

***Biochemistry A Short Course 4th edition Tymoczko  
Test Bank***

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## **Chapter 2**

1. Molecules that are readily soluble in water are considered:

- a. nonpolar.
- b. polar.
- c. zwitterionic.
- d. volatile.
- e. dielectric.

ANSWER: b

2. The interaction that is described by Coulomb's law is called:

- a. hydrophobic.
- b. weak.
- c. electrostatic.
- d. hydrogen.
- e. physical.

ANSWER: c

3. What would be the solubility of a salt in a solvent with a low dielectric constant?

- a. excellent
- b. good
- c. suitable
- d. poor
- e. exclusive

ANSWER: d

4. Hydrophobic molecules are driven together by:

- a. entropy.
- b. enthalpy.
- c. van der Waals interactions.
- d. affinity.
- e. hydrogen bonds.

ANSWER: a

5. The protein that interacts with both water and the hydrophobic regions of the membrane is considered:

- a. polar.
- b. nonpolar.
- c. amphibious.
- d. anabolic.
- e. amphipathic.

ANSWER: e

6. Protonation of a base yields its:

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- a. conjugate molecule.
- b. conjugate base.
- c. conjugate acid.
- d. ionized derivative.
- e. ionized base.

ANSWER: c

7. An organic acid ionizes to form a conjugate base and:

- a. hydrogen.
- b. water.
- c. a hydroxyl ion.
- d. a proton.
- e. hydrogen peroxide.

ANSWER: d

8. Gastroesophageal reflux disease is a common example of a pathological change in:

- a.  $pK_a$  of acetic acid.
- b. hydrogen bonds in a key digestive enzyme.
- c. protein structure.
- d. water content in cells.
- e. pH level.

ANSWER: e

9. What is the pH of human blood?

- a. 5.5
- b. 7.0
- c. 9.4
- d. 6.4
- e. 7.4

ANSWER: e

10. Choose the functional group that CANNOT form a hydrogen bond with water.

- a. carbonyl group
- b. amino group
- c. aromatic ring
- d. alcohol group
- e. sulfhydryl group

ANSWER: c

11. Which combination can associate to form a hydrogen bond?

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- a. N–H and O
- b. N–H and S
- c. O–H and P
- d. C=O and S
- e. C=O and P

ANSWER: a

12. What is the typical length of noncovalent bonds?

- a. 0.4 angstroms
- b. 4 angstroms
- c. 40 angstroms
- d. 4 nm
- e. 0.04 nm

ANSWER: b

13. In a typical cell, the water content is about:

- a. 60%.
- b. 70%.
- c. 80%.
- d. 90%.
- e. 99%.

ANSWER: b

14. Oxygen is an electronegative atom. That means that in a molecule of water the:

- a. electrons of covalent bonds spend more time near the oxygen atom than near the hydrogen atoms.
- b. electrons of covalent bonds spend more time near the hydrogen atoms than near the oxygen atom.
- c. electrons of bonds are located closely to the hydrogen atoms.
- d. electrons of bonds are located closely to the oxygen atom.
- e. bonds joining the hydrogen atoms to the oxygen atom are noncovalent.

ANSWER: a

15. What does it mean that liquid water has a partly ordered structure?

- a. There are van der Waals interactions between water molecules.
- b. Hydrogen-bonded clusters of molecules are continually being formed and broken apart in liquid water.
- c. In the physiological range of temperatures liquid water can undergo phase transition to gas that is completely unordered and to ice that is completely ordered.
- d. There is Brownian motion of water molecules.
- e. Water molecules can form hydrogen bonds with polar molecules but not with nonpolar molecules.

ANSWER: b

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16. How many neighboring water molecules are hydrogen-bonded on average to one water molecule in a sample of pure water?

- a. 1.4
- b. 2.4
- c. 3.4
- d. 4.4
- e. 5.4

ANSWER: c

17. What type of interactions is NOT a weak interaction?

- a. nuclear interactions
- b. salt bridges
- c. van der Waals interactions
- d. ionic bonds
- e. hydrogen bonds

