exam

36. Refer to the periodic table, and decide which of the following molecules is held together by ionic bonds.

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57-71 La-Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89-103 Ac-Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo

Abundance in cells

High

Low

Trace

None

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

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- A. NH_3
- B. CO_2
- C. KCl

ANSWER: C

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.3, 2.6, 2.7, 2.9

Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: Medium

Setting: Exam

37. Refer to the periodic table, and decide which of the following molecules is held together by polar covalent bonds.

1 H																	2 He						
3 Li	4 Be																	5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg																	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr						
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe						
55 Cs	56 Ba	57-71 La-Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn						
87 Fr	88 Ra	89-103 Ac-Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo						
			57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu						
			89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr						

Abundance in cells

High

Low

Trace

None

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- A. NH_3
- B. CO_2
- C. KCl

ANSWER: A

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.3, 2.6, 2.7, 2.9

Cognitive level: HOC

Bloom's: Analyzing

Level of difficulty: Medium

Setting: Exam

38. Refer to the periodic table, and decide which of the following molecules is held together by nonpolar covalent bonds.

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57-71 La-Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89-103 Ac-Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo
			57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
			89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Abundance in cells

High

Low

Trace

None

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- A. NH_3
- B. CO_2
- C. KCl

ANSWER: B

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.3, 2.6, 2.7, 2.9

Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: Medium

Setting: Exam

39. Of the following types of bonds between atoms, which is the strongest?

- A. ionic bond
- B. hydrogen bond
- C. covalent bond
- D. van der Waals forces

ANSWER: C

Chapter 2

Core concept: 2.2

Connections: Fig. 2.5, 2.6

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Exam

40. A pair of atoms joined by a polar covalent bond:

- A. has the charge spread evenly across both atoms.
- B. has a slight positive charge on one atom and a slight negative charge on the other.
- C. is unlikely to form hydrogen bonds with water.
- D. mixes well with nonpolar solvents.

ANSWER: B

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.5, 2.6

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

41. The ability of atoms to form bonds is due largely to electrons farthest from the nucleus. These electrons are called _____ electrons.

ANSWER: valence

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.4, 2.6

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Exam

42. Which one of the following elements would most likely have bonding properties similar to nitrogen (N)? Consult the periodic table in Fig. 2.3 if necessary.

1 H																	2 He						
3 Li	4 Be																	5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg																	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr						
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe						
55 Cs	56 Ba	57-71 La-Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn						
87 Fr	88 Ra	89-103 Ac-Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	118 Uuo						
			57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu						
			89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr						

Abundance in cells

High

Low

Trace

None

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- A. carbon (C)
- B. silicon (Si)
- C. phosphorus (P)
- D. sulfur (S)
- E. oxygen (O)

ANSWER: C

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.3

Cognitive level: HOC

Bloom's level: Applying

Level of difficulty: Medium

Setting: Homework

43. Which of the following accurately describes a polar covalent bond?

- A. the interaction of a hydrogen atom connected to an atom with a high electronegativity, and an electronegative atom of another molecule
 - B. the interaction of an atom with very high electronegativity, and an atom with very low electronegativity
 - C. the unequal sharing of electrons between an atom with a partial positive charge, and an atom with a partial negative charge
 - D. the equal sharing of electrons between atoms of identical or similar electronegativities
- None of the other answer options is correct.

ANSWER: C

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.7

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: In-class

44. Which one of the following is maintained during a chemical reaction?

- A. the number of atoms present in the reactants
- B. the identity of the atoms present in the reactants
- C. the arrangement of chemical bonds present in the reactants
- D. the number and identity of the atoms present in the reactants
- E. the number and identity of the atoms, and the arrangement of chemical bonds present in the reactants.

ANSWER: D

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.5

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: In-class

45. A pair of shared valence electrons is referred to as a(n):

- A. ionic bond.
- B. hydrogen bond.
- C. van der Waals interaction.
- D. covalent bond.
- E. hydrophobic effect.

ANSWER: D

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.5, 2.6

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

46. The ability of atoms to attract electrons is referred to as:

- A. van der Waals attraction.
- B. potential energy.
- C. hydrophobicity.
- D. cohesion.
- E. electronegativity.

ANSWER: E

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.7

Cognitive level: LOC

Bloom's level: Remembering
Level of difficulty: Easy
Setting: Pre-class

47. An ionic interaction, such as the interaction between Na^+ and Cl^- , is considered a covalent bond.

- A. true
- B. false

ANSWER: B
Chapter: 2
Core concept: 2.2
Connections: Fig. 2.5, 2.8
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Easy
Setting: Pre-class

48. A(n) _____ is a substance composed of two or more atoms.

ANSWER: molecule
Chapter: 2
Core concept: 2.2
Connections: Fig. 2.5
Cognitive level: LOC
Bloom's level: Remembering
Level of difficulty: Easy
Setting: Pre-class

49. The valence electrons of an atom are at the lowest energy level because their increased distance from the nucleus reduces their attraction to the atom's protons.

- A. true
- B. false

ANSWER: B
Chapter: 2
Core concept: 2.2
Connections: Fig. 2.4
Cognitive level: LOC
Bloom's level: Remembering
Level of difficulty: Easy
Setting: Pre-class

50. The _____ of a chemical reaction are transformed into different molecules called _____.

- A. reactants; products
- B. reactants; isomers
- C. products; compounds
- D. products; reactants
- E. compounds; products

ANSWER: A

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.5

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

51. A polar bond is due to:

- A. equal sharing of valence electrons.
- B. an attraction of opposite charges.
- C. uneven sharing of electrons in a covalent bond.
- D. the interaction between an ion and a non-ionic atom.
- E. None of the other answer options is correct

ANSWER: C

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.7

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

52. Hydrogen bonding is ultimately due to differences in _____ between two atoms.

ANSWER: electronegativity

Chapter: 2

Connections: Fig. 2.8

Core concept: Fig. 2.2

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

53. Which one of the following elements is likely to form exactly three non-ionic interactions with hydrogen?

- A. phosphorus
- B. oxygen
- C. carbon
- D. sulfur
- E. chlorine

ANSWER: A

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.3, 2.4, 2.6

Cognitive level: HOC

Bloom's level: Applying

Level of difficulty: Medium

Setting: Pre-class

Instructional guidance: Students will need to consult and apply their understanding of the periodic table in order to answer this question.

54. The structural formula for hydrogen gas (H_2) is represented as $H-H$. Here, the dash (—) represents a(n):

- A. product.
- B. reactant.
- C. chemical reaction.
- D. chemical bond.
- E. electronegative bond.

ANSWER: D

Chapter: 2

Core concept: Fig. 2.2

Connections: Fig. 2.5

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

55. Which of the following statements regarding an atom with high electronegativity is true?

- A. It will have fewer protons than an atom with low electronegativity.
- B. It will have a tendency not to attract electrons.
- C. It will most likely be located on the left-most side of the periodic table of elements.
- D. None of the other answer options is correct.

ANSWER: D

Chapter: 2
Core concept: 2.2
Connections: Fig. 2.3
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Medium
Setting: Pre-class

56. When two atoms form a covalent bond, they share electrons from all of their orbitals. All of their orbitals, in turn, combine to form a single molecular orbital.

- A. true
- B. false

ANSWER: B

Chapter: 2
Core concept: 2.2
Connections: Fig. 2.5
Cognitive level: LOC
Bloom's level: Remembering
Level of difficulty: Medium
Setting: Pre-class

57. A young girl is staring at the raindrops running down her window. She notices that the raindrops remain more or less intact, even as they cascade down the windowpane. This is a result of:

- A. covalent bonds between water molecules.
- B. oxygen bonds between water molecules.
- C. polar covalent bonds between water molecules.
- D. hydrogen bonds between water molecules.
- E. ionic bonds between water molecules.

ANSWER: D

Chapter: 2
Core concepts: 2.2, 2.3
Connections: Fig. 2.8, 2.11
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Easy
Setting: Pre-class

58. Which of the following is an example of a hydrogen bond?

- A. the bond that forms between a hydrogen and oxygen atom within the same water molecule
- B. the bond that forms between two hydrogen atoms within the same water molecule

- C. the bond that forms between hydrogen and oxygen atoms within different water molecules
- D. the bond that forms between two hydrogen atoms within different water molecules
- E. the bond that forms between two oxygen atoms within different water molecules

ANSWER: C

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.8

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

59. A molecule of common table salt, or NaCl, is the result of _____ bond forming between a sodium (Na) atom and a chlorine (Cl) atom.

- A. an ionic
- B. a covalent
- C. a polar covalent
- D. a hydrogen
- E. either an ionic or a polar covalent

ANSWER: A

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.9

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

60. An ionic bond is really a modified polar covalent bond, because two atoms "share" electrons when one atom steals a valence electron from the other.

- A. true
- B. false

ANSWER: B

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.9

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

61. A woman's doctor tells her to gargle with salt water. She stirs a tablespoon of salt into a cup of warm water and watches it dissolve. Why does the salt dissolve in water?

- A. The positive hydrogen atoms in water molecules are attracted to chlorine ions.
- B. The positive hydrogen atoms in water molecules are attracted to sodium ions.
- C. The negative oxygen atoms in water molecules are attracted to chlorine ions.
- D. The negative oxygen atoms in water molecules are attracted to sodium ions.
- E. The positive hydrogen atoms in water molecules are attracted to chlorine ions, and the negative oxygen atoms in water molecules are attracted to sodium ions.

ANSWER: E

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.9

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

62. Part of the reason why salt dissolves in water is that hydrogen bonds form between water molecules and chlorine ions.

- A. true
- B. false

ANSWER: A

Chapter: 2

Core concept: 2.2

Connections: Fig. 2.8, 2.9

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Pre-class

63. What is the chemical basis for water's role as the universal solvent?

- A. Because water is polar, it disrupts most covalent bonds.
- B. Because water is polar, it disrupts hydrogen bonds.
- C. Because water is polar, it disrupts ionic bonds.
- D. Because water is polar, it disrupts both covalent and hydrogen bonds.
- E. Because water is polar, it disrupts both hydrogen and ionic bonds.

ANSWER: E

Chapter: 2

Core concepts: 2.2, 2.3

Connections: Fig. 2.7, 2.8, 2.9

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Settings: Exam

Instructional guidance: This question assesses knowledge of basic structure and properties of water and understanding of hydrogen bonds and ionic bonds.

64. What is the chemical basis for water's role as the universal solvent?

ANSWER: Because water is polar, it disrupts hydrogen and ionic bonds in and between other molecules.

Chapter: 2

Core concepts: 2.2, 2.3

Connections: Fig. 2.7, 2.8, 2.9

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Settings: Exam

Instructional guidance: This question assesses knowledge of basic structure and properties of water and understanding of hydrogen bonds and ionic bonds.

65. Several chemical properties make water uniquely suited for its role as a central "molecule of life." Which of the following is false?

A. Hydrogen bonding leads to high cohesiveness between water molecules.

B. Water resists temperature changes.

C. Water molecules are always polar.

D. The structure of a water molecule is stabilized by hydrogen bonds.

E. Water is a good solvent of polar molecules and ions.

ANSWER: D

Chapter: 2

Core concepts: 2.2, 2.3

Connections: Fig. 2.7, 2.8, 2.11

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question assesses knowledge of basic structure and properties of water.

66. Describe three chemical properties of water that make it uniquely suited for its role as a central "molecule of life."

ANSWER: 1) Water is a polar molecule that forms hydrogen bonds between water molecules (cohesion) and between water molecules and other polar molecules (adhesion). 2) The high

frequency of hydrogen bonding between water molecules resists changes in temperature. 3) The polarity of water molecules is responsible for their ability to act as a good solvent of ions and other polar molecules.

Chapter: 2

Core concepts: 2.2, 2.3

Connections: Fig. 2.7, 2.8, 2.11

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question assesses knowledge of basic structure and properties of water.

67. The association of individual water molecules with other water molecules is called _____ and occurs through _____ bonds between water molecules.

- A. adhesion; polar covalent
- B. cohesion; polar covalent
- C. cohesion; hydrogen bonds
- D. adhesion; hydrogen bonds

ANSWER: C

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.7, 2.8

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

68. The unique properties of water are due to the _____ of water molecules and the ability of water to form _____ with other water molecules and with other polar molecules.

