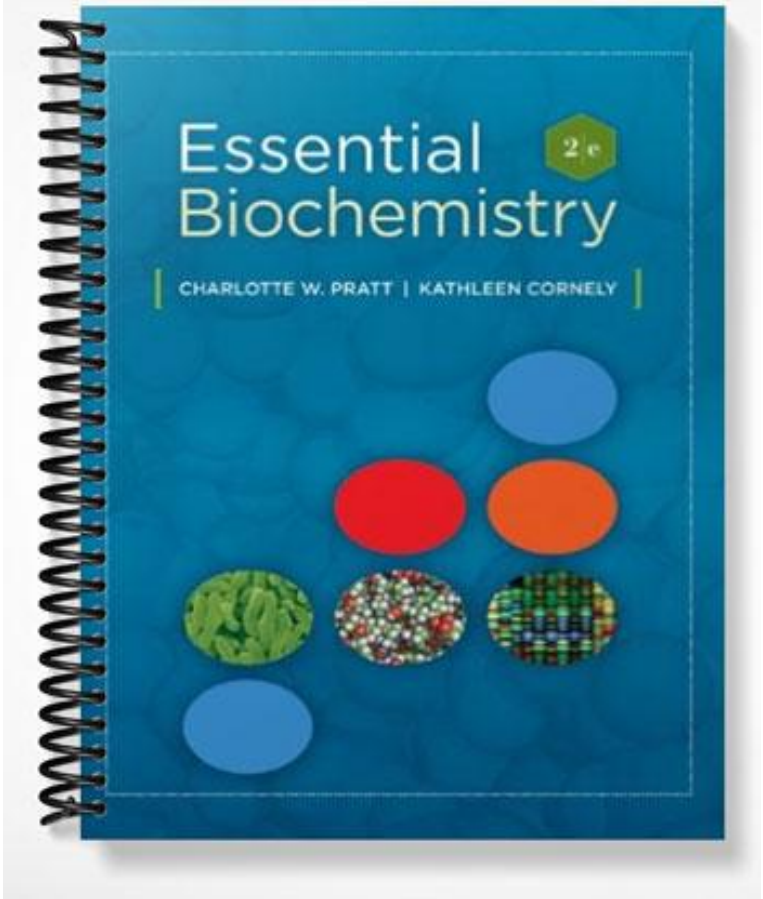
TEST BANK


Essential
2e
Biochemistry
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Chapter 2: Aqueous Chemistry

1. Choose the correct answer from the list. Not all the answers will be used.

Translational and _____ thermal motion causes liquid water molecules to reorient approximately every 10^{-12} seconds.

A) positive entropy

B) negative entropy

C) tetrahedral structure arrangement

D) hydrogen bond(s)

E) higher electronegativity

F) acid versus base

G) insoluble

H) base versus acid

I) dissolved but only partially ionized

J) rotational

L) H_3PO_4

L) $H_2PO_4^-$

M) HPO_4^{2-}

N) disordered

Ans: J
Difficulty Level: Medium
Section Ref: 2-1

2. Choose the correct answer from the list. Not all the answers will be used.

The 104.5° bond angle in the water molecule is the result of the _____ of electron orbitals around oxygen.

A) hydrogen bond(s)

B) H_3PO_4

C) $H_2PO_4^-$

D) higher electronegativity

E) dissolved but only partially ionized

F) base versus acid

G) rotational

H) acid versus base

I) tetrahedral structure arrangement

J) HPO_4^{2-}

K) disordered

L) insoluble

M) positive entropy

N) negative entropy

Ans: I
Difficulty Level: Medium
Section Ref: 2-1

3. Choose the correct answer from the list. Not all the answers will be used.

The polarity of the O–H bond is caused by the _____ of oxygen.

A) rotational

B) H_3PO_4

C) $H_2PO_4^-$

D) negative entropy

E) acid versus base

F) hydrogen bond(s)

G) HPO_4^{2-}

H) higher electronegativity

I) disordered

J) insoluble

K) tetrahedral structure arrangement

L) positive entropy

M) base versus acid

N) dissolved but only partially ionized

Ans: H

Difficulty Level: Easy
Section Ref: 2-1

4. Choose the correct answer from the list. Not all the answers will be used.

For the _____ represented by D–H . . . . A, the donor D is weakly acidic and the acceptor A is weakly basic.

A) rotational

B) $H_2PO_4^-$

C) H_3PO_4

D) disordered

E) HPO_4^{2-}

F) positive entropy

G) dissolved but only partially ionized

H) higher electronegativity

I) insoluble

J) tetrahedral structure arrangement

K) acid versus base

L) negative entropy

M) base versus acid

N) hydrogen bond(s)

Ans: N
Difficulty Level: Medium
Section Ref: 2-1,3

5. Choose the correct answer from the list. Not all the answers will be used.

Octane molecules dispersed in water tend to aggregate because that allows water molecules to be more

A) hydrogen bond(s).