ANSWER: a

18. What is the amount of energy needed to apply a 1-newton force over a distance of 1 angstrom?

- a.  $10^{10}$  J
- b.  $10^{-10}$  J
- c. 1 J
- d. 10 J
- e. 1 kcal

ANSWER: b

19. What is the amount of energy needed to raise the temperature of 2 kilograms of water from 14.5°C to 15.5°C?

- a. 2 J
- b. 2 kJ
- c. 2 cal
- d. 20 cal
- e. 2 kcal

ANSWER: e

20. How does Coulomb's energy depend on the distance ( $r$ ) between the two interacting corpuscles?

- a. directly proportional to  $r$
- b. directly proportional to  $r^2$
- c. inversely proportional to  $r$
- d. inversely proportional to  $r^2$
- e. directly proportional to  $2r$

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ANSWER: d

21. What factor does NOT affect electrostatic interaction according to Coulomb's law?

- a. the charges on the two interacting atoms
- b. a change in entropy if the interaction occurs
- c. the distance between the two interacting atoms
- d. the dielectric constant of the medium
- e. presence and concentration of other charged corpuscles in the medium

ANSWER: b

22. How much weaker are hydrogen bonds as compared to covalent bonds?

- a. from 2 to 10 times
- b. from 20 to 50 times
- c. from 100 to 1000 times
- d. from 1000 to 10,000 times
- e. from 10,000 to a million times

ANSWER: b

23. What is the difference in length between a typical hydrogen bond and a covalent bond?

- a. They are equal in length.
- b. A hydrogen bond is somewhat shorter than a covalent bond.
- c. A hydrogen bond is much shorter than a covalent bond.
- d. A hydrogen bond is somewhat longer than a covalent bond.
- e. A hydrogen bond is much longer than a covalent bond.

ANSWER: d

24. What group in nucleotide bases is a hydrogen-bond donor?

- a. N–H
- b. S–H
- c. P–O
- d. C=O
- e. C–H

ANSWER: a

25. Van der Waals interactions do not depend on:

- a. the distance between the two interacting atoms.
- b. the distribution of electrons around the nuclei.
- c. the presence of other charged corpuscles in the medium.
- d. a transient asymmetry in electrical charge of atoms.
- e. the geometry of the large molecules.

ANSWER: c

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26. What amino acids are most likely to be found in the core of a water-soluble globular protein?

- a. nonpolar
- b. polar but uncharged
- c. positively charged
- d. negatively charged
- e. random

ANSWER: a

27. Choose the molecule around which in an aqueous solution water molecules are most ordered.

- a. alcohol
- b. aliphatic amino acid
- c. aromatic amino acid
- d. hydrocarbon chain
- e. carboxylic acid

ANSWER: d

28. HCl is a strong acid that is easily and completely hydrolyzed in an aqueous solution. What is the concentration of hydroxyl ions in a 50 mM aqueous HCL solution?

- a.  $2 \times 10^{-7}$  M
- b.  $5 \times 10^{-6}$  M
- c.  $2 \times 10^{-12}$  M
- d.  $2 \times 10^{-13}$  M
- e.  $5 \times 10^{-4}$  M

ANSWER: d

29. What is the net charge of a glycine molecule in human blood at pH 7.4, for an amino group of glycine  $pK_a = 9.6$  and for a carboxyl group  $pK_a = 2.3$ ?

- a. -2
- b. -1
- c. 0
- d. +1
- e. +2

ANSWER: c

30. Choose the correct name for the plot of pH changes in a weak acid solution under stepwise addition of a strong acid or base.

- a. van der Waals curve
- b. Michaelis–Menten curve
- c. Henderson–Hasselbalch curve

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- d. compensatory respiratory alkalosis curve
- e. titration curve

ANSWER: e

31. Tris buffers are commonly used in biochemistry because they buffer within the physiological range of pH due to a  $pK_a$  of 8.1. What is the  $[A^-]/[HA]$  ratio in a 0.1 M tris solution with pH 9.1?

- a. 1:100
- b. 1:10
- c. 10:1
- d. 2:1
- e. 1:2

ANSWER: c

32. What organ in the human body is crucial for blood pH regulation by compensatory respiratory alkalosis?

- a. heart
- b. kidneys
- c. liver
- d. lungs
- e. muscles

ANSWER: d

33. Tris buffers are commonly used in biochemistry because they buffer within the physiological range of pH due to a  $pK_a$  of 8.1. What is the concentration of the conjugate base in a 0.1 M tris solution with pH 5.1?