- A. electronegativity; polar covalent bonds
- B. polarity; polar covalent bonds
- C. polarity; hydrogen bonds
- D. hydrophobicity; hydrogen bonds

ANSWER: C

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.7, 2.8

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

69. You have an aqueous solution with a pH of exactly 7.0. What would you add to make the solution more acidic?

- A. hydrogen chloride (HCl)
- B. sodium hydroxide (NaOH)
- C. sodium chloride (NaCl)
- D. deionized water (dH₂O)

ANSWER: A

Chapter: 2

Core concept: 2.3

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Hard

Setting: Exam

70. You have an aqueous solution with a pH of 6.0. What would you add to make the solution more basic?

- A. Hydrogen chloride (HCl)
- B. Sodium hydroxide (NaOH)
- C. Sodium chloride (NaCl)
- D. Deionized water (dH₂O)

ANSWER: B

Chapter: 2

Core concept: 2.3

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Hard

Setting: Exam

71. You have an aqueous solution with a pH of 8.0. You add sodium chloride to a concentration of 1 gram per 100 milliliters. What happens to the pH?

- A. It goes up.
- B. It goes down.
- C. It stays the same.
- D. It depends on the temperature.

ANSWER: C

Chapter: 2

Core concept: 2.3

Bloom's level: Understanding

Cognitive level: LOC
Level of difficulty: Medium
Setting: Exam

72. Complete the matching exercise below by choosing the correct description of each bond type in aqueous solution.

1. covalent bond
2. hydrogen bond
3. ionic bond

- A. an interaction of a hydrogen atom and an electronegative atom
- B. an interaction between oppositely charged ions
- C. electrons shared by atoms

ANSWER: 1 = C; 2 = A; 3 = B

Chapter: 2

Core concepts: 2.2, 2.3

Connections: Fig. 2.5, 2.7, 2.9

Cognitive Level LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Homework

73. Complete the matching exercise below by choosing the correct strength of each bond type in aqueous solution. Responses may be used once, more than once, or not at all.

1. covalent bond in aqueous solution
2. hydrogen bond in aqueous solution
3. ionic bond in aqueous solution

- A. weak
- B. strong

ANSWER: 1 = B; 2 = A; 3 = A

Chapter: 2

Core concepts: 2.2, 2.3

Connections: Fig. 2.5, 2.7, 2.9

Cognitive Level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Homework

74. Describe the following bonds and their relative strength in aqueous solutions: covalent, hydrogen, ionic.

Bond Type	Description of Bond	Bond Strength in an Aqueous Solution
Covalent	Electrons shared by atoms	Strong
Hydrogen bond	An interaction of a hydrogen atom and an electronegative atom	Weak
Ionic bond	An interaction between oppositely charged ions	Weak

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Chapter: 2

Core concepts: 2.2, 2.3

Connections: Fig. 2.5, 2.7, 2.9

Cognitive Level LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Homework

75. Which of the following is **not** a property of water?

- A. contracts during freezing
- B. floats when solid
- C. is a good solvent
- D. adheres to polar compounds
- E. is a polar molecule

ANSWER: A

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.11

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Homework

76. Which statement best describes an effect of the low density of frozen water in a lake?

- A. When water freezes, it contracts, decreasing the water level in the lake.
- B. Water in a lake freezes from the bottom up, killing most aquatic organisms.
- C. When water in a lake freezes, it floats, providing insulation for organisms below the ice.
- D. Water removes thermal energy from the land around a lake, causing the lake to freeze.

ANSWER: C

Chapter: 2

Core concept: 2.3
Connections: Fig. 2.11
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Medium
Setting: Homework

77. Which one of the following represents the pH of a solution with the highest concentration of hydrogen ions?

- A. 1.0
- B. 4.5
- C. 7.0
- D. 9.1
- E. 11.5

ANSWER: A
Chapter: 2
Core concept: 2.3
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Easy
Setting: Homework

78. In a solution that has $\text{pH} = 7.0$, the ratio of protons (H^+) to hydroxide ions (OH^-) equals

- A. 70
- B. 7
- C. 1
- D. $1/7$
- E. $1/70$

ANSWER: C
Chapter: 2
Core concept: 2.3
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Medium
Setting: Homework

79. A water molecule contains what type of bond?

- A. hydrogen
- B. ionic
- C. polar covalent
- D. van der Waals interactions

ANSWER: C

Chapter: 2

Core concepts: 2.2, 2.3

Connections: Fig. 2.6, 2.7

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: In-class

80. Which of the following statements about water is correct?

- A. Water is the most abundant molecule in living cells.
- B. Water is a polar molecule.
- C. Water has good solvent properties.
- D. Water molecules form hydrogen bonds with other polar molecules.
- E. All of these choices are correct.

ANSWER: E

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.8, 2.11

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

81. Which one of the following properties of water is primarily responsible for the ability of trees to draw water up from the roots to the leaves?

- A. polarity
- B. density
- C. solvent capability
- D. cohesion
- E. pH neutrality

ANSWER: D

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.8, 2.11

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

82. Water is able to dissolve many compounds as a result of which of the following?

- A. the fact that water molecules are polar
- B. the fact that water molecules are nonpolar
- C. the fact that the hydrogen atoms in water molecules have a slight negative charge
- D. the fact that most nonwater molecules are hydrophobic
- E. the fact that water molecules are polar, and that the hydrogen atoms in water molecules have a slight negative charge

ANSWER: A

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.8, 2.9

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

83. Which of the following statements about water is correct?

- A. Ice is less dense than liquid water.
- B. Ice forms on top and sinks to the bottom of lakes and rivers.
- C. Ice is more dense than liquid water.
- D. Bodies of water freeze from the bottom up.
- E. Water molecules in ice demonstrate a disorganized, non-lattice arrangement.

ANSWER: A

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.11

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

84. Water is neither hydrophilic nor hydrophobic, because these terms only define the interaction of other molecules with water molecules.

- A. true
- B. false

ANSWER: B

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.11

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

85. Which of the following statements is true regarding a polar molecule?

- A. A polar molecule is hydrophobic.
- B. A polar molecule is hydrophilic.
- C. A polar molecule will dissolve in water.
- D. A polar molecule will not dissolve in water.
- E. A polar molecule is hydrophilic and it will dissolve in water.

ANSWER: E

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.7

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

86. Imagine you are looking at a bottle of salad dressing containing oil, vinegar, and water. You notice that the oil sits on "top" of the other liquids. This is due, in part, to the fact that:

- A. water is hydrophobic.
- B. oil is hydrophilic.
- C. vinegar is hydrophobic.
- D. oil is hydrophobic.
- E. water is hydrophobic and oil is hydrophilic.

ANSWER: D

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.8

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

87. A researcher has measured the pH of a solution, and found that the pH is 10. This solution is _____, and has more _____ compared to _____.

- A. basic; protons; hydroxide ions
- B. basic; hydroxide ions; protons
- C. acidic; protons; hydroxide ions
- D. acidic; hydroxide ions; protons
- E. neutral; hydroxide ions; protons

ANSWER: B

Chapter: 2

Core concept: 2.3

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

88. Evidence exists that atmospheric CO₂ has increased over the last several decades due to human activities. How do increased CO₂ levels affect the pH of Earth's waters?

- A. It does not affect the pH of Earth's waters, because atmospheric CO₂ is not located in oceans.
- B. Due to the formation of carbonic acid, increased CO₂ levels decrease the pH of Earth's waters.
- C. Due to the formation of carbonic acid, increased CO₂ levels increase the pH of Earth's waters.
- D. Due to the formation of carbonic acid, increased CO₂ levels cause Earth's waters to become neutral.

ANSWER: B

Chapter: 2

Core concept: 2.3

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Difficult

Setting: Pre-class

89. A man heats water in a teakettle while drinking a glass of water at room temperature. The water molecules in the teakettle are moving _____ the water molecules in the glass.

- A. faster than
- B. slower than
- C. at the same speed as

ANSWER: A

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.11

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

90. As water is heated, the temperature rises before any hydrogen bonds between water molecules are broken.

- A. true

B. false

ANSWER: B

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.11

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

91. A man has ordered a glass of soda in a restaurant. When his drink arrives, he notices that quite a bit of ice is floating at the top of the glass. Why does the ice float?

- A. The water molecules in ice are arranged in a lattice pattern, causing ice to float.
- B. The water molecules in the soda are arranged in a lattice pattern, providing a “net” on which ice can sit.
- C. The water molecules in the soda are more densely packed compared to the water molecules in the ice.
- D. The water molecules in the ice are more densely packed compared to the water molecules in the soda.
- E. The water molecules in ice are arranged in a lattice pattern, and the water molecules in the soda are more densely packed compared to the water molecules in the ice, causing ice to float.

ANSWER: E

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.11

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

92. If hydrogen bonds between water molecules were, collectively, not as strong as they are, how would this affect plant height?

- A. As hydrogen bonds impede the movement of water through plant vasculature, plants would be able to grow taller.
- B. As hydrogen bonds are responsible for the movement of water through plant vasculature, plants would be shorter.
- C. As plants actively transport water through their vasculature, weaker hydrogen bonds would have no effect on plant height.
- D. As hydrogen bonds cause water to stick to the sides of plant vasculature, plants would be able to grow taller.
- E. As hydrogen bonds increase the amount of sugar that plants can transport through their vasculature, plants would be able to grow taller.

ANSWER: B

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.8, 2.11

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

93. Water readily dissolves compounds that are referred to as _____.

A. hydrophobic

B. solvent

C. nonpolar

D. hydrophilic

E. aqueous

ANSWER: D

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.9

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

94. The tendency of nonpolar molecules to self-associate in water instead of dissolve individually is called the hydrophobic effect.

A. true

B. false

ANSWER: A

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.8

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

95. Which one of the following statements about pH is incorrect?

A. An acidic solution has a higher concentration of protons than of hydroxide ions.

B. Physiological pH is defined as the pH of pure water, 7.0.

- C. Some cellular compartments have different pH values than others.
- D. The pH of a solution can range from 0 to 14.
- E. A solution of pH 5 has a proton concentration 100 times greater than a solution of pH 7.

ANSWER: B

Chapter: 2

Core concept: 2.3

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

96. Some species of insects are able to walk across liquid water because:

- A. of the high surface tension of water due to the hydrophobic effect.
- B. insects have a low center of gravity.
- C. of the higher density of liquid water compared to solid water.
- D. water has high surface tension due to ionic bonding.
- E. of the high surface tension of water due to its cohesion.

ANSWER: E

Chapter: 2

Core concept: 2.3

Connections: Fig. 2.8, 2.11

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

97. Which of the following ranks the elements carbon, sodium, calcium, and iodine in order of decreasing number of electrons?

- A. $C \rightarrow Na \rightarrow Ca \rightarrow I$
- B. $I \rightarrow Ca \rightarrow Na \rightarrow C$
- C. $I \rightarrow C \rightarrow Ca \rightarrow Na$
- D. $C \rightarrow Ca \rightarrow Na \rightarrow I$

ANSWER: B

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which they are found on the table.

98. Rank the elements carbon, sodium, calcium, and iodine in order of decreasing number of electrons.

ANSWER: I, Ca, Na, C

Chapter: 2

Core concept: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Connections: Fig. 2.3, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which they are found on the table.

99. Which of the following ranks the elements carbon, sodium, calcium, and iodine in order of decreasing abundance in living organisms?

A. $C \rightarrow a \rightarrow Ca \rightarrow I$

B. $I \rightarrow Ca \rightarrow Na \rightarrow C$

C. $I \rightarrow C \rightarrow Ca \rightarrow Na$

D. $C \rightarrow Ca \rightarrow Na \rightarrow I$

ANSWER: D

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which they are found on the table.

100. Rank the elements carbon, sodium, calcium, and iodine in order of greatest abundance in living organisms.

ANSWER: C, Ca, Na, I

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which they are found on the table.

101. Rank the elements carbon, phosphorus, calcium, and iodine in order of decreasing number of electrons.

A. $C \rightarrow P \rightarrow Ca \rightarrow I$

B. $I \rightarrow Ca \rightarrow P \rightarrow C$

C. $I \rightarrow P \rightarrow C \rightarrow Ca$

D. $C \rightarrow P \rightarrow Ca \rightarrow I$

ANSWER: B

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which the element is found on the table.

