

**Chapter 02 - Water: The Solvent for Biochemical Reactions**

1. The tendency for an atom to attract electrons to itself in a chemical bond is called
- a. polarity.
  - b. electronegativity.
  - c. hydrophilicity
  - d. electrophilicity.

**ANSWER:** b  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.1 - New in 6e  
**TOPICS:** Water and Polarity  
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2. If atoms with greatly differing electronegativities form a bond, that bond will be
- a. polar.
  - b. nonpolar.
  - c. amphipathic.
  - d. acidic.

**ANSWER:** a  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.1 - New in 6e  
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3. Many of the properties of water can be accounted for by the fact that
- a. it is polar
  - b. it forms hydrogen bonds
  - c. it is a bent molecule
  - d. all of these are true

**ANSWER:** d  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.6 - Modified in 7e  
**TOPICS:** Water and Polarity  
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4. Which of the following is true about ionic compounds?
- a. They are more likely to dissolve in non-polar solvents than covalent compounds.

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- b. They always dissolve completely in water.
- c. They never dissolve in polar solvents.
- d. Some of them dissolve completely in water or other polar solvents, while others do not.

**ANSWER:** d  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.4 - New in 7e  
**TOPICS:** Water and Polarity  
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5. Which of the following is a correct listing of electronegativity values, from low to high?
- a. C, H, O, N
  - b. N, H, O, C
  - c. H, C, N, O
  - d. H, C, O, N

**ANSWER:** c  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**TOPICS:** Water and Polarity  
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6. Which of the following elements has the highest electronegativity?
- a. C
  - b. H
  - c. N
  - d. O
  - e. P

**ANSWER:** d  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.5 - Modified from 5e  
**TOPICS:** Water and Polarity  
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7. The water molecule is polar because:
- a. Electrons are not distributed symmetrically in the molecule.
  - b. The hydrogen atoms are found on one "side" of the molecule.
  - c. Hydrogen is less electronegative than oxygen.

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- d. The hydrogen atoms are found on one "side" of the molecule and hydrogen is less electronegative than oxygen.
- e. All of these are correct.

ANSWER: e  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
TOPICS: Water and Polarity  
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8. Which of the following molecules is polar?

- a.  $\text{CCl}_4$
- b.  $\text{CH}_4$
- c.  $\text{CO}_2$
- d.  $\text{NH}_3$
- e. None of these molecules is polar.

ANSWER: d  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
LEARNING OBJECTIVES: CAFA.BIOC.15.5 - Modified from 5e  
TOPICS: Water and Polarity  
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9. Which of the following molecules is amphipathic?

- a. sodium chloride
- b. acetic acid
- c. benzene
- d. palmitic acid

ANSWER: d  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
LEARNING OBJECTIVES: CAFA.BIOC.15.5 - Modified from 5e  
TOPICS: Water and Polarity  
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10. Which of the following classes of compounds is hydrophilic?

- a. Sugars
- b. Fatty acids

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- c. Amino acids
- d. Sugars and amino acids.
- e. All of these

**ANSWER:** d  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**TOPICS:** Water and Polarity  
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11. Which of the following classes of compounds is hydrophobic?

- a. Table Salt
- b. Cholesterol
- c. Phosphate esters
- d. Cholesterol and phosphate esters.
- e. All of these are hydrophobic.

**ANSWER:** b  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**TOPICS:** Water and Polarity  
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12. Which of the following molecules has polar bonds but is itself not polar?

- a.  $\text{NH}_3$
- b.  $\text{CO}_2$
- c.  $\text{CH}_4$
- d.  $\text{H}_2\text{O}$

**ANSWER:** b  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.4 - New in 7e  
**TOPICS:** Water and Polarity  
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13. When a carboxylate side-chain of one amino acid in a protein is in close proximity to a charged amino group of another amino acid, we call the resulting interaction a(n)

- a. ion - dipole bond
- b. ionic bond

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- c. van der Waal's bond
- d. salt bridge

**ANSWER:** d  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.3 - New in 8e  
**TOPICS:** Water and Polarity  
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14. A London dispersion force is another name for a(n)
- a. induced dipole - induced dipole bond
  - b. ionic bond
  - c. covalent bond
  - d. non-polar bond

**ANSWER:** a  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.3 - New in 8e  
**TOPICS:** Water and Polarity  
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15. Ionic compounds and polar covalent compounds tend to dissolve in water because of
- a. ion-dipole and dipole-dipole interactions
  - b. dipole-induced dipole interactions
  - c. van der Waals bonds
  - d. hydrophobic interactions

