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Name:_____ Class:_____ Date:_____

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. 2×10^{-7} M
    b. 5×10^{-6} M
    c. 2×10^{-12} M
    d. 2×10^{-13} M
    e. 5×10^{-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

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