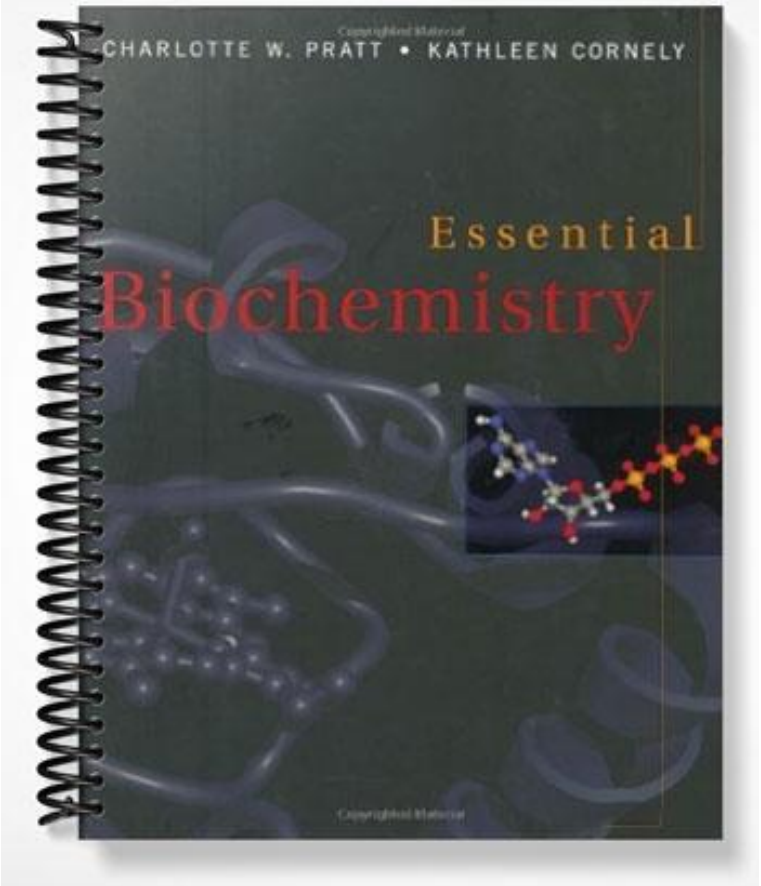
TEST BANK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Essential
Biochemistry

Chapter 2 Aqueous Chemistry

MATCHING

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

1. A water molecule has a _____ shape, with the oxygen at the center.
2. The uneven distribution of charges on a water molecule makes it _____.
3. Water has high _____, because it is cohesive.
4. The closest two non-interacting atoms can come to each other is dependent on their _____ radii.
5. A particle dissolved in water is a _____.
6. Substances that are easily hydrated are said to be _____.
7. Molecules that are insoluble, or barely soluble, in water, are referred to as _____.
8. Amphiphilic molecules such as lipids can form spherical structures called _____.
9. A substance that can donate a proton is a(n) _____.
10. A substance that can accept a proton is a(n) _____.

A) polar
B) hydrophobic
C) solute
D) micelles
E) tetrahedral
F) acid
G) London Forces
H) base
I) surface tension
J) amphipathic
K) hydrophilic
L) van der Waals

ANSWER KEY:

1. E) tetrahedral [Section: 1; Learning Objective: 1]
2. A) polar [Section: 1; Learning Objective: 1]
3. I) surface tension [Section: 1; Learning Objective: 1]
4. L) van der Waals [Section: 1; Learning Objective: 2]
5. C) solute [Section: 1; Learning Objective: 2]
6. K) hydrophilic [Section: 2; Learning Objective: 3, 4]
7. B) hydrophobic [Section: 2; Learning Objective: 3, 4]
8. D) micelles [Section: 2; Learning Objective: 5]
9. F) acid [Section: 3; Learning Objective: 6]
10. H) base [Section: 3; Learning Objective: 6]

Terms not used: G) London Forces and J) amphipathic

FILL IN
Write the word or phrase that best completes each statement or answers the question.

11. The _____ theory states that glaciers covered the earth's continents and the oceans were topped by ice nearly a kilometer thick.
Answer: snowball earth
Section: Introduction
Learning Objective: --

12. A critical requirement for life on earth is the presence of the chemical _____.
Answer: water (H_2O)
Section: 1
Learning Objective: --

13. The hydrogen bonds in water have _____ lifetimes.
Answer: fast (or short) ~~The hydrogen bonds in water have very fast short lifetimes only about 10^{-12} s. As a result Consequently, water is very dynamic, as the molecules bend and reorient and re-form the hydrogen bonds with other water molecules.~~
Section: 1
Learning Objective: 1

14. An atom's affinity for electrons is referred to as its _____.
Answer: electronegativity
Section: 1
Learning Objective: 2

15. Interactions between nonpolar molecules can occur due to small, temporary variations in electron distributions~~, and;~~ these are called _____.
Answer: London dispersion forces
Section: 1
Learning Objective: 2

16. An ion that is surrounded by water molecules is said to be _____, or hydrated.
Answer: solvated
Section: 1
Learning Objective: 3