**ANSWER:** a  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**TOPICS:** Water and Polarity  
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16. Which of the following is not considered a van der Waal's force?
- a. dipole - dipole bond
  - b. dipole - induced dipole bond
  - c. induced dipole - induced dipole bond
  - d. ion - dipole bond

**ANSWER:** d

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**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.3 - New in 8e  
**TOPICS:** Water and Polarity  
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17. A micelle is a structure which
- aggregates with other micelles in water.
  - has its polar groups on the outside and non-polar groups on the inside when in water.
  - explains how soaps and detergents work.
  - has its polar groups on the outside and non-polar groups on the inside when in water and explains how soaps and detergents work.
  - All of these are true.

**ANSWER:** d  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.6 - Modified in 7e  
**TOPICS:** Water and Polarity  
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18. Which of the following compounds is most likely to form a micelle?
- Acetic acid.
  - Glucose.
  - Glycerol.
  - Sodium palmitate.
  - Sodium phosphate.

**ANSWER:** d  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.7 - Modified in 8e  
**TOPICS:** Water and Polarity  
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19. The substance most likely to form a micelle is
- acetic acid
  - sodium palmitate
  - methyl alcohol
  - acetone

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**ANSWER:** b  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**TOPICS:** Water and Polarity  
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20. Molecules which contain both hydrophilic and hydrophobic regions are:

- a. Amphipathic
- b. Amphiphilic
- c. Able to form micelles
- d. Both amphipathic and amphiphilic
- e. All of these

**ANSWER:** e  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**TOPICS:** Water and Polarity  
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21. How do hydrogen bonds tend to affect the melting and boiling points of substances?

- a. They tend to increase both melting and boiling points.
- b. They tend to decrease both melting and boiling points.
- c. They tend to increase melting points and decrease boiling points.
- d. They tend to decrease melting points and increase boiling points.
- e. They do not have any affect on either melting or boiling points.

**ANSWER:** a  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.1 - New in 6e  
**TOPICS:** Hydrogen Bonds  
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22. Hydrogen bonds

- a. play an important role in the solvent properties of water
- b. are not involved in protein structure
- c. play a role in the properties of DNA, but not of RNA
- d. give water a lower boiling point than expected

**ANSWER:** a  
**POINTS:** 1

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**QUESTION TYPE:** Multiple Choice

**HAS VARIABLES:** False

**TOPICS:** Hydrogen Bonds

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23. Which of the following molecules will not form hydrogen bonds?

a. CH<sub>4</sub>

b. NH<sub>3</sub>

c. H<sub>2</sub>O

d. HF

**ANSWER:** a

**POINTS:** 1

**QUESTION TYPE:** Multiple Choice

**HAS VARIABLES:** False

**TOPICS:** Hydrogen Bonds

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24. How does the strength of hydrogen bonds compare with covalent bonds?

a. Hydrogen bonds are much stronger than covalent bonds.

b. Hydrogen bonds are much weaker than covalent bonds.

c. Hydrogen bonds and covalent bonds have similar strengths.

d. The question cannot be answered without knowing which covalent bonds are being referred to

**ANSWER:** b

**POINTS:** 1

**QUESTION TYPE:** Multiple Choice

**HAS VARIABLES:** False

**LEARNING OBJECTIVES:** CAFA.BIOC.15.6 - Modified in 7e

**TOPICS:** Hydrogen Bonds

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25. A hydrogen bond is a special type of

a. diiole - dipole bond

b. induced dipole - induced dipole bond

c. covalent bond

d. ionic bond

**ANSWER:** a

**POINTS:** 1

**QUESTION TYPE:** Multiple Choice

**HAS VARIABLES:** False

**LEARNING OBJECTIVES:** CAFA.BIOC.15.3 - New in 8e



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**TOPICS:** Hydrogen bonds  
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26. Which of the following is true regarding hydrogen bonds.
- They can only form between two different molecules
  - They are important in protein folding but not DNA structure
  - They are important in DNA structure but not protein folding
  - They can be found within a single molecule

**ANSWER:** d  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.4 - New in 7e  
**TOPICS:** Hydrogen Bonds  
**DATE CREATED:** 12/23/2013 2:14 PM  
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27. In a hydrogen bond
- three atoms lie in a straight line
  - there is stronger bonding than in a covalent bond
  - unpaired electrons play no role
  - none of the above

**ANSWER:** a  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**TOPICS:** Hydrogen Bonds  
**DATE CREATED:** 12/23/2013 2:14 PM  
**DATE MODIFIED:** 12/23/2013 2:14 PM

28. The non-covalent interaction below associated with the strongest force in aqueous solution is
- dipole-induced dipole
  - hydrophobic interactions
  - hydrogen bonding
  - van der Waals forces

**ANSWER:** c  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**TOPICS:** Hydrogen Bonds  
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29. Which of the following statements about hydrogen bonds is false?
- The donor is a hydrogen atom bonded to a less electronegative atom than hydrogen.
  - The more linear the bond, the stronger the attraction.
  - The acceptor must contain a non-bonded pair of electrons.
  - It is a type of non-covalent bond.