102. Rank the elements carbon, phosphorus, calcium, and iodine in order of decreasing number of electrons.

ANSWER: $I \rightarrow Ca \rightarrow P \rightarrow C$

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Cognitive level: LOC

Bloom's level: understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which the element is found on the table.

103. Rank the elements carbon, phosphorus, calcium, and iodine in order of greatest abundance in living organisms.

A. $C \rightarrow P \rightarrow Ca \rightarrow I$

B. $I \rightarrow Ca \rightarrow P \rightarrow C$

C. $I \rightarrow P \rightarrow C \rightarrow Ca$

D. $C \rightarrow P \rightarrow Ca \rightarrow I$

ANSWER: D

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which the element is found on the table.

104. Rank the elements carbon, phosphorus, calcium, and iodine in order of greatest abundance in living organisms.

ANSWER: $C \rightarrow P \rightarrow Ca \rightarrow I$

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which the element is found on the table.

105. Single covalent bonds between carbon atoms:

- A. allow free rotation of the carbon atoms around the bond.
- B. are strong enough to support long chains of carbon atoms.
- C. allow a molecule to twist and turn into many different arrangements.
- D. All of these choices are correct.

ANSWER: D

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.6, 2.13, 2.14

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

106. Three carbon atoms are linked by single covalent bonds such that they form the shape of a V. All of the unshared electrons form covalent bonds with hydrogen. How many hydrogen atoms does this molecule contain?

- A. 2
- B. 4
- C. 6
- D. 8
- E. 10

ANSWER: D

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.14

Cognitive level: HOC

Bloom's level: Applying

Level of difficulty: Medium

Setting: Exam

107. Which of the following ranks the elements carbon, sodium, calcium, and iodine in order of decreasing number of protons?

- A. $C \rightarrow Na \rightarrow Ca \rightarrow I$

- B. $I \rightarrow Ca \rightarrow Na \rightarrow C$
C. $I \rightarrow C \rightarrow Ca \rightarrow Na$
D. $C \rightarrow Ca \rightarrow Na \rightarrow I$

ANSWER: B

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Connections: Fig. 2.3, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Homework

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which they are found on the table.

108. Rank the elements carbon, sodium, calcium, and iodine in order of decreasing number of protons.

ANSWER: I, Ca, Na, C

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Homework

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which they are found on the table.

109. Rank the elements carbon, phosphorus, calcium, and iodine in order of decreasing number of protons.

- A. $C \rightarrow P \rightarrow Ca \rightarrow I$
B. $I \rightarrow Ca \rightarrow P \rightarrow C$
C. $I \rightarrow P \rightarrow C \rightarrow Ca$
D. $C \rightarrow P \rightarrow Ca \rightarrow I$

ANSWER: B

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Homework

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which they are found on the table.

110. Rank the elements carbon, phosphorus, calcium, and iodine in order of decreasing number of protons.

ANSWER: I→Ca→P→C

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Homework

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which the element is found on the table.

111. The structural diversity of carbon-based molecules is determined by which of the following properties?

- A. the ability of carbon to form four covalent bonds
- B. the ability of those bonds to rotate freely
- C. the orientation of those bonds in the form of a tetrahedron
- D. All of these choices are correct.

ANSWER: D

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.4, 2.6, 2.13

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Homework

112. Which one of the following statements about a carbon-carbon double bond is correct?

- A. Each of the two carbons is capable of bonding to three other atoms.
- B. The double bond allows free rotation of the molecule at the bond position.
- C. The double bond is longer than a corresponding carbon-carbon single bond.
- D. Double bonds are often found in cyclical structures.
- E. None of the other answer options is correct.

ANSWER: D

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.15

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Homework

113. Which of the following correctly lists the five most abundant elements found in living organisms?

- A. carbon, hydrogen, oxygen, nitrogen, phosphorus
- B. sodium, carbon, oxygen, nitrogen, phosphorus
- C. magnesium, carbon, hydrogen, oxygen, nitrogen
- D. carbon, hydrogen, oxygen, nitrogen, iron

ANSWER: A

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: In-class

114. List the five most abundant elements found in living organisms. For each of the following, indicate the biologically important molecules in which they are most important.

ANSWER:

carbon – all macromolecules

hydrogen – all macromolecules

oxygen – all macromolecules

nitrogen – proteins and nucleic acids

phosphorus – nucleic acids and some lipids (phospholipids)

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.12
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Medium
Setting: In-class

115. Which of the following ranks the elements carbon, sodium, calcium, and iodine in order of decreasing number of valence electrons?

- A. $C \rightarrow Na \rightarrow Ca \rightarrow I$
- B. $I \rightarrow Ca \rightarrow Na \rightarrow C$
- C. $I \rightarrow C \rightarrow Ca \rightarrow Na$
- D. $C \rightarrow Ca \rightarrow Na \rightarrow I$

ANSWER: C

Chapter: 2
Core concepts: 2.1, 2.4
Connections: Fig. 2.1, 2.3, 2.4, 2.12
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Medium
Setting: In-class

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which they are found on the table.

116. Rank the elements carbon, sodium, calcium, and iodine in order of decreasing number of valence electrons.

ANSWER: I, C, Ca, Na

Chapter: 2
Core concepts: 2.1, 2.4
Connections: Fig. 2.1, 2.3, 2.4, 2.12
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Medium
Setting: In-class

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which they are found on the table.

117. Which of the following ranks the elements carbon, sodium, calcium, and iodine in order of decreasing number of energy shells/levels?

- A. $C \rightarrow Na \rightarrow Ca \rightarrow I$
- B. $I \rightarrow Ca \rightarrow Na \rightarrow C$
- C. $I \rightarrow C \rightarrow Ca \rightarrow Na$
- D. $C \rightarrow Ca \rightarrow N \rightarrow I$

ANSWER: B

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: In-class

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which they are found on the table.

118. Rank the elements carbon, sodium, calcium, and iodine in order of decreasing number of energy shells/levels.

ANSWER: I, Ca, Na, C

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: In-class

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which they are found on the table.

119. Rank the elements carbon, phosphorus, calcium, and iodine in order of decreasing number of valence electrons.

- A. $C \rightarrow P \rightarrow Ca \rightarrow I$
- B. $I \rightarrow Ca \rightarrow P \rightarrow C$
- C. $I \rightarrow P \rightarrow C \rightarrow Ca$
- D. $C \rightarrow P \rightarrow Ca \rightarrow I$

ANSWER: C

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: In-class

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which the element is found on the table.

120. Rank the elements carbon, phosphorus, calcium, and iodine in order of decreasing number of valence electrons.

ANSWER: $I \rightarrow P \rightarrow C \rightarrow Ca$

Chapter: 2

Core concepts: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: In-class

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which the element is found on the table.

121. Rank the elements carbon, phosphorus, calcium, and iodine in order of decreasing number of energy shells/levels.

A. $C \rightarrow P \rightarrow Ca \rightarrow I$

B. $I \rightarrow Ca \rightarrow P \rightarrow C$

C. $I \rightarrow P \rightarrow C \rightarrow Ca$

D. $C \rightarrow P \rightarrow Ca \rightarrow I$

ANSWER: B

Chapter: 2

Core concept: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: In-class

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which the element is found on the table.

122. Rank the elements carbon, phosphorus, calcium, and iodine in order of decreasing number of energy shells/levels.

ANSWER: I→Ca→P→C

Chapter: 2

Core concept: 2.1, 2.4

Connections: Fig. 2.1, 2.3, 2.4, 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: In-class

Instructional guidance: This question provides practice using the periodic table to discern structural differences between the elements. Students work with the periodic table to learn how atomic structure relates to position within a period and group. Students will discover that valence number is not dependent on a period but instead on a group. They will discover that the number of protons and electrons **are** related to the row, or period, in which the element is found on the table.

123. Which one of the following elements is found in every organic molecule?

- A. carbon
- B. phosphorus
- C. nitrogen
- D. oxygen
- E. sulfur

ANSWER: A

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.6

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

124. Isomers are defined as:

- A. elements with the same number of electrons in the outer shell.
- B. molecules with the same chemical formula but different structures.
- C. atoms with the same number of protons but different numbers of neutrons.
- D. molecules with the same general three-dimensional structures but different chemical formulas.
- E. molecules with different chemical formulas but similar biological functions.

ANSWER: B

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.16

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Pre-class

125. _____ are molecules with identical chemical formulas but different three-dimensional structures.

ANSWER: Isomers

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.16

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

126. Organic molecules are those molecules that contain _____.

ANSWER: carbon

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.14

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

127. Consider the following two statements about structural representations of molecules, and select the correct response.

1. In a ring structure, an unlabeled atom at the angle where two lines join is assumed to be a carbon atom.

2. Unlabeled atoms joined to carbon atoms, which are not directly part of a ring structure, are assumed to be oxygen atoms.

- A. Statements 1 and 2 are both true.
- B. Statements 1 and 2 are both false.
- C. Statement 1 is true; statement 2 is false.
- D. Statement 1 is false; statement 2 is true.

ANSWER: C

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.14

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Pre-class

128. Which one of the following statements about carbon is correct?

- A. Each of carbon's three valence electrons shares a bond with another atom.
- B. Carbon-carbon single bonds allow for free rotation around the bond; carbon-carbon double bonds do not allow for free rotation around the bond.
- C. The spatial orientation of carbon's bonds results in a carbon atom resting in the center of a three-dimensional structure referred to as a hexahedron.
- D. Carbon is not only the most abundant element on Earth, but it is believed to be the most abundant element in the universe.
- E. Single bonds between carbon atoms are typically shorter than double bonds between carbon atoms.

ANSWER: B

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.15

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Pre-class

129. Earth's elemental composition is a good reflection of the elemental composition of the universe.

- A. true
- B. false

ANSWER: B

Chapter: 2

Core concept: 2.4
Cognitive level: LOC
Bloom's level: Remembering
Level of difficulty: Easy
Setting: Pre-class

130. Humans are often referred to as “carbon-based” life forms. Given that humans breathe oxygen, shouldn't humans be referred to as “oxygen-based” life forms?

- A. Yes, because oxygen is the most abundant element in human cells, not carbon.
- B. Yes, because humans inhale oxygen.
- C. No, because carbon is the most abundant element in human cells, not oxygen.
- D. No, because humans exhale carbon dioxide.
- E. No, because oxygen is not an organic molecule.

ANSWER: C
Chapter: 2
Core concept: 2.4
Connections: Fig. 2.12
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Easy
Setting: Pre-class

131. Recall that a carbon atom behaves as if it possesses four valence electrons. Given this information, what is the most likely structural formula for carbon dioxide (CO₂)?

- A. O—C—O
- B. O=C=O
- C. O=C—O
- D. O—C=O

ANSWER: B
Chapter: 2
Core concept: 2.4
Connections: Fig. 2.6, 2.13
Cognitive level: LOC
Bloom's level: Applying
Level of difficulty: Medium
Setting: Pre-class

132. What unique property of carbon enables this element to be “life's chemical backbone”?

- A. Carbon can form double bonds.
- B. Carbon has four electrons.
- C. Carbon behaves as if it has four valence electrons.

- D. Carbon can form double or single bonds.
- E. Carbon is the most abundant element in the universe.

ANSWER: C

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.4, 2.6

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

133. Could silicon-based life ever exist within the universe?

- A. Yes, although it is unlikely given the interaction between silicon and oxygen.
- B. Yes, because silicon is in the same family as carbon, and these elements have similar properties.
- C. No, because silicon has a different atomic number than carbon, and these elements have dissimilar properties.
- D. No, because silicon is remarkably rare in the universe.
- E. Yes, because silicon is in the same family as carbon, and these elements have similar properties, although it is unlikely given the interaction between silicon and oxygen.

ANSWER: E

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.3

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

134. Imagine that you have a (simplified) structural diagram of an organic molecule depicted as $\backslash\backslash\backslash$, with no letters included. What can you deduce?