17. The exclusion of nonpolar molecules ~~are excluded~~ from an aqueous phase ~~it~~ is called the _____.
Answer: hydrophobic effect
Section: 2
Learning Objective: 4

18. A molecule that possesses both hydrophobic and hydrophilic parts is said to be _____.
Answer: amphipathic (or ~~amphibolic~~amphiphilic)
Section: 2
Learning Objective: 5

19. The movement of a proton from one water molecule to the next is known as _____.
Answer: proton jumping
Section: 3

Learning Objective: 6

20. In some illnesses an increase in hydrogen ions results in a blood pH below 7.35. This is a dangerous condition known as _____.
Answer: metabolic acidosis
Section: 3
Learning Objective: --

MULTIPLE CHOICE
Choose the one alternative that best completes the statement or answers the question.

21. When the earth was covered with ice during a frozen period, the only surviving organisms in the water layers beneath the ice were likely:
    A) bacteria
    B) algae
    C) insects
    D) A and B
    E) A, B, and C
Answer: D
Section: Introduction
Learning Objective: --

22. How many hydrogen bonds can a water molecule potentially ~~coordinate~~take part in forming?
    A) one
    B) two
    C) three
    D) four
    E) none of the above
Answer: D
Section: 1
Learning Objective: 1

23. Rank the following in terms of strength, from greatest to lowest:
    A) covalent bonds, hydrogen bonds, ionic interactions
    B) covalent bonds, ionic interactions, hydrogen bonds
    C) ionic interactions, covalent bonds, hydrogen bonds
    D) hydrogen bonds, covalent bonds, ionic interactions
    E) none of the above
Answer: B
Section: 1
Learning Objective: 1

24. Which of the following are typical hydrogen bond interactions?
    A) N—H, H—H, S—H, Na—Cl~~Na$^+$ Cl$^-$~~
    B) O—H, S—H, Fe—H
    C) N—H, O—H, S—H
    D) N—H, S—H, Na—Cl
    E) none of the above

Answer: C
Section: 1
Learning Objective: 1, 2

25. How does the hydrophobic effect influence the structures of large molecules?
    A) nonpolar molecules are not easily solubilized in water and aggregate ~~together~~
    B) polar groups are oriented on the surface, interacting with the water
    C) nonpolar molecules can mask the polar characteristics of the hydrophilic molecules
    D) A and B
    E) A and C

Answer: D
Section: 2
Learning Objective: 4

26. Lipids can form the following structures:
    A) micelles
    B) vesicles
    C) bilayers
    D) none of the above
    E) all of the above

Answer: E
Section: 2
Learning Objective: 5

27. In a neutral aqueous solution the concentrations of H^+ and OH^- are each:
    A) 55 M
    B) 1 x 10^{-7} M
    C) 1 x -10^{-14} M
    D) 5 mM
    E) none of the above

Answer: B
Section: 3
Learning Objective: 6

28. What is the final pH ~~of a solution of water to which~~ when 100 mL of 0.5 M HCl is added to 900 mL of water?
    A) 1.3
    B) 5.0
    C) 13.0

D) 0.5
E) none of the above

Answer: A
Section: 3
Learning Objective: 8

29. Which of the following statements is true?
A) Buffers work best ~~in a~~ when the pH ~~range~~ is within 3 units ~~within~~ of the pK_a ~~values.~~
B) Buffers can be prepared using the Henderson~~-~~ Hasselbalch equation.
C) A buffer requires a combination of a weak acid~~/~~ and its conjugate base ~~pair~~.
D) A and B
E) B and C

Answer: E
Section: 3
Learning Objective: 9

30. The most important buffering system for maintaining proper blood pH is:
A) the charges on the amino acids
B) the bicarbonate buffer system of CO_2, carbonic acid, and bicarbonate
C) phosphate groups of serum phosphoproteins
D) none of the above
E) all of the above

Answer: B
Section: 3
Learning Objective: --

SHORT ANSWER
Write your answer in the space provided or on a separate sheet of paper.

31. Where is most of the water in humans found?
Answer: In humans, most water is found in the intracellular fluid (within cells) and in the interstitial fluids (surrounding cells).
Section: 1
Learning Objective: --

32. Describe the appearance of a water molecule.
Answer: A water molecule has an oxygen atom with two pairs of unshared electrons and two covalently bound hydrogen atoms ~~covalently bound~~. This gives the molecule a nearly ~~tetrahedron~~ tetrahedral shape, with the hydrogens at two corners, ~~and~~ the unshared electrons at the other corners, ~~surrounding~~ and the oxygen in the center.
Section: 1
Learning Objective: 1

33. Why are ~~the small~~ weak chemical forces compared to Gulliver's entrapment by the Lilliputians?

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Answer: ~~Small~~ Weak chemical forces are ~~not strong bonds, many being much weaker than a~~ not as strong as covalent bonds. However, the cumulative effect of ~~the small bonds in~~ London forces, van der Waals interactions, and hydrogen bonds can be large, much like the combined tethers the Lilliputians used to constrain Gulliver.
Section: 1
Learning Objective: 2