**ANSWER:** a  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.5 - Modified from 5e  
**TOPICS:** Hydrogen Bonds  
**DATE CREATED:** 12/23/2013 2:14 PM  
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30. True hydrogen bonds can NOT form between hydrogen and this element:
- N
  - F
  - C
  - O
  - All of these elements can form hydrogen bonds.

**ANSWER:** c  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**TOPICS:** Hydrogen Bonds  
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31. What is the maximum number of hydrogen bonds a single water molecule can form?
- 1
  - 2
  - 3
  - 4
  - 5

**ANSWER:** d  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.5 - Modified from 5e  
**TOPICS:** Hydrogen Bonds  
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32. Which of the following characteristics makes for a good hydrogen bond acceptor?

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- a. a high electronegativity
- b. a nonbonding pair of electrons
- c. both of these
- d. neither of these

**ANSWER:** c  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.6 - Modified in 7e  
**TOPICS:** Hydrogen Bonds  
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33. Which of the following characteristics makes for a good hydrogen bond donor?
- a. a high electronegativity
  - b. a nonbonding pair of electrons
  - c. both of the above
  - d. neither of the above

**ANSWER:** a  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.5 - Modified from 5e  
**TOPICS:** Hydrogen Bonds  
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34. Which of the following properties of water are related to its ability to form hydrogen bonds?
- a. boiling point
  - b. melting point
  - c. density
  - d. solvent potency
  - e. all of the choices

**ANSWER:** e  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.3 - New in 8e  
**TOPICS:** Hydrogen bonds  
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35. Hydrogen bonds explain which of the following properties of water?
- a. Water is a great solvent for all ionic and polar molecules.

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- b. Water has high melting and boiling points for its small size.
- c. Ice expands when frozen.
- d. Both the abnormal melting and freezing points and that ice expands when frozen.
- e. Hydrogen bonds explain all of these properties.

**ANSWER:** e  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**TOPICS:** Hydrogen Bonds  
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36. Hydrogen bonds can only form when the hydrogen atom is involved in a polar bond.
- a. True
  - b. False

**ANSWER:** a  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**TOPICS:** Hydrogen Bonds  
**DATE CREATED:** 12/23/2013 2:14 PM  
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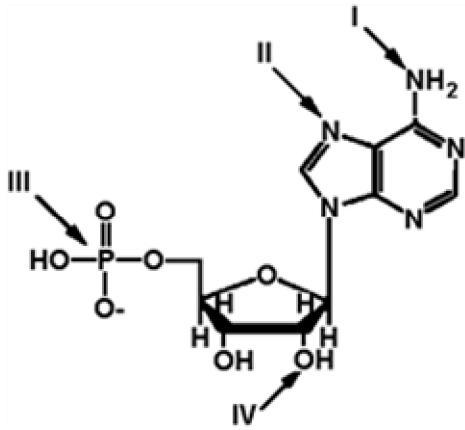
37. Which of the following is a true statement?
- a. most substances contract when they freeze.
  - b. water expands when it freezes.
  - c. hydrogen bonding is related to water's tendency to expand as it freezes.
  - d. all of these are true

**ANSWER:** d  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.4 - New in 7e  
**TOPICS:** Hydrogen Bonds  
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### **Exhibit 2A**

The structure of ATP with various groups labeled.  
Group III is the entire phosphate group.

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38. Refer to Exhibit 2A. Which of the functional groups **cannot** function as a hydrogen donor to water?

- a. I
- b. II
- c. III
- d. IV
- e. All can donate a hydrogen to water.

ANSWER: b

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

PREFACE NAME: Exhibit 2A

TOPICS: Hydrogen Bonds

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39. Refer to Exhibit 2A. Which of the functional groups is the most electrophilic?

- a. I
- b. II
- c. III
- d. IV
- e. The answer cannot be determined without further information.