- a. 0.1 M
- b. 0.01 M
- c. 0.05 M
- d. 0.5 nM
- e. 0.1 mM

ANSWER: e

34. What is the concentration of acetate in a 0.1 M acetic acid solution at pH near to  $pK_a = 4.76$ ?

- a. 0.5 M
- b. nearly 0.1 M
- c. 0.05 M
- d. 0.01 M
- e. almost 0

ANSWER: b

35. What is the  $[A^-]/[HA]$  ratio when a weak acid is in a solution two pH units below its  $pK_a$ ?

- a. 1:100

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- b. 1:10
- c. 10:1
- d. 2:1
- e. 1:2

ANSWER: a

36. What is the hydroxyl ion concentration in a urine sample that has a pH of 6?

- a.  $10^{-6}$  M
- b.  $10^{-8}$  M
- c.  $10^6$  M
- d.  $10^{-14}$  M
- e. 6 M

ANSWER: b

37. What is the molar concentration of water in pure water?

- a. 1 M
- b. 100 M
- c. 55.5 M
- d. 5.55 M
- e. 1 mM

ANSWER: c

38. What is the  $H^+$  concentration in a urine sample that has a pH of 6?

- a.  $10^{-6}$  M
- b.  $10^{-8}$  M
- c.  $10^6$  M
- d.  $10^{-14}$  M
- e. 8 M

ANSWER: a

39. Typical van der Waals energies are about:

- a. 4–20 kJ/mol.
- b. 2–4 kJ/mol.
- c. 200–400 kJ/mol.
- d. 2–4 J/mol.
- e. 200–400 MJ/mol.

ANSWER: b

40. Nonpolar molecules in water:

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- a. dissolve independently.
- b. aggregate together.
- c. precipitate.
- d. dissociate to ions.
- e. form hydrogen bonds with water molecules.

ANSWER: b

41. What is the  $[A^-]/[HA]$  ratio when a weak acid is in a solution one pH unit above its  $pK_a$ ?

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

ANSWER: c

42. What are the primary chemical components present in a phosphate buffer at pH 7.4?

- a.  $H_3PO_4$  and  $PO_4^{3-}$
- b.  $H_2PO_4^-$  and  $PO_4^{3-}$
- c.  $HPO_4^{2-}$  and  $PO_4^{3-}$
- d.  $H_2PO_4^-$  and  $HPO_4^{2-}$
- e.  $H_3PO_4$  and  $HPO_4^{2-}$

ANSWER: d

43. What is the concentration of acetic acid in 250 ml of a 100 mM acetate buffer at pH 4.76?

- a. 250 mM
- b. 100 mM
- c. 50 mM
- d. 75 mM
- e. 25 mM

ANSWER: c

44. Citric acid is an important intermediate in glucose metabolism and is synthesized in the mitochondrial matrix. The  $pK_a$  values for each of the three carboxylic groups of the citric acid are 3.1, 4.8, and 6.4. What is the charge on a citrate molecule formed in the mitochondrial matrix where the pH is 7.8?

- a. +3
- b. +2
- c. -3
- d. -2
- e. +1

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ANSWER: c

45. A student observes that when an unknown molecule is added to water, it forms micelles, which under the right conditions can form membranes. What can this student infer about this phenomenon?

- a. The unknown molecule is amphipathic.
- b. The micelle formation is driven by the resulting decrease in entropy of water.
- c. The unknown molecule forms many van der Waals interactions with water.
- d. The micelle formation is driven by the hydrophilic effect.
- e. The unknown molecule dissociates to ions in water.

ANSWER: a

46. What is the term for the movement of particles due to the random fluctuations of energy content of the environment?

- a. dissociation
- b. Brownian motion
- c. hydrophobic interaction
- d. van der Waals interaction
- e. entropy

ANSWER: b

47. What is the term for the electrostatic interactions between atoms with opposite electrical charges?

- a. salt bridges
- b. Brownian motion
- c. hydrophobic interactions
- d. hydrogen bonds
- e. van der Waals interactions

ANSWER: a

48. Water weakens the electrostatic interaction of ions due to its:

- a. ionic bonds or salt bridges.
- b. Brownian motion.
- c. entropy.
- d. ion product of water.
- e. dielectric constant.

ANSWER: e

49. What is the contact distance when two atoms no longer repulse each other yet have the strongest attraction?

- a. amphipathic
- b. Brownian
- c. hydrophobic
- d. hydrogen

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e. van der Waals

ANSWER: e

50. Which type of amino acid is responsible for increasing entropy as a protein folds?

a. nonpolar

b. polar but uncharged

c. charged positively

d. charged negatively

e. amphipathic

ANSWER: a