***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 $—NH_3^+$ 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 (pKa = 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 (pKa = 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