ANSWER: c

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

PREFACE NAME: Exhibit 2A

TOPICS: Hydrogen Bonds

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40. Refer to Exhibit 2A. Which of the groups could **not** act as a proton acceptor in a hydrogen bond?

- a. I
- b. II

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- c. III
- d. IV
- e. All can accept a hydrogen in a hydrogen bond.

ANSWER: e  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
PREFACE NAME: Exhibit 2A  
TOPICS: Hydrogen Bonds  
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41. Is water an acid or a base?
- a. Water is an acid.
  - b. Water is a base.
  - c. Water is both an acid and a base.
  - d. Water is neither an acid nor a base.

ANSWER: c  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
LEARNING OBJECTIVES: CAFA.BIOC.15.5 - Modified from 5e  
TOPICS: Acids, Bases, and pH  
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42. For an acid that undergoes this reaction:



- $K_a =$
- a.  $[\text{H}^+][\text{A}^-]/[\text{HA}]$
  - b.  $[\text{H}^+][\text{HA}]/[\text{A}^-]$
  - c.  $[\text{HA}][\text{A}^-]/[\text{H}^+]$
  - d.  $[\text{A}^-]/[\text{HA}][\text{H}^+]$
  - e.  $[\text{H}^+]/[\text{HA}][\text{A}^-]$

ANSWER: a  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
LEARNING OBJECTIVES: CAFA.BIOC.15.1 - New in 6e  
TOPICS: Acids, Bases, and pH  
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43. Which will dissociate most in water, a weak acid or a strong acid?

- a. A weak acid.
- b. A strong acid
- c. They should dissociate about the same.
- d. It's impossible to predict.

**ANSWER:** b

**POINTS:** 1

**QUESTION TYPE:** Multiple Choice

**HAS VARIABLES:** False

**LEARNING OBJECTIVES:** CAFA.BIOC.15.1 - New in 6e

**TOPICS:** Acids, Bases, and pH

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44. Bases are

- a. proton donors.
- b. proton acceptors.
- c. hydrogen bond donors.
- d. hydrogen bond acceptors.

**ANSWER:** b

**POINTS:** 1

**QUESTION TYPE:** Multiple Choice

**HAS VARIABLES:** False

**LEARNING OBJECTIVES:** CAFA.BIOC.15.5 - Modified from 5e

**TOPICS:** Acids, Bases, and pH

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45. Which has the greater  $K_a$ , a weak acid or a strong acid?

- a. A weak acid.
- b. A strong acid
- c. They should dissociate about the same.
- d. It's impossible to predict.

**ANSWER:** b

**POINTS:** 1

**QUESTION TYPE:** Multiple Choice

**HAS VARIABLES:** False

**LEARNING OBJECTIVES:** CAFA.BIOC.15.1 - New in 6e

**TOPICS:** Acids, Bases, and pH

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46. Which has the greater  $pK_a$ , a weak acid or a strong acid?

- a. A weak acid.
- b. A strong acid
- c. They should dissociate about the same.
- d. It's impossible to predict.

ANSWER: a

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

LEARNING OBJECTIVES: CAFA.BIOC.15.1 - New in 6e

TOPICS: Acids, Bases, and pH

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47. The dissociation constant for an acid with a  $pK_a$  value of 6.0 is

- a.  $1 \times 10^{-6}$
- b.  $-1 \times 10^6$
- c.  $1 \times 10^6$
- d.  $-1 \times 10^{-6}$

ANSWER: a

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

TOPICS: Acids, Bases, and pH

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48. A buffer solution at pH 10 has a ratio of  $[HA]/[A^-]$  of 10. What is the  $pK_a$  of the acid?

- a. 8
- b. 9
- c. 10
- d. 11
- e. 12

ANSWER: d

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

LEARNING OBJECTIVES: CAFA.BIOC.15.5 - Modified from 5e

TOPICS: Acids, Bases, and pH

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## Chapter 02 - Water: The Solvent for Biochemical Reactions

49. The dissociation constant for an acid is  $1 \times 10^{-6}$ . What is its  $pK_a$ ?

- a. -6
- b. 6
- c. 0.6
- d. -0.6

ANSWER: b

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

LEARNING OBJECTIVES: CAFA.BIOC.15.6 - Modified in 7e

TOPICS: Acids, Bases, and pH

NOTES: Answer was incorrect in 6e

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50. The pH of a solution of 0.04 M HCl is:

- a. 4
- b. 1.4
- c. 0.4
- d. 0.04
- e. The pH cannot be determined

ANSWER: b

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

TOPICS: Acids, Bases, and pH

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51. The pOH a solution of 0.04 M HCl is:

- a. 1.4
- b. 10
- c. 12.6
- d. 13.6
- e. The pOH cannot be determined

ANSWER: c

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

TOPICS: Acids, Bases, and pH

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52. An HCl solution has a  $pH = 3$ . If you dilute 10 mL of the solution to 1000mL, the final pH will be:

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- a. 1.0
- b. 2.0
- c. The pH does not change.
- d. 4.0
- e. 5.0

ANSWER: e

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

TOPICS: Acids, Bases, and pH

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53. If a solution has a pH = 9.6, the  $[H^+]$  is

- a.  $2.5 \times 10^{10}$
- b. 9.6 M
- c. 2.5 M
- d.  $2.5 \times 10^{-10}$  M
- e.  $9.6 \times 10^{-10}$  M

ANSWER: d

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

TOPICS: Acids, Bases, and pH

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54. What is the pH of a solution with  $[H^+] = 10$  mM?

- a. 10
- b. 1
- c. 2
- d. -2

ANSWER: c

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

LEARNING OBJECTIVES: CAFA.BIOC.15.1 - New in 6e

TOPICS: Acids, Bases, and pH

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55. Calculate the final pH of a solution made by the addition of 10 mL of a 0.5 M NaOH solution to 500 mL of a 0.4 M HA originally at pH = 5.0 ( $pK_a = 5.0$ ) Neglect the volume change.

## Chapter 02 - Water: The Solvent for Biochemical Reactions

- a. 6.10
- b. 5.09
- c. 7.00
- d. 5.55

ANSWER: d  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
TOPICS: Acids, Bases, and pH  
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56. If a solution has a pH = 6, the  $[H^+]$  is

- a. 6 M
- b.  $10^6$  M
- c.  $10^{-6}$  M
- d. 0.6 M

ANSWER: c  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
LEARNING OBJECTIVES: CAFA.BIOC.15.5 - Modified from 5e  
TOPICS: Acids, Bases, and pH  
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57. What is the pH of an acetic acid solution where the concentration of acetic acid is 2 mM and the concentration of sodium acetate is 20 mM. The  $pK_a$  of acetic acid is 4.76.

- a. 5.76
- b. 10.6
- c. 12.6
- d. 8.8

ANSWER: a  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
LEARNING OBJECTIVES: CAFA.BIOC.15.4 - New in 7e  
TOPICS: Acids, Bases, and pH  
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58. The ion product constant for water ( $K_w$ ) is equal to:

- a.  $10^{14}$

## Chapter 02 - Water: The Solvent for Biochemical Reactions

- b.  $10^7$
- c.  $10^0$
- d.  $10^{-7}$
- e.  $10^{-14}$

ANSWER: e

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

TOPICS: Acids, Bases, and pH

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59. In a titration of a weak acid by a strong base
- a. two equivalents of base are always needed to neutralize all the acid present
  - b. the equivalence point cannot be defined exactly
  - c. there is a region in which the pH changes slowly
  - d. the equivalence point depends on the nature of the added base

ANSWER: c

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

TOPICS: Titration Curves

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60. A solution at pH 7 contains a weak acid, HA. The  $pK_a$  of the acid is 6.5. What is the ratio of  $[A^-]:[HA]$ ?
- a. 1:3
  - b. 1:1
  - c. 3:1
  - d. 10:1

ANSWER: c

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

TOPICS: Titration Curves

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61. When does a weak acid buffer best?
- a. From one pH unit below its  $pK_a$  to its  $pK_a$ .
  - b. From its  $pK_a$  to one pH unit above its  $pK_a$ .
  - c. Within one pH unit of its  $pK_a$ , both above and below.

## Chapter 02 - Water: The Solvent for Biochemical Reactions

d. Weak acids do not make good buffers at all.

ANSWER: c  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
LEARNING OBJECTIVES: CAFA.BIOC.15.5 - Modified from 5e  
TOPICS: Titration Curves  
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62. The inflection point of the titration curve for a weak monoprotic acid is equal to its  $pK_a$

- a. True
- b. False

ANSWER: a  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
TOPICS: Titration Curves  
NOTES: Answer was incorrect in 6e  
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63. Which of the following is true?

- a. The pH of a solution where the  $A^-$  to HA ratio is 1 has a  $pH = pK_a$ .
- b. If the pH does not equal the  $pK_a$ , the solution is not a buffer.
- c. The best buffer for any experiment will always have a pH equal to the  $pK_a$ .
- d. If a buffer has more weak acid than conjugate base, the pH will be higher than the  $pK_a$ .