- A. The molecule is composed of carbon only.
- B. The molecule is composed of hydrogen only.
- C. The molecule may contain any element and needs to be labeled.
- D. The molecule contains only carbon and hydrogen.
- E. The molecule contains only oxygen and carbon.

ANSWER: D

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.14

Cognitive level: LOC

Bloom's level: Understanding
Level of difficulty: Easy
Setting: Pre-class

135. Which of the following molecules is classified as an organic molecule?

- A. NH_3 (ammonia)
- B. H_2O (water)
- C. NaCl (sodium chloride or salt)
- D. O_2 (oxygen gas)
- E. None of the other answer options is correct.

ANSWER: E

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.14

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Pre-class

136. An organic molecule **must** contain which of the following elements?

- A. oxygen
- B. helium
- C. carbon
- D. nitrogen
- E. phosphorous

ANSWER: C

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.14

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

137. Recall that isoleucine and leucine can both be written as $\text{C}_6\text{H}_{13}\text{O}_2\text{N}_1$; however, the structures of these two molecules are not identical (Fig. 2.16). Thus, isoleucine and leucine are:

- A. polar molecules.
- B. isotopes.
- C. isomers.
- D. reactants.
- E. proteins.

**Chemical
formula**

**C₆H₁₃O₂N₁
Isoleucine**

**C₆H₁₃O₂N₁
Leucine**

**Structural
formula**

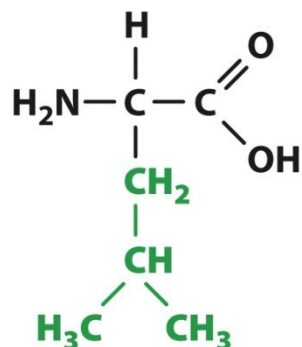
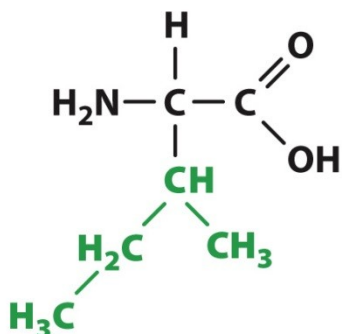


Figure 2.16
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ANSWER: C

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.16

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

138. Which of the following statements is true regarding carbon?

- A. Carbon atoms can only form single covalent bonds with other carbon atoms.
- B. Double bonds that form between carbon atoms are only found in "ring" molecules.
- C. Isomers of carbon-containing compounds always have the same structure but different chemical formulas.
- D. When a carbon atom forms a molecule, it acquires four dumbbell-shaped orbitals.
- E. None of the other answer options is correct.

ANSWER: E

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.14, 2.15, 2.16

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

139. Imagine that a few centuries from now, scientists discover life on a new planet. This life will most likely be based on:

- A. silicon.
- B. magnesium.
- C. oxygen.
- D. carbon.
- E. None of the other answer options is correct.

ANSWER: D

Chapter: 2

Core concept: 2.4

Connections: Fig. 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

140. Because of hydrogen bonding, water is uniquely suited for its central role in life. Many hydrophilic molecules interact freely with water, but a number of hydrophobic molecules are important for life, too. How does the interaction between water and hydrophobic molecules help to organize biological systems?

- A. Because cells are not pure water (they have many substances dissolved within them), the hydrophilic/hydrophobic effect has a limited role in biological organization.
- B. The ionic bonds between water molecules cause hydrophobic molecules to associate with each other and not with water molecules.
- C. Because water molecules preferentially associate with each other, they force hydrophobic molecules to associate with each other and not with water molecules.
- D. None of the other answer options is correct.

ANSWER: C

Chapter: 2

Core concepts: 2.3, 2.5

Connections: Fig. 2.7, 2.8, 2.11, 2.25, 2.28; Concept 5.1 (Ch. 5)

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Hard

Setting: Exam

Instructional guidance: This question assesses understanding of hydrophilic/hydrophobic interactions as an organizing principle.

141. How does the interaction between water and hydrophobic molecules help to organize biological systems?

ANSWER: Because water molecules preferentially associate with each other, they force hydrophobic molecules to associate with each other and not with water molecules.

Chapter: 2

Core concepts: 2.3, 2.5

Connections: Fig. 2.7, 2.8, 2.11, 2.25, 2.28; Concept 5.1 (Ch. 5)

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Hard

Setting: Exam

Instructional guidance: This question assesses understanding of hydrophilic/hydrophobic interactions as an organizing principle.

142. Which of the following are covalent bonds?

- A. peptide bonds
- B. glycosidic bonds
- C. phosphodiester bonds
- D. All of these choices are correct.

ANSWER: D

Chapter: 2

Core concepts: 2.2, 2.5

Connections: Fig. 2.15, 2.17, 2.18, 2.20, 2.24

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question reinforces the polymer structure of organic molecules.

143. Name the specific types of bonds that hold the monomers together in proteins, nucleic acids, and complex carbohydrates.

ANSWER:

Proteins are made of amino acids covalently bonded, with peptide bonds between the carboxyl group of one amino acid and the amino group of the next amino acid.

Nucleic acids are made of nucleotides connected via phosphodiester bonds between the sugar and phosphate groups of adjacent nucleotides.

Carbohydrates are made from monosaccharide subunits connected via glycosidic bonds between a carbon on one monosaccharide and a hydroxyl group on the other.

Chapter: 2

Core concepts: 2.2, 2.5

Connections: Fig. 2.15, 2.17, 2.18, 2.20, 2.24

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question reinforces the polymer structure of organic molecules.

144. In general, colder temperatures reduce the fluidity of the membrane, so cells will produce different molecules to maintain the proper degree of fluidity. How would the membrane change in response to colder temperatures?

- A. The amount of saturated triacylglycerols would increase.
- B. The amount of unsaturated fatty acids would increase.
- C. The length of the fatty acid side chains in the phospholipids would increase.
- D. The amount of unsaturated fatty acids would decrease.
- E. The amount of saturated triacylglycerols would decrease.

ANSWER: B

Chapter: 2

Core concepts: 2.5

Connections: Fig. 2.25, 2.26, 2.28; Concept 5.1 (Ch. 5)

Cognitive level: LOC

Bloom's level: Applying

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This is a good class discussion question.

145. If a cell is placed in a cooler environment, the fluidity of the membrane can decrease. What change could the cell make in the membrane composition to restore the normal level of fluidity?

ANSWER: The cell could increase the amount of unsaturated fatty acids in the phospholipid bilayer. Because these molecules have a bend in the chain, fewer van der Waals forces can form between them, and the cell membrane will become less rigid and more fluid.

Chapter: 2

Core concepts: 2.5

Connections: Fig. 2.25, 2.26, 2.28; Concept 5.1 (Ch. 5)

Cognitive level: LOC

Bloom's level: Applying

Level of difficulty: Hard

Setting: Exam

Instructional guidance: This is a good class discussion question.

146. Consider the structure and function of DNA. Which of the following statements is true?

- A. Because DNA contains carbohydrates, it provides structural support to the cells.
- B. The phosphodiester bonds that stabilize the association of the two strands are easily broken and reformed.
- C. If the sequence of one DNA strand is known, then the sequence of the other strand can be determined.
- D. Because DNA is made of phosphate groups that are ionized, it could easily pass through a cell membrane.

ANSWER: C

Chapter: 2

Core concepts: 2.5

Connections: Fig. 2.18, 2.19, 2.20, 2.21, 2.30; Concept 3.2 (Ch.3), Concept 5.2 (Ch.5), Concept 12.1 (Ch. 12)

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question emphasizes the basic structure of DNA.

147. If one strand of the DNA double helix is known, explain how the other strand can be determined.

ANSWER: Because the strands are held together via hydrogen bonding of the base pairs, and the pairing is always the same (A with T and G with C), then by applying the complementary base-pairing rules, one can determine the complementary strand of a known strand. For example, if the one strand is AAGCTTG, then the complement will be TTCGAAC.

Chapter: 2

Core concepts: 2.5

Connections: Fig. 2.18, 2.19, 2.20, 2.21, 2.30 Concept 3.2 (Ch. 3), Concept 5.2 (Ch. 5), 12.1 Concept (Ch. 12)

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question emphasizes the basic structure of DNA.

148. In DNA molecules, complementary base pairs always include one purine nucleotide and one pyrimidine nucleotide. In the DNA of certain bacterial cells, 16% of the nucleotides are adenine nucleotides. What are the percentages of the other nucleotides in the bacterial DNA?

- A. 16% thymine, 34% guanine, 34% cytosine
- B. 34% uracil, 16% guanine, 16% cytosine
- C. 34% thymine, 34% guanine, 16% cytosine
- D. 34% thymine, 16% guanine, 34% cytosine
- E. None of the other answer options is correct.

ANSWER: A

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.19, 2.21

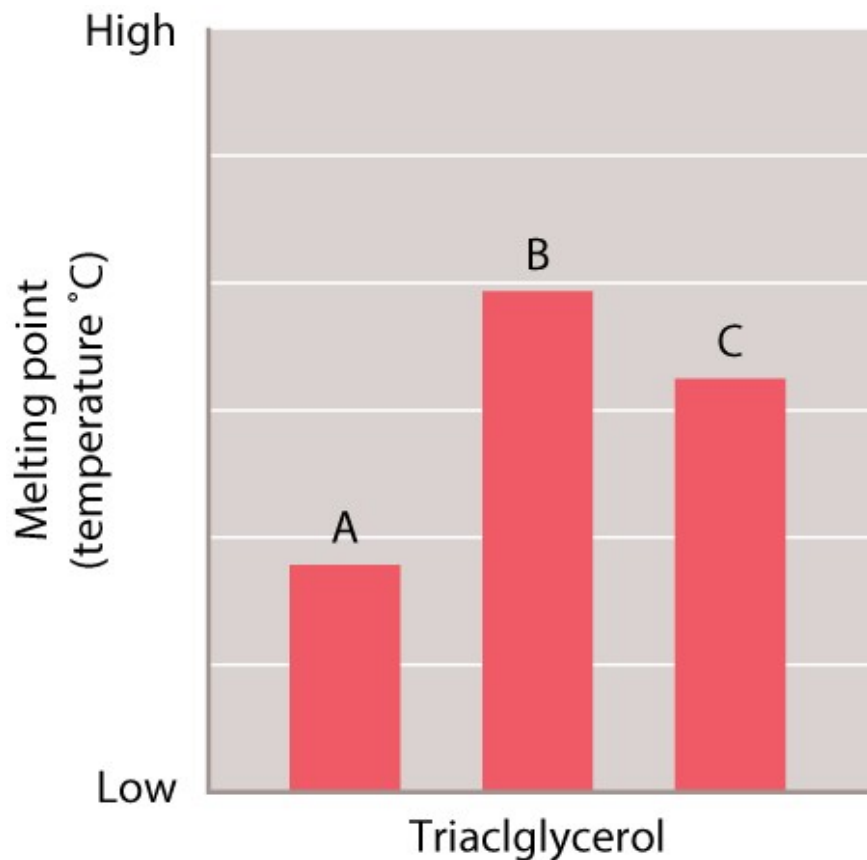
Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: Easy

Setting: Exam

149. Samples of three different triacylglycerols were tested to determine the melting point of each one. The results of the tests are shown in the graph.



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The length of the fatty acids A, B, and C is the same. Which of the three triacylglycerols is likely to have the most double bonds in the fatty acids?

- A. A
- B. B
- C. C
- D. There is no way of knowing based on the information available.