B) H_3PO_4.

C) tetrahedral structure arrangement.

D) higher electronegativity.

E) $H_2PO_4^-$.

F) base versus acid.

G) acid versus base.

H) rotational.

I) HPO_4^{2-}.

J) dissolved but only partially ionized.

K) disordered.

L) positive entropy.

M) negative entropy.

N) insoluble.

Ans: K
Difficulty Level: Easy
Section Ref: 2-2

6. Choose the correct answer from the list. Not all the answers will be used.

Although nonpolar molecules are attracted to water, their insolubility in water is due to the large _____ term (-TΔS), which is due to the water molecules dissolving the nonpolar molecule.

A) HPO_4^{2-}

B) dissolved but only partially ionized

C) disordered

D) $H_2PO_4^-$

E) negative entropy

F) H_3PO_4

G) higher electronegativity

H) positive entropy

I) insoluble

J) rotational

K) tetrahedral structure arrangement

L) acid versus base

M) base versus acid

N) hydrogen bond(s)

Ans: E
Difficulty Level: Easy
Section Ref: 2-2

7. Choose the correct answer from the list. Not all the answers will be used.

A strong acid is completely ionized in water, whereas a weak acid is

A) base versus acid.

B) positive entropy.

C) negative entropy.

D) rotational.

E) dissolved but only partially ionized.

F) higher electronegativity.

G) disordered.

H) insoluble.

I) hydrogen bond(s).

J) tetrahedral structure arrangement.

K) acid versus base.

L) H_3PO_4.

M) $H_2PO_4^-$.

N) HPO_4^{2-}.

Ans: E
Difficulty Level: Easy
Section Ref: 2-3

8. Choose the correct answer from the list. Not all the answers will be used.

Phosphate, with a pK_2 of = 6.82, will be mostly in the HPO_4^{2-} form at pH 7.2. At pH 5.82 it is mostly in the _____ form.

A) positive entropy

B) H_3PO_4

C) acid versus base

D) negative entropy

E) rotational

F) $H_2PO_4^-$

G) dissolved but only partially ionized

H) insoluble

I) HPO_4^{2-}

J) tetrahedral structure arrangement

K) disordered

L) higher electronegativity

M) base versus acid

N) hydrogen bond(s)

Ans: F
Difficulty Level: Hard
Section Ref: 2-3

9. Choose the correct answer from the list. Not all the answers will be used.

A solution of buffer at a pH of 8.5 with a p*K* of = 7.5 would have more capacity to buffer the addition of

A) higher electronegativity.

B) $H_2PO_4^-$.

C) hydrogen bond(s).

D) HPO_4^{2-}.

E) acid versus base.

F) disordered.

G) positive entropy.

H) negative entropy.

I) insoluble.

J) H_3PO_4.

K) rotational.

L) base versus acid.

M) tetrahedral structure arrangement.

N) dissolved but only partially ionized.

Ans: E
Difficulty Level: Hard
Section Ref: 2-3

10. Choose the correct answer from the list. Not all the answers will be used.

A phosphate buffer solution at a pH = pK_1 = 2.15 would have equal amounts of phosphate in the _____ form and the $H_2PO_4^-$ form.

A) tetrahedral structure arrangement

B) disordered

C) HPO_4^{2-}

D) negative entropy

E) acid versus base

F) $H_2PO_4^-$

G) positive entropy

H) higher electronegativity

I) insoluble

J) base versus acid

K) dissolved but only partially ionized

L) hydrogen bond(s)

M) rotational

N) H_3PO_4

Ans: N
Difficulty Level: Medium
Section Ref: 2-3

11. Hydrogen bonds within liquid water:

A) are attractions between the protons of the oxygen nuclei.

B) are dipole-dipole attractions.

C) are ion-induced dipole attractions.

D) are attractions between two hydrogen atoms.

E) are attractions between the H^+ and OH^- ions of the liquid.

Ans: B
Difficulty Level: Medium
Section Ref: 2-1, 2-3

12. In a hydrogen bond between a water molecule and another biomolecule:

A) a hydrogen ion on the water molecule forms an ionic bond with a hydride ion on the other molecule.

B) the partial charge on a hydrogen of the water interacts with the partial charge on a hydrogen of the other molecule.

C) the hydrogen bond will typically form between a hydrogen atom and either a nitrogen, sulfur, or oxygen atom.