ANSWER: a  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
LEARNING OBJECTIVES: CAFA.BIOC.15.4 - New in 7e  
TOPICS: Titration Curves  
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64. Using the Henderson-Hasselbalch equation, calculate the pH of an ammonia buffer when the  $NH_3:NH_4^+$  ratio is 0.4 moles:0.6 moles. ( $pK = 9.75$ )

- a. 7.40
- b. 9.07
- c. 9.25
- d. 9.43
- e. 11.05

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ANSWER: b  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
TOPICS: Titration Curves  
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65. An ammonia buffer contains  $\text{NH}_3:\text{NH}_4^+$  in a ratio of 0.4 moles:0.6 moles ( $\text{pK} = 9.75$ ). What will be the pH if you add 0.01 moles of HCl to this buffer?

- a. 8.98
- b. 9.04
- c. 9.25
- d. 9.46
- e. 9.52

ANSWER: a  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
TOPICS: Titration Curves  
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66. The ratio of a weak acid and its conjugate base at the point of maximum buffering capacity is

- a. 1/1
- b. 1/10
- c. 10/1
- d. no definite ratio is needed

ANSWER: a  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
TOPICS: Titration Curves  
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67. Which substance would be the best buffer at pH 8 if it had to be able to buffer against either acid or base?

- a. one with a  $\text{pK}_a$  of 7
- b. one with a  $\text{pK}_a$  of 8
- c. one with a  $\text{pK}_a$  of 9
- d. The  $\text{pK}_a$  of a substance doesn't tell you whether it would be a good buffer at this pH.

ANSWER: b  
POINTS: 1

## Chapter 02 - Water: The Solvent for Biochemical Reactions

**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**LEARNING OBJECTIVES:** CAFA.BIOC.15.8 - Modified from 6e  
**TOPICS:** Titration Curves  
**DATE CREATED:** 12/23/2013 2:14 PM  
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68. Buffering capacity refers to
- the effectiveness of commercial antacids
  - the extent to which a buffer solution can counteract the effect of added acid or base
  - the pH of a buffer solution
  - the molecular weight of the substance used as a buffer

**ANSWER:** b  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**TOPICS:** Titration Curves  
**DATE CREATED:** 12/23/2013 2:14 PM  
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69. If the pH of 1 liter of a 1.0 M carbonate buffer is 7.0, what is the molar ratio of  $\text{H}_2\text{CO}_3$  to  $\text{HCO}_3^-$ ? ( $\text{pK} = 6.37$ )
- 0.234
  - 4.27
  - 6.37
  - 7.00
  - 10.20

**ANSWER:** b  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**TOPICS:** Titration Curves  
**DATE CREATED:** 12/23/2013 2:14 PM  
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70. Consider a reaction that produces a significant amount of hydrogen ion and is to be carried out a pH 7. Only two acids are available for making the buffer solution. The  $\text{pK}_a$  values for acids A and B are 6.3 and 7.3, respectively. Which acid would serve as the optimum buffer for this reaction? Or would carrying out the reaction in water simply serve as well?
- acid A
  - acid B
  - water
  - both acids would be equally effective

**ANSWER:** a  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice

## Chapter 02 - Water: The Solvent for Biochemical Reactions

*HAS VARIABLES:* False  
*LEARNING OBJECTIVES:* CAFA.BIOC.15.5 - Modified from 5e  
*TOPICS:* Titration Curves  
*DATE CREATED:* 12/23/2013 2:14 PM  
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71. Which of the following acids would serve as a good buffer for a reaction at pH = 8.0?

	<u><math>K_a</math></u>
I. acetic acid	$1.76 \times 10^{-5}$
II. $H_2PO_4^-$	$6.31 \times 10^{-8}$
III. bicarbonate	$5.6 \times 10^{-11}$
IV. TRIS	$5.01 \times 10^{-9}$

a. I  
b. II  
c. III  
d. IV

*ANSWER:* d  
*POINTS:* 1  
*QUESTION TYPE:* Multiple Choice  
*HAS VARIABLES:* False  
*TOPICS:* Buffers  
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72. If the pH of 1 liter of a 1.0 M carbonate buffer is 7.0, what is actual number of moles of  $H_2CO_3$  and  $HCO_3^-$ ? (pK = 6.37)