ANSWER: A

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.25, 2.26

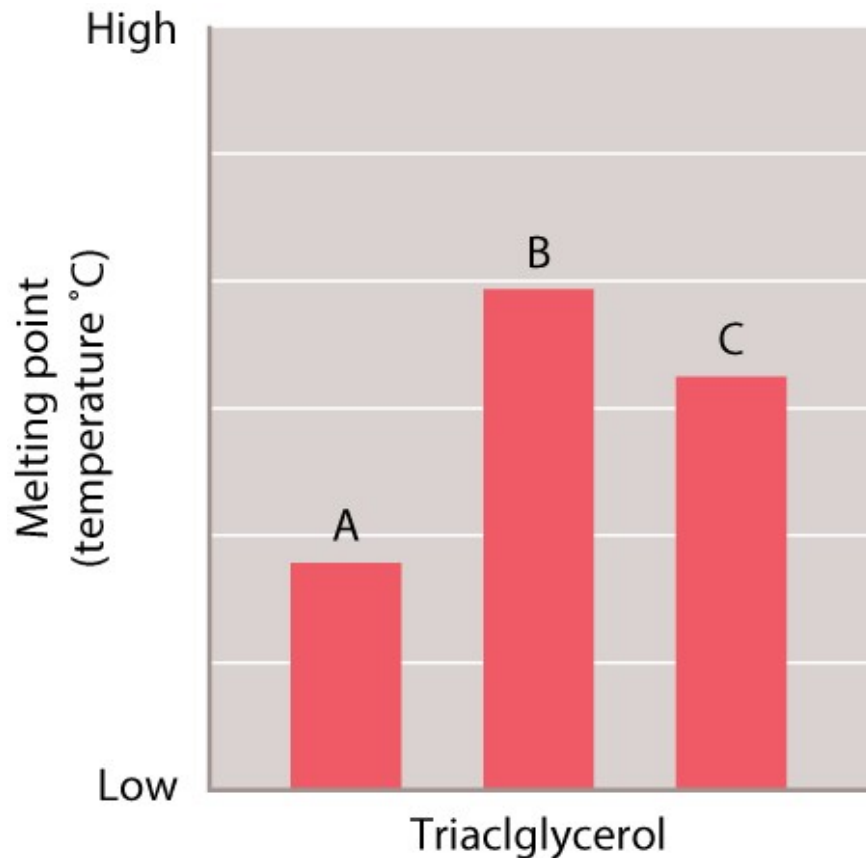
Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: Medium

Setting: Exam

150. Samples of three different triacylglycerols were tested to determine the melting point of each one. The results of the tests are shown in the graph.



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The length of the fatty acids in A, B, and C is the same. Which of the three triacylglycerols is likely to have the fewest number double bonds in the fatty acids?

- A. A
- B. B
- C. C
- D. There is no way of knowing based on the information available.

ANSWER: B

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.25, 2.26

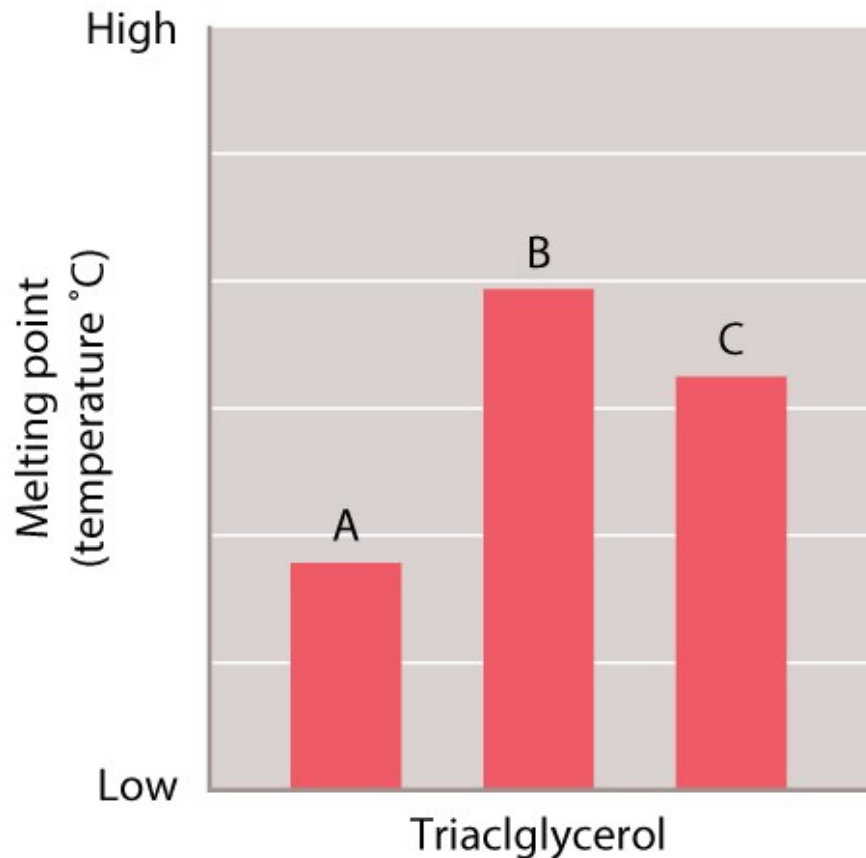
Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: Medium

Setting: Exam

151. Samples of three different triacylglycerols were tested to determine the melting point of each one. The results of the tests are shown in the graph.



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The length of the fatty acids in A, B, and C is the same. Which of the three fatty acids is likely to have the most saturated fatty acids?

- A. A
- B. B
- C. C
- D. There is no way of knowing based on the information available.

ANSWER: B

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.25, 2.26

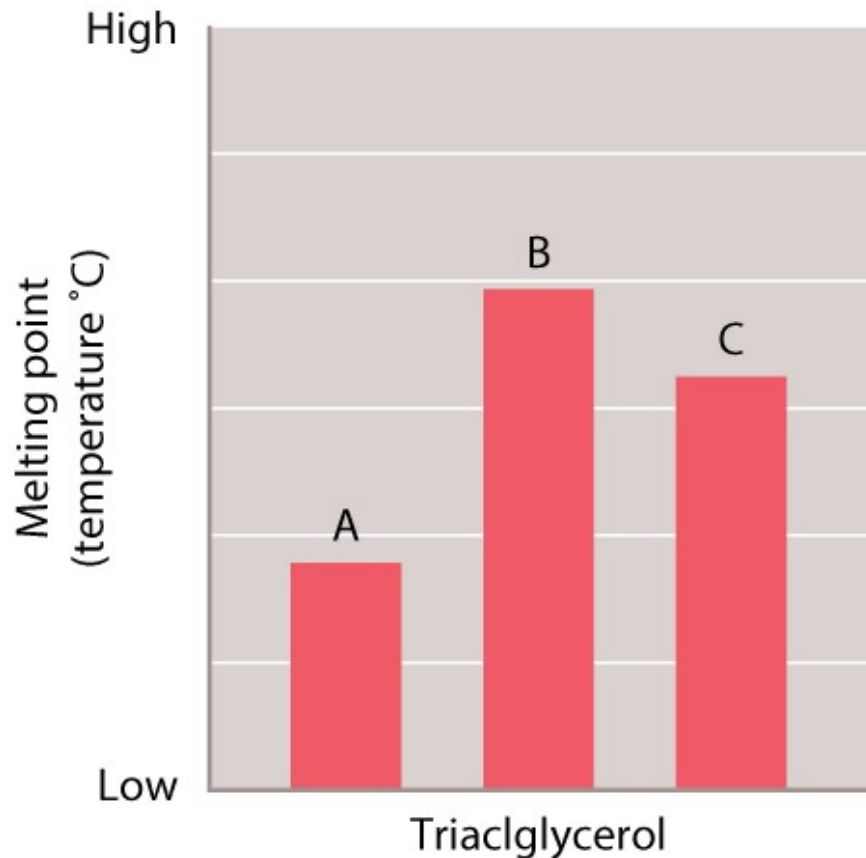
Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: Medium

Setting: Exam

152. Samples of three different triacylglycerols were tested to determine the melting point of each one. The results of the tests are shown in the graph.



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The length of the fatty acids in A, B, and C is the same. Which of the three fatty acids is likely to have the most unsaturated fatty acids?

- A. A
- B. B
- C. C
- D. There is no way of knowing based on the information available.

ANSWER: A

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.25, 2.26

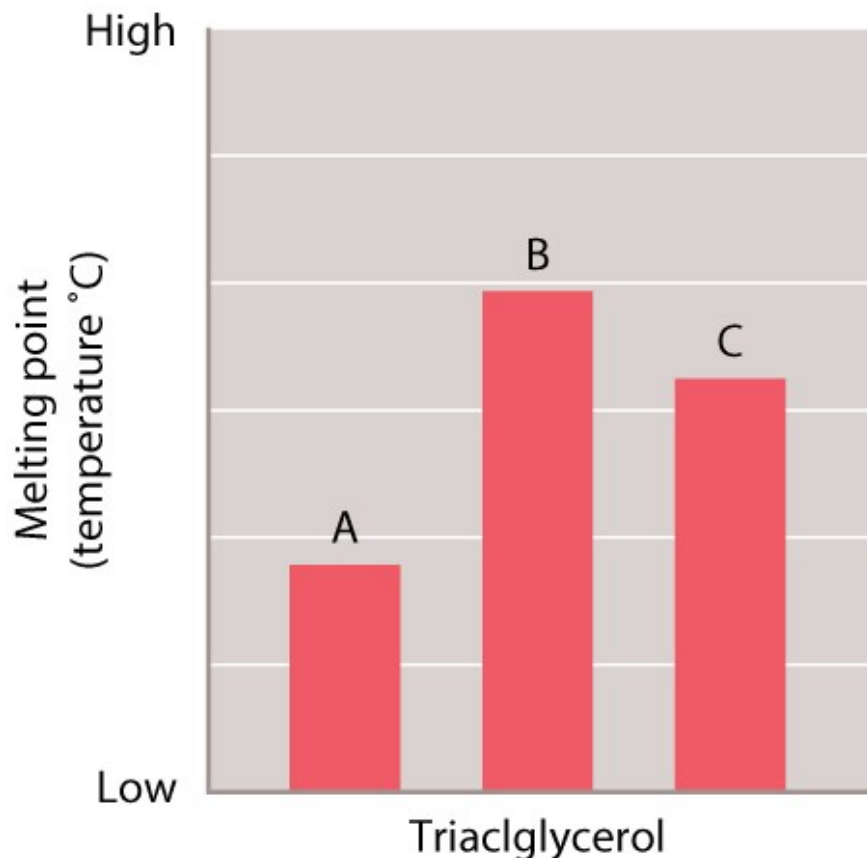
Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: Medium

Setting: Exam

153. Samples of three different triacylglycerols were tested to determine the melting point of each one. The results of the tests are shown in the graph.



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The number of double bonds in each of the fatty acids A, B, and C is the same. Which of the three triacylglycerols is likely to have the fatty acids with the longest hydrocarbon chains?

- A. A
- B. B
- C. C
- D. There is no way of knowing based on the information available.

ANSWER: B

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.25, 2.26

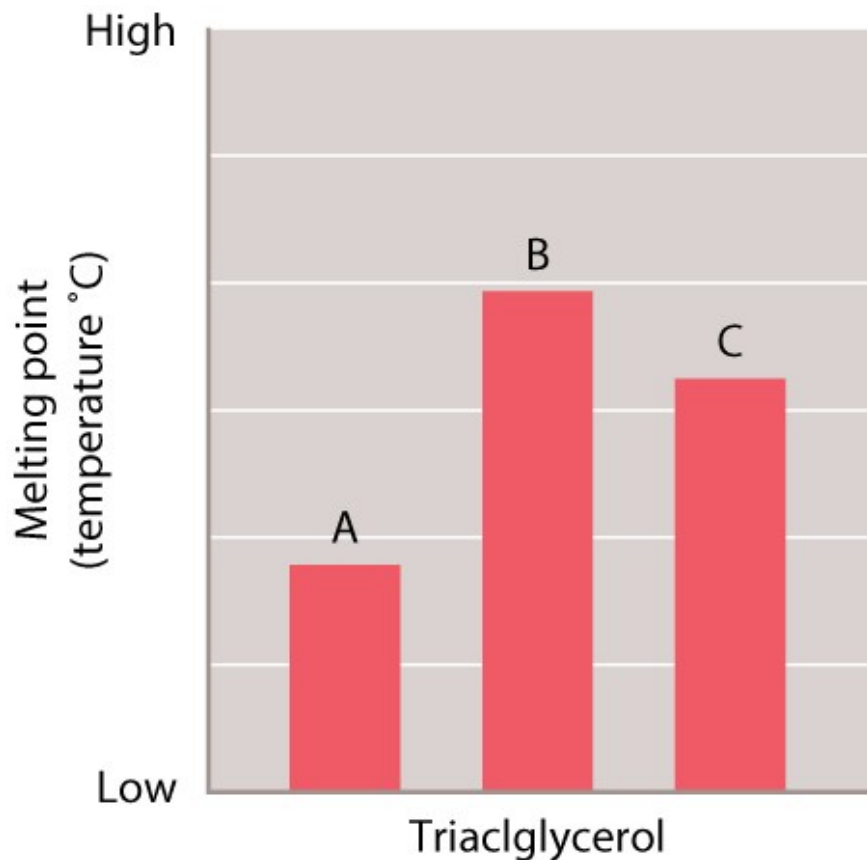
Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: Medium

Setting: Exam

154. Samples of three different triacylglycerols were tested to determine the melting point of each one. The results of the tests are shown in the graph.