D) a hydrogen on the water molecule forms a covalent bond to a hydrogen atom on the other molecule.

E) the hydrogen atom is located between an oxygen atom of the water and a carbon atom of the other molecule.

Ans: C
Difficulty Level: Medium
Section Ref: 2-1

13. Hydrophobic interactions between nonpolar molecules or groups:

A) result from the tendency to maximize water's contact with nonpolar molecules.

B) require the presence of surrounding water molecules.

C) are the result of strong attractions between nonpolar regions.

D) are the result of strong repulsion between water and nonpolar regions.

E) depend on strong permanent dipoles in the nonpolar molecules.

Ans: B
Difficulty Level: Medium
Section Ref: 2-2

14. Weak acids:

A) are only partially ionized in aqueous solution.

B) do not provide hydronium ions.

C) give solutions a high pH.

D) are almost insoluble in water.

E) are of no value in a buffering system.

Ans: A
Difficulty Level: Easy
Section Ref: 2-3

15. To make a phosphate buffer at pH 6.82 starting with one liter of 10 mM phosphoric acid (p*K*s are of 2.15, 6.82, and 12.38), you could add

A) 5 millimoles of HCl.

B) 20 millimoles of K^+.

C) 25 millimoles of HCl.

D) 15 millimoles of KOH.

E) You can't make a buffer by adding HCl or KOH.

Ans: D
Difficulty Level: Hard
Section Ref: 2-3

16. To make an acetate buffer at pH 4.76 (pK = 4.76) starting with 500 mL of 0.1 M sodium acetate (p*K* = 4.76), you could add:

A) 0.1 moles of HCl.

B) 0.025 moles of HCl.

C) You can't make a buffer by adding HCl or NaOH.

D) 0.1 moles of NaOH.

E) 0.2 moles of HCl.

Ans: B
Difficulty Level: Hard
Section Ref: 2-3

17. Amphiphilic molecules:

A) have both oxidizing and reducing groups.

B) have chromophores in two different wavelength regions.

C) have both acidic and basic groups.

D) have both hydrophilic and hydrophobic groups.

E) are micelles.

Ans: D
Difficulty Level: Easy
Section Ref: 2-2

18. If you added a drop (about 0.05 mL) of 1.0 M HCl to one liter of pure water (assume pH 7.0), the pH would become:

A) 7.0 (there would be no significant change)

B) 4.3

C) 5.0

D) 2.7

E) 9.7

Ans: B
Difficulty Level: Hard
Section Ref: 2-3

19. If you add 1.0 mL of 1.0 M acetic acid (pK = 4.76, K = 1.74 x 10^{-5}) to one liter of pure water, the resulting pH would be approximately:

A) 10.1

B) 3.9

C) 1.0

D) 3.0

E) 1.32

Ans: B
Difficulty Level: Hard
Section Ref: 2-3

20. The pH of a 0.1M solution of sodium acetate would be:

A) basic, because of the acetate ion reacts with water to form acetic acid and OH^-.

B) acidic, because the acetate ion is acidic.

C) acidic, because the acetate ion forms acetic acid.

D) neutral, because salts are neither acidic nor basic.

E) basic, because the Na^+ ionizes and combines with OH^-.

Ans: A
Difficulty Level: Medium
Section Ref: 2-3

21. Which of the following statements is <u>not true</u> about hydrophobic interactions?

A) They are the main driving force for protein folding into 3D structures.

B) When a non-polar solute dissolves in water, it causes a highly-ordered shell of water molecules to form at the interface between it and water: A hydrophobic interaction is caused by the desire of water molecules to regain entropy lost during this organization around the non-polar substance by excluding the substance from interaction with water molecules.

C) They are the driving force for micelle formation in <u>amphiphilic</u> substances where micelle formation is due to the desire of water molecules to exclude the hydrophobic regions –forcing them to interact with themselves instead of water molecules.

D) They are entropy driven.

E) They are caused by hydrophobic molecules interacting strongly with each other.

Ans: E
Difficulty Level: Medium
Section Ref: 2-2

22. What is the ratio of citric acid ($pK_1 = 3.09$) to monosodium citrate in a 1.0 M citric acid solution with a pH = 2.09?

A) 10:11

B) 1:11

C) 10:1

D) 1:1

E) 1:10

Ans: C
Difficulty Level: Hard

Section Ref: 2-3

23. Which of the following statements about water is incorrect?

A) Water is an excellent solvent for polar molecules.

B) Pure water has a concentration of approximately 55.5 M.

C) Non-polar molecules do not dissolve in water, but form a separate phase.

D) Cations are solvated by shells of water molecules oriented with their hydrogen atoms pointed toward the ions.

