

***Biochemistry: Concepts and Connections (Appling et al.)***

**Chapter 2 The Chemical Foundation of Life: Weak Interactions in an Aqueous Environment**

1) Each of the following is a noncovalent interaction EXCEPT:

- A) a hydrogen bond.
- B) a carbon-hydrogen bond.
- C) the interaction between an amino and a carboxylate group.
- D) a van der Waals interaction.
- E) an interaction between  $\text{—NH}_3^+$  and a water molecule.

Answer: B

Objective: 2.1

Global LO: G7

2) The most important noncovalent interaction in biochemistry is the \_\_\_\_\_ bond.

Answer: hydrogen

Objective: 2.1

Global LO: G7

3) Which of the following is FALSE when considering van der Waals interactions?

- A) The van der Waals radius represents the most stable distance between two interacting centers.
- B) Van der Waals radii can determine molecular surfaces.
- C) Molecules that interact by van der Waals forces do not interpenetrate.
- D) The total interaction energy is the sum of the attractive and repulsive forces.
- E) They are not important in determining the stability of three-dimensional structures of proteins.

Answer: E

Objective: 2.2

Global LO: G2

4) Which of the following in biological compounds are sufficiently electronegative to serve as strong donors in a hydrogen bond?

- A) Hydrogen and oxygen
- B) Oxygen and nitrogen
- C) Nitrogen and hydrogen
- D) Hydrogen and carbon
- E) Nitrogen and carbon

Answer: B

Objective: 2.2

Global LO: G7

5) Hydrogen bonds share features of both covalent and noncovalent bonds.

Answer: TRUE

Objective: 2.2

Global LO: G2

6) Which of the following is TRUE of hydrophobic molecules?

- A) They have limited solubility in water.
- B) Water forms a cage-like structure around them.
- C) Dissolving in water decreases the entropy of the mixture.
- D) They self-associate by releasing some of the surrounding water molecules.
- E) All of the above

Answer: E

Objective: 2.3

Global LO: G2

7) Water is both a hydrogen bond donor and acceptor.

Answer: TRUE

Objective: 2.3

Global LO: G2

8) Amphipathic molecules are not able to interact via van der Waals forces.

Answer: FALSE

Objective: 2.3

Global LO: G2

9) Ionic compounds can be readily dissolved in water because the high dielectric constant of water screens and decreases the \_\_\_\_\_ force between the oppositely charged ions.

Answer: electrostatic

Objective: 2.3

Global LO: G7

10) The \_\_\_\_\_ describes the tendency for hydrophobic molecules to aggregate because of the exclusion of water with the consequent increase of entropy of the solvent.

Answer: hydrophobic effect

Objective: 2.3

Global LO: G7

11) Glycine cannot serve as a buffer because it has two ionizable groups.

Answer: FALSE

Objective: 2.4

Global LO: G7

12) The average charge on an amino acid below its pI will be positive.

Answer: TRUE

Objective: 2.4

Global LO: G2

13) Calculate the acid dissociation constant  $K_a$  of a 0.2 M solution of weak acid that is 0.1% ionized.

Answer:  $2 \times 10^{-7}$

Objective: 2.4

Global LO: G4

14) Calculate the pH of a 0.1 M phosphate buffer ( $pK_a = 6.86$ ) that contains equal amounts of acid and conjugate base.

Answer: 6.86

Objective: 2.4

Global LO: G4

15) Calculate the pH of a 0.2 M acetate buffer ( $pK_a = 4.77$ ) that contains twice as much acid as conjugate base.

Answer: 4.47

Objective: 2.4

Global LO: G4

16) The  $pK_a$  of each amino acid residue in a protein will not be influenced by the adjacent residue.

Answer: FALSE

Objective: 2.5

Global LO: G2

17) Calculate the pH at the end of an enzyme-catalyzed reaction if it were carried out in a 0.1 M phosphate buffer, pH 6.86 and 0.005 M of acid was produced during the reaction?

Answer: 6.77

Objective: 2.5

Global LO: G4

18) If hydroxide is added to an amino acid it will become increasingly \_\_\_\_\_ charged.

Answer: negatively

Objective: 2.6

Global LO: G7

19) Calculate the pH of a weak acid that is 0.2% ionized in a 0.2 M solution.

Answer: 3.39

Objective: 2.6

Global LO: G4

20) The net charge on an amino acid at its isoelectric point (pI) is \_\_\_\_\_.

Answer: zero

Objective: 2.7

Global LO: G7

21) Many proteins interact with DNA at physiological pH because:

- A) proteins are naturally attracted to DNA regardless of the pH.
- B) the negatively charged DNA is electrostatically attracted to positively charged regions on proteins.
- C) the positively charged DNA is electrostatically attracted to negatively charged regions on proteins.
- D) proteins and DNA interact using mainly hydrophobic interactions.
- E) both proteins and DNA are at their isoelectric points at physiological pH and tend to aggregate.

Answer: B

Objective: 2.8

Global LO: G2

22) Small ions in biological fluids:

- A) encourage strong electrostatic interactions between oppositely charged macroions at low ionic strengths.
- B) encourage strong electrostatic interactions between oppositely charged macroions at high ionic strengths.
- C) have no effect on the interactions between oppositely charged macroions.
- D) tend to cluster around macroions of the same charge.
- E) have large effects on pH.

Answer: A

Objective: 2.8

Global LO: G7