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The number of double bonds in each of the fatty acids in A, B, and C is the same. Which of the three triacylglycerols is likely to have the fatty acids with the shortest hydrocarbon chains?

- A. A
- B. B
- C. C
- D. There is no way of knowing based on the information available.

ANSWER: A

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.25, 2.26

Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: Medium

Setting: Exam

155. How many hydrogen atoms are present in a hydrocarbon chain of five carbon atoms with one double bond and the rest single bonds?

- A. 6
- B. 8
- C. 10
- D. 12

ANSWER: C

Chapter: 2

Core concepts: 2.2, 2.4, 2.5

Connections: Fig. 2.14, 2.15

Cognitive level: HOC

Bloom's level: Evaluating

Level of difficulty: Hard

Setting: Exam

Instructional guidance: Students will need to apply what they know about carbon atoms and covalent bonds. They will need to evaluate the information given to them, and perhaps draw the structural formulas to find the correct answers to these problems. Suggest that students draw simple structural formulas to determine the answer to these problems.

156. How many hydrogen atoms are present in a hydrocarbon chain of five carbon atoms with two double bonds and two single bonds?

- A. 6
- B. 8
- C. 10
- D. 12

ANSWER: B

Chapter: 2

Core concepts: 2.2, 2.4, 2.5

Connections: Fig. 2.14, 2.15

Cognitive level: HOC

Bloom's level: Evaluating

Level of difficulty: Hard

Setting: Exam

Instructional guidance: Students will need to apply what they know about carbon atoms and covalent bonds. They will need to evaluate the information given to them, and perhaps draw the structural formulas to find the correct answers to these problems. Suggest that students draw simple structural formulas to determine the answer to these problems.

157. How many hydrogen atoms are present in a five-carbon hydrocarbon molecule with four of the carbons linked by a single covalent bond, and with the fifth carbon attached by a single bond as a branch to the second carbon in the chain?

- A. 6
- B. 8
- C. 10
- D. 12

ANSWER: C

Chapter: 2

Core concepts: 2.2, 2.4, 2.5

Connections: Fig. 2.14, 2.15

Cognitive level: HOC

Bloom's level: Evaluating

Level of difficulty: Hard

Setting: Exam

Instructional guidance: Students will need to apply what they know about carbon atoms and covalent bonds. They will need to evaluate the information given to them, and perhaps draw the structural formulas to find the correct answers to these problems. Suggest that students draw simple structural formulas to determine the answer to these problems.

158. How many hydrogen atoms are present in a ring of six carbon atoms held together by alternating single and double bonds?

- A. 6
- B. 8
- C. 10
- D. 12

ANSWER: A

Chapter: 2

Core concepts: 2.2, 2.4, 2.5

Connections: Fig. 2.14, 2.15

Cognitive level: HOC

Bloom's level: Evaluating

Level of difficulty: Hard

Setting: Exam

Instructional guidance: Students will need to apply what they know about carbon atoms and covalent bonds. They will need to evaluate the information given to them, and perhaps draw the structural formulas to find the correct answers to these problems. Suggest that students draw simple structural formulas to determine the answer to these problems.

159. What important feature(s) of noncovalent bonds make(s) them so important to life?

- A. They are strong in a cellular environment that holds atoms together tightly.
- B. They are weak in a cellular environment, so they can be made, broken, and reformed easily.
- C. They can only occur in cells.
- D. None of the other answer options is correct.

ANSWER: B

Chapter: 2

Core concepts: 2.2, 2.3, 2.5

Connections: Fig. 2.7, 2.9; Concept 3.2 (Ch. 3)

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question emphasizes the importance of the “weak” characteristic of noncovalent bonds. This question will be useful for similar discussions when working with Chapters 3, 4, 12, and 14, among others.

160. What important feature(s) of noncovalent bonds make(s) them so important to life?

ANSWER: They are weak in a cellular environment so they can be made, broken, and reformed easily.

Chapter: 2

Core concepts: 2.2, 2.3, 2.5

Connections: Fig. 2.7, 2.9; Concept 3.2 (Ch. 3)

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This question emphasizes the importance of the “weak” characteristic of noncovalent bonds. This question will be useful for similar discussions when working with Chapters 3, 4, 12, and 14, among others.

161. Peptide bonds are characteristic of:

- A. nucleic acids.
- B. carbohydrates.
- C. lipids.
- D. fatty acids.
- E. proteins.

ANSWER: E

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.17

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Exam

162. Pyrimidine and purine bases are found in:

- A. nucleic acids.
- B. carbohydrates.
- C. lipids.
- D. fatty acids.
- E. proteins.

ANSWER: A

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.19

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Exam

163. Aldoses and ketoses are examples of:

- A. nucleic acids.
- B. carbohydrates.
- C. lipids.
- D. fatty acids.
- E. proteins.

ANSWER: B

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.22

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Exam

164. An unsaturated fatty acid contains:

- A. only carbon and hydrogen.
- B. only single covalent bonds between carbon atoms.
- C. one or more double bonds between carbon atoms.
- D. one or more double bonds between hydrogen atoms.

ANSWER: C

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.25

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Exam

165. A phosphodiester bond is formed between:

- A. a fatty acid and a glycerol molecule.
- B. two amino acids.
- C. a base and a sugar.
- D. a 3' phosphate and a 5' hydroxyl group.
- E. a 5' phosphate and a 3' hydroxyl group.

ANSWER: E

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.20

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Hard

Setting: Exam

166. Which one of the following components of an amino acid differs from one amino acid to another?

- A. the α -carbon atom
- B. the carboxyl group
- C. the side chain
- D. the amino group
- E. the hydrogen atom opposite the R group

ANSWER: C

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.17

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Exam

167. A How many hydrogen atoms are present in a hydrocarbon chain of five carbons joined to each other by single covalent bonds?

- A. 6
- B. 8
- C. 10
- D. 12

ANSWER: D

Chapter: 2

Core concepts: 2.2, 2.4, 2.5

Connections: Fig. 2.14, 2.15

Cognitive level: HOC

Bloom's level: Applying

Level of difficulty: Hard

Setting: Homework

Instructional guidance: Students will need to apply what they know about carbon atoms and covalent bonds. They will need to evaluate the information given to them, and perhaps draw the structural formulas to find the correct answers to these problems. Suggest that students draw simple structural formulas to determine the answer to these problems.

168. How many hydrogen atoms are present in a hydrocarbon chain of eight carbon atoms with three double bonds and the rest single bonds?

A. 10

B. 12

C. 14

D. 16

ANSWER: B

Chapter: 2

Core concepts: 2.4, 2.2, 2.5

Connections: Fig. 2.14, 2.15

Cognitive level: HOC

Bloom's level: Applying

Level of difficulty: Hard

Setting: Homework

Instructional guidance: Students will need to apply what they know about carbon atoms and covalent bonds. They will need to evaluate the information given to them, and perhaps draw the structural formulas to find the correct answers to these problems. Suggest that students draw simple structural formulas to determine the answer to these problems.

169. Which one of the following is a pyrimidine found in DNA?

A. adenine

B. guanine

C. uracil

D. thymine

E. None of the other answer options is correct

ANSWER: D

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.19

Cognitive level: LOC

Bloom's level: Remembering
Level of difficulty: Medium
Setting: Homework

170. _____ are the subunits of nucleic acids, and _____ are the subunits of proteins.

- A. Nucleotides; amino acids
- B. Bases; polypeptides
- C. Polypeptides; sugars
- D. Amino acids; nucleic bases
- E. Nucleoli; amino acids

ANSWER: A

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.17, 2.18

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Homework

171. Carbohydrates and proteins are two types of macromolecules. Which functional characteristic of proteins distinguishes them from carbohydrates?

- A. tendency to make cell membranes hydrophobic
- B. efficient storage of usable chemical energy
- C. ability to catalyze biochemical reactions
- D. large amount of stored information
- E. None of the other answer options is correct.

ANSWER: C

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.17

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Homework

172. Which one of the following most accurately describes the ratio of oxygen to carbon to hydrogen in a simple 6-carbon sugar such as glucose?

- A. 1:2:1
- B. 1:1:2
- C. 2:1:1
- D. 1:2:3

E. 1:3:2

ANSWER: B

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.22

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Hard

Setting: Homework

173. Sucrose is composed of:

- A. two ketose sugars.
- B. a six-carbon sugar and a five-carbon sugar.
- C. a simple sugar and a nucleotide.
- D. an aldose and a ketose.
- E. glycerol and three fatty acids.

ANSWER: D

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.22

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Hard

Setting: Homework

174. Which one of the following biological polymers is defined by a physical property instead of a chemical structure?

- A. proteins
- B. lipids
- C. monosaccharides
- D. nucleic acids
- E. polysaccharides

ANSWER: B

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.25

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Homework

175. Which one of the following types of fatty acids would be likely to have the lowest melting temperature?

- A. long tails and low saturation
- B. long tails and high saturation
- C. short tails and low saturation
- D. short tails and high saturation
- E. All fatty acids have the same melting temperature, regardless of tail length or level of saturation.

ANSWER: C

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.25, 2.26

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Hard

Setting: Homework

176. Which one of the following types of fatty acids would be likely to participate in the highest number of van der Waals forces with other fatty acids? Fatty acids with:

- A. long tails and low saturation.
- B. long tails and high saturation.
- C. short tails and low saturation.
- D. short tails and high saturation.

ANSWER: B

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.26

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Hard

Setting: Homework

177. Helicase is an enzyme that separates the double helix of the DNA into two separate strands. How do you think helicase does this?

- A. by breaking hydrogen bonds
- B. by breaking phosphodiester bonds
- C. by breaking peptide bonds
- D. by breaking ionic bonds

ANSWER: A

Chapter: 2

Core concept: 2.5
Connections: Fig. 2.21
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Easy
Setting: In-class

178. You spill a little bit of olive oil on your hands. You wash off the oil with soap and water. How does the soap get the oil off your hands?

- A. The hydrophilic part of soap interacts with the oil and sequesters it.
- B. The hydrophobic part of soap interacts with the oil and sequesters it.
- C. The soap dissolves the oil.
- D. The soap makes the water and oil interact in such a way that it dissolves the oil.

ANSWER: B
Chapter: 2
Core concepts: 2.3, 2.5
Cognitive level: LOC
Bloom's level: Applying
Level of difficulty: Difficult
Setting: In-class

Instructional guidance: There is no mention made in the chapter of how detergents work, so this question will be difficult for many students. This question would be useful to prompt discussion of how detergents work and introduce the existence and behavior of amphipathic molecules.

179. Two of the main ingredients in plant fertilizer are phosphorus and nitrogen. These elements are required for the synthesis of _____ in the cells of the plants.

- A. DNA and proteins
- B. proteins and complex carbohydrates
- C. complex carbohydrates and DNA

ANSWER: A
Chapter: 2
Core concept: 2.4, 2.5
Connections: Fig. 2.12
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Medium
Setting: In-class

Instructional guidance: This question can help make chemistry relevant to biology. Students will discover **why** components of common fertilizer are important to living organisms. They will see precisely where these elements are needed in biologically important molecules.

180. Two of the main ingredients in most plant fertilizers are phosphorus and nitrogen. Why are these elements so important for the growth of a plant?

ANSWER: Phosphorus is required for nucleic acid synthesis, and nitrogen is required for both nucleic acid and protein synthesis.