E) Amphiphilic detergents often form micelles with the polar groups on the outside exposed to the water (solvent) and the non-polar groups sequestered in the interior.

Ans: D
Difficulty Level: Medium
Section Ref: 2-1, 2-2

24. Approximately how many grams of monosodium succinate (FW = 140 g/mol; succinic acid pK_2=5.64) and disodium succinate (FW = 162 g/mol) must be added to 1L of water to produce a solution with a pH 5.28 and a total solute concentration of 100 mM. (Answer in grams monosodium succinate, grams disodium succinate)

A) 11.3, 4.2

B) 9.7, 4.9

C) 4.9, 9.7

D) 14.9, 1.1

E) 1.1, 14.9

Ans: B
Difficulty Level: Hard
Section Ref: 2-3

25. The strongest *non-covalent* interactions are:

A) van der Waal forces

B) London dispersion forces

C) hydrogen bonds

D) dipole-dipole interaction

E) ionic interactions

Ans: E
Difficulty Level: Easy
Section Ref: 2-1

26. Which of the following is the best explanation for the hydrophobic effect?

A) It is caused by an affinity of hydrophobic groups for each other.

B) It is an entropic effect, caused by the desire of water molecules to increase their entropy by forming highly ordered structures (called clathrates) around the hydrophobic groups.

C) It is an entropic effect caused by the desire of hydrophobic groups to increase their entropy by associating with other hydrophobic groups.

D) It is an entropic effect, caused by the desire of water molecules to increase their entropy by excluding hydrophobic groups, which they must otherwise surround with highly ordered structures (called clathrates).

E) It is caused by the affinity of water for hydrophobic groups.

Ans: D
Difficulty Level: Medium
Section Ref: 2-2

27. What is the approximate pK of a weak acid HA if a solution 0.1 M HA and 0.3 M A^- has a pH of 6.5?

A0 6.0

B) 6.6

C) 5.8

D) 6.2

E) 6.4

Ans: A
Difficulty Level: Medium
Section Ref: 2-3

28. Ice

A) is a crystal of water molecules packed in an open structure of hydrogen bonds

B) is less dense than liquid water

C) Is H-bonded to a similar extent as liquid water

D) all of the above

E) none of the above

Ans: D
Difficulty Level: Easy
Section Ref: 2-1

29. Hydrogen bonds are approximately ____% of the bond strength of covalent C-C or C-H bonds?

A) 1%

B) 95%

C) 50%

D) 5%

E) 20%

Ans: D
Difficulty Level: Medium
Section Ref: 2-1

30. _____ is exceptionally soluble in water due to the formation of hydrogen bonds.

A) oxygen

B) benzene

C) NaCl

D) ethanol

E) sodium palmitate

Ans: D
Difficulty Level: Medium
Section Ref: 2-1

31. In the energetics of transferring hydrocarbons from water to nonpolar solvents, the factor $T\Delta S$ is commonly:

A) unimportant

B) negative

C) assumed to be zero

D) positive

E) unmeasurable

Ans: D
Difficulty Level: Medium
Section Ref: 2-2

32. In water solvent, globules of up to several thousand amphiphilic molecules arranged with the hydrophilic groups on the surface and the hydrophobic groups buried in the center are called:

A) micelles

B) liposomes

C) vacuoles

D) bilayer membranes

E) none of the above

Ans: A
Difficulty Level: Easy
Section Ref: 2-2

33. K_w, the ionization constant of water, is _____ at _____.

A) 10^{-14}; 0°C

B) 10^{14}; 25°C

C) 10^{-14}; 25°C

D) 10^{-7}; 25°C

E) 10^{7}; 25K

Ans: C
Difficulty Level: Easy
Section Ref: 2-3

34. The pH at the midpoint of an acid/base titration is:

A) equal to the pK of the corresponding acid

B) equal to the pK of the corresponding base

C) equal to 14 minus the pK of the corresponding acid

D) equal to 14 plus the pK of the corresponding base

E) none of the above

Ans: A
Difficulty Level: Medium
Section Ref: 2-3

35. The blood buffering system is based on:

A) the reaction of CO_2 with H_2O to form carbonic acid

B) the ionization of aqueous carbonic acid to H^+ and the bicarbonate anion

C) the decrease of the blood pH due to the production of H^+

D) the excretion of bicarbonate and ammonium from the kidneys

E) all of the above

Ans: E
Difficulty Level: Easy
Section Ref: 2-3

36. Fatty acid anions assemble into _____ in aqueous solution.

A) two dimensional membranes

B) solvent-filled vesicles

C) micelles

D) lipid bilayers

E) liposomes

Ans: C
Difficulty Level: Easy
Section Ref: 2-2