34. Why are polar molecules readily solubilized?
Answer: Polar molecules are easily solubilized in water because the polar groups can form hydrogen bonds with the atoms in the solvent water.
Section: 1
Learning Objective: 3

35. What happens when a substance such as oil is added to water?
Answer: Oil is non~~-~~polar and hydrophobic~~,~~ and will coalesce as a separate phase, often on top of the water. It will ~~only~~ mix only if energy is added to the system, for example, by heat or stirring.
Section: 2
Learning Objective: 3

36. Discuss the changes in entropy that occur when molecules are dissolved in water~~, which processes are important to solvation?~~.
Answer: ~~Both entropy and enthalpy changes are critical to altering the free energy barrier (ΔG) in the process. Entropy has the greatest effect, as the water molecules must reorient and align, and this limits the degree of freedom the molecules have to move, thus lowering the entropy.~~The entropy of the solute molecules increases as they become dispersed in solution. The entropy of the water molecules decreases, however, because they must reorient to accommodate the solute molecules and are therefore not as free to form hydrogen bonds with other water molecules.
Section: 2
Learning Objective: 3

37. Why are lipid bilayers so important to cells?
Answer: The bilayer prevents polar molecules from diffusing freely across the barrier. Consequently, cellular compartments that are sequestered by bilayers~~, thus, the sequestered compartments~~, such as the ~~interior of cells~~ cytosol, organelles, and vesicles, can have ~~a~~ different concentrations of solutes than the external solution.
Section: 2
Learning Objective: 5

38. Why do humans sweat?
Answer: Humans generate heat, especially during exercise, and the act of sweating allows for the dissipation of heat. During exercise, water and ions are excreted through sweat glands, and the evaporation ~~process causes heat loss, and thus~~of water molecules, a process that requires heat, is a mechanism for cooling the body.
Section: 3
Learning Objective: --

39. What is the difference between strong acids ~~and~~ or bases~~,~~ and weak acids ~~and~~ or bases, when they are added to a solution?

Answer: Strong acids ~~and bases~~ will completely dissociate. Weak acids ~~and bases~~ will only partially ionize, existing in an equilibrium of ~~partial dissociation~~the intact (protonated) and dissociated (unprotonated) forms. Strong bases become completely protonated, whereas weak bases become only partly protonated, existing in an equilibrium of protonated and unprotonated forms.

Section: 3

Learning Objective: 8

40. What is the effective buffering range of ~~an~~ a weak acid?

Answer: The buffering range is considered effective within one pH unit of the acid's p*K* value.

Section: 3

Learning Objective: 9

SHORT ANSWER FROM WEBSITE

Write your answer in the space provided or on a separate sheet of paper.

41. Vinegar is a common household item. What type of acid is vinegar?

Answer: Vinegar is a 3% solution of acetic acid.

42. What are alkaloids, and ~~provide~~ what are some examples of alkaloids found in foods?

Answer: Alkaloids are a type of base that contains nitrogen. Examples include caffeine, nicotine, and quinine (tonic water).

43. In what form are protons found in water?

Answer: Protons are usually found associated with a water molecule, forming a hydronium ion, H_3O^+.

44. How is the concentration of ~~the~~ H^+ used to determine the pH of a solution?

Answer: The formula pH = ~~-~~ log $[H^+]$ is used to determine the pH of a solution.

45. Describe the pH scale.

Answer: The pH scale ranges ~~is fro~~ from 1~~-~~ to 14. Values below 7 are acidic, and values greater than 7 are alkaline. A pH of 7 is considered neutral. The further the number is from 7 (e.g., a pH of 2 or 13), the ~~stronger the acid or base~~ more acidic or basic the solution.

46. What is a K_a value?

Answer: The K_a value is the acid dissociation constant, ~~and is~~ a measure of how readily a weak acid dissociates in water.

47. What is an ~~acid~~ acid/base conjugate pair?

Answer: An ~~acid~~ acid/base conjugate pair consists of the protonated (acid) and unprotonated (base) forms of a molecule. The acid can donate a proton, becoming the conjugate base. The base can accept a proton, becoming the conjugate acid. ~~is the pair of molecules that can act as the proton donors and acceptors in a reaction.~~ For example, the conjugate base of acetic acid ~~would be an~~ is the acetate anion.

48. What is the Henderson~~-~~ Hasselbalch ~~reaction~~ equation?

Answer: This ~~reaction~~ equation relates ~~is used to examine~~ the pH and the p*K* of a weak acid in a solution of the weak acid and its conjugate base. The equation is: pH = pK + log [base]/[acid]

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49. What is the utility of the Henderson-~~–~~Hasselbalch reaction?
Answer: The equation can be used to calculate the concentrations of an acid and its conjugate base ~~that are~~ required to make a buffer of a specific pH~~, using a conjugate acid base pair~~.

50. Define a buffer.
Answer: A buffer is a solution that resists a change in pH~~,~~ when bases or acids are added.