Core concepts: 2.4, 2.5

Connections: Fig. 2.12

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: In-class

Instructional guidance: This question can help make chemistry relevant to biology. Students will discover **why** components of common fertilizer are important to living organisms. They will see precisely where these elements are needed in biologically important molecules.

181. As part of their normal function, many proteins bind to DNA briefly and then release it again. Which types of bonds might be involved in these transient protein-DNA interactions? Select all answers that apply.

A. hydrogen

B. ionic

C. covalent

D. van der Waals forces

ANSWER: A, B, and D

Chapter: 2

Core concepts: 2.2, 2.4, 2.5

Connections: Fig. 2.8, 2.20; Ch. 3, 4, 12, 14

Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: Medium

Setting: In-class

Instructional guidance: This question is an in-class question because there is not enough information in Chapter 2 to enable students to work through the question successfully on their own. This question is good for class discussion or group work and discussion; the example in the stem could be changed to any molecular interaction. It will be useful for similar discussions when working with Chapters 3, 4, 12, and 14, among others.

182. Which types of bonds might be involved in the following: DNA double helix, folding of a protein, protein binding to DNA, protein-protein interactions?

ANSWER: DNA double helix—covalent (phosphodiester) and hydrogen. Folding of a protein—covalent (disulfide bridge), hydrogen and ionic bonds and van der Waals forces. Protein binding to DNA—hydrogen and ionic bonds. Protein-protein interaction—hydrogen and ionic bonds and van der Waals forces.

Chapter: 2

Core concepts: 2.2, 2.4, 2.5

Connections: Fig. 2.8, 2.20; Ch. 3, 4, 12, 14

Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: Medium

Setting: In-class

Instructional guidance: This question is an in-class question because there is not enough information in Chapter 2 to enable students to work through the question successfully on their own. This question is good for class discussion or group work and discussion; the example in the stem could be changed to any molecular interaction. It will be useful for similar discussions when working with Chapters 3, 4, 12, and 14, among others.

183. Based on your knowledge of the different sorts of bonds in biological systems, describe some cellular structures or interactions that rely upon those bonds. Consider all the different bonds and as many specific examples as you can.

ANSWER:

Examples:

DNA – hydrogen bonds help hold the helix together

Protein folding – hydrogen bonds and ionic bonds

Enzyme-substrate interactions – mostly noncovalent interactions of multiple types

Molecular structure – covalent bonds hold atoms together tightly for membrane integrity

Thermophilic bacteria – extensive covalent bonds in proteins to stabilize shape

Chapter: 2

Core concepts: 2.2, 2.4, 2.5

Connections: Fig. 2.8, 2.20; Ch. 3, 4, 12, 14

Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: Medium

Setting: In-class

Instructional guidance: This question is an in-class question because there is not enough information in Chapter 2 to enable students to work through the question successfully on their own. This question is good for class discussion or group work and discussion; the example in the stem could be changed to any molecular interaction. It will be useful for similar discussions when working with Chapters 3, 4, 12, and 14, among others

184. Recall the stalactite-like slime formations oozing from cave walls in the case “The First Cell: Life's Origin” just before Chapter 2. The slimy bits hanging from the cave surface are secretions from the extremophile bacteria that live in this unusual environment and are composed of water, acids, and mucous secretions. What types of chemical bonds are likely to anchor and stabilize these long, slender strands found hanging in the caves?

A. nonpolar covalent bonds and hydrogen bonds

B. hydrogen bonds

C. hydrogen bonds and disulfide bridges

D. polar covalent bonds and hydrogen bonds

ANSWER: B

Chapter: 2

Core concepts: 2.3, 2.5, Case 1

Connections: Fig. 2.7, Case 1

Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: Medium

Setting: In-class

Instructional guidance: This question emphasizes the role of hydrogen bonds in cohesion and adhesion.

185. Recall the stalactite-like slime formations oozing from cave walls in the case “The First Cell: Life’s Origin” at the beginning of Chapter 2. The slimy bits hanging from the cave surface are secretions from the extremophile bacteria that live in this unusual environment and are composed of water, acids, and mucous secretions. How might hydrogen bonding hold the snottites together?

ANSWER: The snottites are held together by hydrogen bonding. Hydrogen bonding occurs between water molecules, between water molecules and other components of the snottite, and between water molecules and the rock surface.

Chapter: 2

Core concepts: 2.3, 2.5, Case 1

Connections: Fig. 2.7, Case 1

Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: hard

Setting: In-class

Instructional guidance: This question emphasizes the role of hydrogen bonds in cohesion and adhesion.

186. Although monosaccharides can exist in linear form, virtually all cellular monosaccharides are found in circular form.

A. true

B. false

ANSWER: A

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.23

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: In-class

187. The linkage of one amino acid to another amino acid in a protein is referred to as a(n):

- A. peptide bond.
- B. glycosidic bond.
- C. ionic bond.
- D. R group.
- E. phosphodiester bond.

ANSWER: A

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.17

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

188. Triacylglycerols are used primarily for:

- A. energy storage.
- B. information storage.
- C. cell membrane biosynthesis.
- D. biological catalysis.
- E. movement.

ANSWER: A

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.25

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

189. The class of organic molecules defined by a physical property instead of a structure is the:

- A. lipids.
- B. carbohydrates.
- C. proteins.
- D. nucleic acids.
- E. None of the other answer options is correct.

ANSWER: A

Chapter: 2

Core concept: 2.5

Cognitive level: LOC
Bloom's level: Remembering
Level of difficulty: Easy
Setting: Pre-class

190. The covalent linkage joining two amino acids together is referred to as a(n)_____ bond.

ANSWER: peptide
Chapter: 2
Core concept: 2.5
Connections: Fig. 2.17
Cognitive level: LOC
Bloom's level: Remembering
Level of difficulty: Easy
Setting: Pre-class

191. Adjacent nucleotides in an RNA chain are held together by hydrogen bonding.

- A. true
- B. false

ANSWER: B
Chapter: 2
Core concept: 2.5
Connections: Fig. 2.20
Cognitive level: LOC
Bloom's level: Remembering
Level of difficulty: Medium
Setting: Pre-class

192. Monosaccharides with an aldehyde group in their linear form are referred to as aldoses.

- A. true
- B. false

ANSWER: A
Chapter: 2
Core concept: 2.5
Connections: Fig. 2.22
Cognitive level: LOC
Bloom's level: Remembering
Level of difficulty: Medium
Setting: Pre-class

193. Fatty acids that contain no carbon-carbon double bonds are referred to as _____.

ANSWER: saturated

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.25

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Pre-class

194. Oils are triacylglycerols with a high level of unsaturated fatty acids.

A. true

B. false

ANSWER: A

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.25

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

195. Which one of the following is **not** a component of an amino acid?

A. an alpha carbon

B. an amino group

C. a carboxyl group

D. an R group

E. a phosphate group

ANSWER: E

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.17

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Pre-class

196. Which one of the following nucleotides could base pair with a pyrimidine?

A. uracil

B. cytosine

C. adenine

D. thymine

E. All of these choices are correct.

ANSWER: C

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.19, 2.21

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

197. The formation of which one of the following large organic molecules from their respective building blocks does **not** result in the release of at least one water molecule?

A. proteins

B. phospholipids

C. polysaccharides

D. nucleic acids

E. All of these choices are correct.

ANSWER: E

Chapter: 2

Core concept: 2.5

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Pre-class

198. Monosaccharides can be found in linear form, but in living organisms are much more commonly found in cyclic form.

A. true

B. false

ANSWER: A

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.22

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Pre-class

199. Which one of the following is **not** a component of a phospholipid?

A. a 3-carbon backbone such as glycerol

- B. a phosphate group
- C. two fatty acid tails
- D. a core of four fused carbon rings
- E. All of these choices are correct.

ANSWER: D

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.25, 2.27, 2.28

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Pre-class

200. Which of the following organic molecules is commonly used for energy storage?

- A. proteins and nucleic acids
- B. lipids and carbohydrates
- C. nucleic acids and lipids
- D. carbohydrates, nucleic acids, and lipids
- E. proteins, carbohydrates, and lipids

ANSWER: B

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.22, 2.23, 2.24, 2.25

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

201. Lipid bilayers spontaneously form to orient the _____ tails _____ to minimize their contact with water.

- A. hydrophilic; outside
- B. hydrophilic; inside
- C. hydrophobic; outside
- D. hydrophobic; inside

ANSWER: D

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.28

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

202. With four distinct nucleotides, how many combinations are possible in a sequence of six nucleotides?

- A. 24
- B. 64
- C. 1,296
- D. 4,096
- E. 64,000,000

ANSWER: D

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.19, 2.21

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

203. A 1,4-glycosidic linkage would refer to which one of the following?

- A. hydrogen bonding between carbon 1 and carbon 4 within a monosaccharide
- B. the covalent bond between the 1' carbon of one nucleotide and the 4' carbon of a second nucleotide
- C. the covalent bond between amino acid 1 in one protein and amino acid 4 in a second protein
- D. hydrogen bonding among the four bases in double-stranded DNA
- E. the covalent bond between carbon 1 of one monosaccharide and carbon 4 of a second monosaccharide

ANSWER: E

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.17, 2.20, 2.21, 2.24

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

204. Based on what the chapter describes about the melting temperature of fatty acids, which of the following would be likely to increase the stability of a lipid bilayer?

- A. an increase in unsaturated fatty acids
- B. an increase in saturated fatty acids
- C. a decrease in overall tail length
- D. an increase in unsaturated fatty acids and an increase in saturated fatty acids

E. an increase in saturated fatty acids and a decrease in overall tail length

ANSWER: B

Chapter: 2

Core concept: 2.5

Connections: Fig. 2.25, 2.26

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

205. Which of the following would **not** be true of the first life forms on Earth, that is, the very first primitive cells?

- A. Oxygen was required for the cells to survive.
- B. A molecule evolved as a way to store genetic information.
- C. A barrier made of organic molecules separated the "cell" from the environment.
- D. Chemical reactions evolved as a way for cells to capture energy from the environment.

ANSWER: A

Chapter: 2

Core concepts: 2.6, Case 1

Connections: Fig. 2.29, Case 1, Concept 5.1 (Ch. 5)

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This is a good discussion question.

206. Describe the three important features that would be necessary to classify the first primitive cells as true cells.

ANSWER: 1) A molecule, such as a nucleic acid, that can act as an information storage system;
2) a barrier (i.e., a lipid membrane) to encapsulate the cell and separate it from the environment;
3) biochemical reactions and pathways to meet the energy requirements of the cell.

Chapter: 2

Core concepts: 2.6, Case 1

Connections: Fig. 2.29, Case 1, Concept 5.1 (Ch. 5)

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

Instructional guidance: This is a good discussion question.

207. If you isolate a single nucleotide from a nucleic acid chain and determine that the nitrogenous ring structure is cytosine, you could say with certainty that the nucleotide may have come from:

- A. DNA but not RNA.
- B. RNA but not DNA.
- C. either DNA or RNA.
- D. neither DNA nor RNA.
- E. double-stranded DNA but not single-stranded DNA.

ANSWER: C

Chapter: 2

Core concept: 2.6

Connections: Fig. 2.19

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Exam

208. Miller and Urey's initial simulation resulted in the formation of which one of the following?

- A. DNA
- B. glucose
- C. RNA
- D. phospholipids
- E. amino acids

ANSWER: E

Chapter: 2

Core concept: 2.6

Connections: Fig. 2.29

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Homework

209. Certain meteorites have been examined and found to carry samples of which one of the following?

- A. lipids
- B. amino acids
- C. polypeptides
- D. lipids and amino acids

E. lipids, amino acids, and polypeptides

ANSWER: D

Chapter: 2

Core concept: 2.6

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Homework

210. Sutherland and colleagues demonstrated the synthesis of which one of the following under conditions thought to resemble those of early Earth?

A. nucleotides

B. amino acids

C. phospholipids

D. nucleic acid chains

E. polypeptides

ANSWER: A

Chapter: 2

Core concept: 2.6

Connections: Fig. 2.30

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: Homework

211. Imagine you were there when Stanley Miller performed his experiment to produce the building blocks of life. If Miller originally identified 5 different amino acids, how many polypeptides that are 10 amino acids long could be made from just these 5 amino acids?