	<u>moles of <math>H_2CO_3</math></u>	<u>moles of <math>HCO_3^-</math></u>
I.	0.86	0.14
II.	0.81	0.19
III.	0.76	0.24
IV.	0.19	0.81
V.	0.14	0.86

a. I  
b. II  
c. III  
d. IV  
e. V

*ANSWER:* d  
*POINTS:* 1  
*QUESTION TYPE:* Multiple Choice  
*HAS VARIABLES:* False  
*TOPICS:* Titration Curves  
*DATE CREATED:* 12/23/2013 2:14 PM



## Chapter 02 - Water: The Solvent for Biochemical Reactions

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73. A buffer solution

- a. is used to control the pH of a solution
- b. contains at least 100 times more of a weak acid than its conjugate base
- c. contains at least 100 times less of a weak acid than its conjugate base
- d. always has a pH of 7

ANSWER: a

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

TOPICS: Titration Curves

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74. The main intracellular buffer system is

- a.  $\text{H}_3\text{PO}_4/\text{H}_2\text{PO}_4^-$
- b.  $\text{H}_2\text{PO}_4^-/\text{HPO}_4^{2-}$
- c.  $\text{HPO}_4^{2-}/\text{PO}_4^{3-}$
- d.  $\text{H}_3\text{PO}_4/\text{PO}_4^{3-}$

ANSWER: b

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

TOPICS: Buffers

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### Exhibit 2B

Contains information on the pK's of some common buffers.

Buffer	pK1	pK2	pK3
Acetate	4.75		
Ammonia	9.25		
Carbonic acid	6.37	10.20	
Citric acid	3.09	4.75	5.41
Formic Acid	3.75		
Phosphoric acid	2.14	7.20	12.4
Pyruvic acid	2.50		
Tris	8.3		

75. **Refer to Exhibit 2B.** The enzyme lysozyme has an optimum pH close to 5. A suitable buffer would be:

- a. Acetate
- b. Carbonate
- c. Phosphate
- d. Pyruvate

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e. None of these is a suitable buffer for this reaction.

**ANSWER:** a  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**PREFACE NAME:** Exhibit 2B  
**TOPICS:** Buffers  
**DATE CREATED:** 12/23/2013 2:14 PM  
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76. **Refer to Exhibit 2B.** An ammonium buffer would work well at this pH:

- a. 5.6
- b. 7.0
- c. 9.0
- d. 11.0
- e. None of these

**ANSWER:** c  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**PREFACE NAME:** Exhibit 2B  
**TOPICS:** Buffers  
**DATE CREATED:** 12/23/2013 2:14 PM  
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77. **Refer to Exhibit 2B.** A carbonate buffer would work well at this pH:

- a. 4.0
- b. 6.0
- c. 8.0
- d. 10.0
- e. 6.0 and 10.0

**ANSWER:** e  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**PREFACE NAME:** Exhibit 2B  
**TOPICS:** Buffers  
**DATE CREATED:** 12/23/2013 2:14 PM  
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78. **Refer to Exhibit 2B.** A phosphate buffer would work well at this pH:

- a. 5.0
- b. 7.0
- c. 8.0

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d. 10.0

e. 7.0 and 8.0

ANSWER: e

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

PREFACE NAME: Exhibit 2B

TOPICS: Buffers

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79. **Refer to Exhibit 2B.** Which of the following would make the best buffer at pH =10.0?

a. Acetic acid and sodium acetate

b. Tris and its acid form

c.  $\text{H}_2\text{CO}_3$  and  $\text{NaHCO}_3$

d.  $\text{Na}_2\text{HPO}_4$  and  $\text{NaH}_2\text{PO}_4$

e.  $\text{NaHCO}_3$  and  $\text{Na}_2\text{CO}_3$

ANSWER: e

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

PREFACE NAME: Exhibit 2B

TOPICS: Buffers

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80. Which of the following is important to know when deciding if a given buffer will be effective for an experiment?

a. the  $\text{pK}_a$  of the buffer compound

b. the buffer capacity

c. the concentration of the buffer

d. whether the experiment is likely to generate hydrogen ions or hydroxide ions

e. all of these are important considerations

ANSWER: e

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

PREFACE NAME: Exhibit 2B

LEARNING OBJECTIVES: CAFA.BIOC.15.4 - New in 7e

TOPICS: Buffers

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81. Nonphysiological buffers such as HEPES and PIPES have come into common use because

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- a. they are inexpensive
- b. they can be prepared much more easily than other buffers
- c. they have less tendency to interfere with reactions
- d. they contain nitrogen

ANSWER: c  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
TOPICS: Buffers  
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82. Buffers which lack biological activity and are unlikely to interfere with any biochemical reactions include:
- a. Tris.
  - b. Hepes.
  - c. Phosphate.
  - d. Both Tris and HEPES.
  - e. All of these.

ANSWER: d  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
TOPICS: Buffers  
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83. Which of the following is **not** true?
- a. A buffer is a solution which maintains a solution at a neutral pH
  - b. Buffer solutions are made to resist change in pH
  - c. Zwitterion buffers are less likely to interfere with biological reactions than non-zwitterions
  - d. HEPES is a zwitterion buffer

ANSWER: a  
POINTS: 1  
QUESTION TYPE: Multiple Choice  
HAS VARIABLES: False  
LEARNING OBJECTIVES: CAFA.BIOC.15.4 - New in 7e  
TOPICS: Buffers  
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84. The main blood buffer system is
- a.  $\text{H}_2\text{CO}_3/\text{HCO}_3^-$
  - b.  $\text{HCO}_3^-/\text{CO}_3^{2-}$

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c.  $\text{H}_2\text{CO}_3/\text{CO}_3^{2-}$

d. none of the above

ANSWER: a

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

TOPICS: Buffers

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85. Buffers work to maintain pH because

- a. they obey LeChatlier's principle
- b. weak acids cannot change the pH of a solution
- c. weak bases added to strong bases neutralize each other
- d. they destroy the hydrogen ion that is added

ANSWER: a

POINTS: 1

QUESTION TYPE: Multiple Choice

HAS VARIABLES: False

LEARNING OBJECTIVES: CAFA.BIOC.15.3 - New in 8e

TOPICS: Buffers

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86. Explain why carbon dioxide is nonpolar.

ANSWER: A carbon dioxide molecule has two C=O polar bonds. However, the bonds in the molecule may be polar, but the molecule itself can be nonpolar because of its geometry. The  $\text{CO}_2$  molecule is linear; therefore, the attraction of the oxygen for the electrons in one bond is cancelled out by the equal and opposite attraction for the electrons by the oxygen on the other side of the molecule, resulting in a nonpolar molecule.

POINTS: 1

QUESTION TYPE: Essay

HAS VARIABLES: False

TOPICS: Water and Polarity

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87. Which of the following statements is true of dipole-induced dipole interactions?

- a. They occur between molecules that are dipoles, with the partial positive side of one molecule attracting the partial negative side of another molecule.
- b. They involve a permanent dipole inducing a transient dipole in a nonpolar molecule.
- c. They are the attraction between two molecules, lacking dipoles, bumping into each other and distorting each other's electron cloud.
- d. They give rise to a London dispersion force between transient-induced dipoles.

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**ANSWER:** b  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**TOPICS:** Water and Polarity  
**DATE CREATED:** 11/25/2016 5:44 AM  
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88. Distinguish between the hydrogen bonding found in liquid water and ice.

**ANSWER:** In liquid water, hydrogen bonds are constantly breaking and new ones are constantly forming, with some molecules breaking off and others joining the cluster. An ice crystal, in contrast, has a more or less stable arrangement of hydrogen bonds and its number of molecules is many orders of magnitude greater than 100.

**POINTS:** 1  
**QUESTION TYPE:** Essay  
**HAS VARIABLES:** False  
**TOPICS:** Hydrogen Bonds  
**DATE CREATED:** 11/25/2016 5:46 AM  
**DATE MODIFIED:** 11/25/2016 5:47 AM

89. Which of the following equations represents the relationship between the  $pK_a$  of an acid and the pH of a solution containing the acid and its conjugate base?

- a. Arrhenius equation
- b. Henderson–Hasselbalch equation
- c. Nernst equation
- d. Butler–Volmer equation

**ANSWER:** b  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False  
**TOPICS:** Acids, Bases, and pH  
**DATE CREATED:** 11/25/2016 5:48 AM  
**DATE MODIFIED:** 11/25/2016 5:49 AM

90. Which of the following principles states that if stress is applied to a system in equilibrium, the equilibrium will shift in the direction that relieves the stress?

- a. Pauli exclusion principle
- b. Mach's principle
- c. Fermat's principle
- d. Le Chatelier's principle

**ANSWER:** d  
**POINTS:** 1  
**QUESTION TYPE:** Multiple Choice  
**HAS VARIABLES:** False

**Chapter 02 - Water: The Solvent for Biochemical Reactions**

*TOPICS:* Which of the following principles states that if stress is applied to a system in equilibrium, the equilibrium will shift in the direction that relieves the stress?

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*DATE MODIFIED:* 11/25/2016 5:51 AM