A. $5 \times 10 = 50$

B. $10^5 = 100,000$

C. $5^{10} = 9,765,625$

D. The answer cannot be determined from the information provided.

ANSWER: C

Chapter: 2

Core concepts: 2.5, 2.6

Connections: Fig. 2.17; Concept 4.2 (Ch. 4)

Cognitive level: HOC

Bloom's level: Applying

Level of difficulty: Hard

Setting: In-class

Instructional guidance: This question provides a good illustration of how much diversity can result from a limited number of molecules.

212. Calculate the number of different polypeptides, each 10 amino acids long, that can be made if you start with just 5 different kinds of amino acids.

ANSWER: Any of the 5 amino acids could occupy any of the positions in the 10 amino acid long chain, creating $5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 = 5^{10}$, or 9,765,625, possible different polypeptide chains

Chapter: 2

Core concepts: 2.5, 2.6

Connections: Fig. 2.17; Concept 4.2 (Ch. 4)

Cognitive level: HOC

Bloom's level: Applying

Level of difficulty: Hard

How Setting: In-class

Instructional guidance: This question provides a good illustration of how much diversity can result from a limited number of molecules.

213. The snottites described in the case "The First Cell: Life's Origin" at the beginning of Chapter 2 are colonies of bacteria, which are extremophiles that have some unique requirements for life processes. For example, they use sulfur from the hydrogen sulfide in the environment to capture energy. Although most life forms that are familiar to you, including humans, don't use sulfur for this purpose, we do use another element to do the same thing. Which element do humans use for this energy conversion? Carefully examine the periodic table.

A. carbon

B. nitrogen

C. hydrogen

D. oxygen

ANSWER: D

Chapter: 2

Core concepts: 2.1, 2.4, 2.6, Case 1

Connections: Fig. 2.3, Case 1, Concept 1.2 (Ch.1), Concept 1.3 (Ch. 1)

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Hard

Setting: In-class

Instructional guidance: This question ties together chemistry, characteristics of life, possibly first life. It is also intended to draw students to the periodic table, where they will discover the chemical similarities between two elements in the same group (O and S; C and Si).

214. The snottites described in “The First Cell: Life’s Origin” just before Chapter 2 are colonies of bacteria, which are extremophiles that have some unique requirements for life processes. For example, they use sulfur from the hydrogen sulfide in the environment to capture energy. Although most life forms that are familiar to you, including humans, don’t use sulfur for this purpose, we do use another element to do the same thing. Using the periodic table, explain how some elements could substitute for others in biochemical reactions. For example, science fiction writers sometimes speculate that there could be silicon-based life forms on other planets, and some extremophiles on Earth, such as the snottites, use sulfur in a similar manner to how humans use oxygen.

ANSWER: Based on their position in the periodic table, we know that many elements have similar properties, particularly with regard to their bonding behaviors. If two elements appear in the same column in the periodic table, they tend to interact with other elements in the same way. Thus, because silicon can form four bonds with other atoms, some speculate it could substitute for carbon. Oxygen and sulfur each require two electrons to make a full octet (and are very electronegative), so they behave similarly—both can be used in energy conversion reactions.

Chapter: 2

Core concepts: 2.1, 2.4, 2.6, Case 1

Connections: Fig. 2.3, Case 1, Concept 1.2 (Ch. 1), Concept 1.3 (Ch. 1)

Cognitive level: LOC

Bloom’s level: Understanding

Level of difficulty: Hard

Setting: In-class

Instructional guidance: This question ties together chemistry, characteristics of life, possibly first life. It is also intended to draw students to the periodic table, where they will discover the chemical similarities between two elements in the same group (O and S; C and Si).

215. Studies of the origin of life on Earth help us to consider what would be required for life elsewhere in the universe. Which of the following is most likely to be true of extraterrestrial life?

- A. Carbon will act as the backbone for organic molecules.
- B. Light from a nearby star will make photosynthesis possible.
- C. Oxygen will be used to convert energy in cells.
- D. Water will not be required to sustain life.

ANSWER: A

Chapter: 2

Core concepts: 2.3, 2.4, 2.6, Case 1

Connections: Fig. 2.4, 2.6, 2.11, 2.13, 2.14, Case 1

Cognitive level: HOC

Bloom’s level: Applying

Level of difficulty: Hard

Setting: In-class

Instructional guidance: This question is a good check for understanding of elements/molecules essential for life.

216. As we look for life elsewhere, we expect it to be different from life on Earth. However, scientists predict it will be carbon-based and it will require water. Explain why.

ANSWER: Carbon is very versatile in the number of molecules that it can create, particularly given its bonding properties. Water's unique properties, from resisting temperature changes to cohesion to loss of density when frozen, make it an important medium for life on this planet, so it's hard to imagine any life existing in its absence.

Chapter: 2

Core concepts: 2.3, 2.4, 2.6, Case 1

Connections: Fig. 2.4, 2.6, 2.11, 2.13, 2.14, Case 1

Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: Hard

Setting: In-class

Instructional guidance: This question is a good check for understanding of elements/molecules essential for life.

217. Would the first cells most likely have used DNA as their genetic (information storage) molecule?

A. yes

B. no

ANSWER: B

Chapter: 2

Core concepts: 2.6, Case 1

Connections: Fig. 2.20, 2.21, Case 1, Section 3.3 (Ch. 3)

Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: Hard

Setting: In-class

Instructional guidance: This question should be discussed in class. Revisit it when discussing RNA in Ch. 3.

218. Explain why DNA was probably not the genetic (information storage) molecule for the first cells.

ANSWER: DNA is a very complex molecule, which is unlikely to have been the first molecule to evolve for this function. In addition, as we'll see in later chapters, DNA relies on proteins to function, and proteins rely on DNA to encode their sequences. These two systems are unlikely to have evolved simultaneously. Thus, it is more likely that another molecule, maybe RNA (which has information storage and catalytic properties), or something before that, was the first genetic molecule.

Chapter: 2

Core concepts: 2.6, Case 1

Connections: Fig. 2.20, 2.21, Case 1, Section 3.3 (Ch. 3)

Cognitive level: HOC

Bloom's level: Analyzing

Level of difficulty: Hard

Setting: In-class

Instructional guidance: This question should be discussed in class. Revisit it when discussing RNA in Ch. 3.

219. The cells that arose on early Earth from primordial reactions are strikingly similar to animal cells of today.

A. true

B. false

ANSWER: B

Chapter: 2

Core concept: 2.6

Connections: Fig. 2.29

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: In-class

220. Which one of the following gases was **not** a component of the simulated atmosphere in the Miller-Urey experiment?

A. hydrogen

B. water vapor

C. oxygen

D. methane

E. ammonia

ANSWER: C

Chapter: 2

Core concept: 2.6

Connections: 2.29

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Medium

Setting: In-class

221. Amino acids can be spontaneously generated in vitro, but only under anaerobic conditions.

A. true

B. false

ANSWER: A

Chapter: 2

Core concept: 2.6

Connections: Fig. 2.29

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

222. Experiments generating simple molecules under conditions resembling that of early Earth demonstrate that the first cells are likely to be extremely similar to cells found today.

A. true

B. false

ANSWER: B

Chapter: 2

Core concept: 2.6

Connections: Fig. 2.29, 2.30

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

223. It is believed that the surfaces upon which the first nucleic acids were able to form were made of:

A. limestone.

B. clay.

C. granite.

D. diamond.

E. sand.

ANSWER: B

Chapter: 2

Core concept: 2.6

Connections: Fig. 2.30

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

224. The age of the Earth is 4.6 billion years. For what percentage of this time is Earth thought to have been anaerobic?

A. 0.1%

- B. 27%
- C. 44%
- D. 68%
- E. 99.3

ANSWER: C

Chapter: 2

Core concept: 2.6

Connections: Fig. 2.29

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Medium

Setting: Pre-class

225. The bacteria found in present-day oceans closely resemble those that existed in Earth's early history.

- A. true
- B. false

ANSWER: B

Chapter: 2

Core concept: 2.6

Connections: Fig. 2.29, 1.18

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

226. Which of the following statements is true regarding Leslie Orgel's experiments?

- A. This work provided insight into how the first nucleotides may have formed on Earth.
- B. This work provided insight into how the first nucleic acids may have formed on Earth.
- C. This work provided insight into how the first amino acids formed on Earth.
- D. This work provided insight into how the first proteins formed on Earth.

ANSWER: B

Chapter: 2

Core concept: 2.6

Connections: Fig. 2.30

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

227. During his experiments, Stanley Miller was able to re-create many of the amino acids found in organisms, but also some not found in organisms.

- A. true
- B. false

ANSWER: A

Chapter: 2

Core concept: 2.6

Connections: Fig. 2.29

Cognitive level: LOC

Bloom's level: Remembering

Level of difficulty: Easy

Setting: Pre-class

228. Imagine an Earth where no life is present, but that has an atmosphere and oceans that are identical to those that exist today. If lightning strikes, would you predict that life would form on this alternate Earth?

- A. Yes, because present-day oxygen levels in Earth's atmosphere would be conducive to the formation of amino acids.
- B. Yes, because present-day oxygen levels in Earth's atmosphere would be conducive to the formations of nucleotides.
- C. No, because oxygen levels on present-day Earth are much lower compared to those on early Earth, and would not be conducive to the formation of amino acids.
- D. No, because oxygen levels on present-day Earth are much higher compared to those on early Earth, and would not be conducive to the formation of amino acids.

ANSWER: D

Chapter: 2

Core concept: 2.6

Connections: Fig. 2.29

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

229. Which of the following was required for early life to form on Earth?

- A. low oxygen conditions, which allowed for the formation of amino acids
- B. clay, which allowed for the formation of nucleic acids
- C. phosphates, which allowed for the formation of nucleotides
- D. the presence of hydrogen, which allowed for the formation of amino acids
- E. All of these choices are correct.

ANSWER: E

Chapter: 2
Core concept: 2.6
Connections: Fig. 2.30
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Medium
Setting: Pre-class

230. Imagine that scientists are examining a meteorite that has crashed into Earth. Which of the following might the researchers find within the meteorite?

- A. carbon-containing molecules
- B. amino acids
- C. lipids
- D. All of these choices are correct.
- E. None of the other answer options is correct.

ANSWER: D

Chapter: 2
Core concept: 2.6
Cognitive level: LOC
Bloom's level: Understanding
Level of difficulty: Medium
Setting: Pre-class

231. Which of the following gases did Stanley Miller **not** use in his experiment to recapitulate the Earth's early atmosphere?

- A. oxygen gas (O_2)
- B. water vapor (H_2O)
- C. ammonia (NH_3)
- D. hydrogen gas (H_2)
- E. methane (CH_4)

ANSWER: A

Chapter: 2
Core concept: 2.6
Connections: Fig. 2.29
Cognitive level: LOC
Bloom's level: Remembering
Level of difficulty: Easy
Setting: Pre-class

232. Stanley Miller's research provided insight into how the first proteins may have appeared on Earth.

- A. true
- B. false

ANSWER: A

Chapter: 2

Core concept: 2.6

Connections: Fig. 2.29

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

233. Fossils provide evidence detailing how early nucleic acids and proteins first appeared on Earth. The work of Stanley Miller, Leslie Orgel, and John Sutherland recapitulated events depicted in the fossil record.

- A. true
- B. false

ANSWER: B

Chapter: 2

Core concept: 2.6

Connections: Fig. 2.29

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

234. Which of the following statements is true regarding nucleic acids?

- A. Nucleic acids cannot form spontaneously; the first nucleic acids were most likely “built” by early proteins.
- B. Nucleic acids can form spontaneously, provided that an adequate number of nucleotides are available.
- C. Early nucleic acids were likely formed spontaneously and could not have formed complementary strands.
- D. None of the other answer options is correct.

ANSWER: B

Chapter: 2

Core concept: 2.6

Connections: Fig. 2.29

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class

235. Scientists only understand how the first amino acids and nucleic acids formed on Earth; researchers have no theories as to how early sugars were produced.

- A. true
- B. false

ANSWER: B

Chapter: 2

Core concepts: 2.6

Connections: Fig. 2.29

Cognitive level: LOC

Bloom's level: Understanding

Level of difficulty: Easy

Setting: Pre-class