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# Chapter 1 Introduction to Biochemistry

1) Which elements account for more than 97% of the weight of most organisms?

   A) C, H, N, Mg, O, S

   B) C, H, N, O, P, S

   C) C, H, N

   D) Fe, C, H, O, P

   E) $Ca^{2+}$, $K^{+}$, $Na^{+}$, $Mg^{2+}$, $Cl^{-}$

Answer: B
*Page Ref: Section 2*

2) Proteins in biological membranes may be

   A) porous.

   B) attached to the membrane surface.

   C) span the membrane.

   D) All of the above

   E) B and C only

Answer: D
*Page Ref: Section 3*

3) Which statement about cellulose is false?

   A) It is the most abundant polysaccharide in nature.

   B) Its monomers are joined by glycosidic bonds.

   C) It is present in the stems of flowering plants.

   D) The hydroxyl groups of neighboring cellulose molecules interact to form strong, insoluble fibers.

   E) It is a branched polymer of glucose.

Answer: E
*Page Ref: Section 3*

4) When $K_{eq}$ of a reaction = 1, then

A) the forward reaction is faster than the reverse reaction.

B) the reverse reaction is faster than the forward reaction.

C) the forward and reverse reaction rate constants are equal.

D) more products are formed than reactants.

E) fewer products are formed than reactants.

Answer: C
*Page Ref: Section 4*

5) Which statement is true about a reaction with an equilibrium constant, $K_{eq}$, equal to 1000?

A) The forward rate constant is 1000 times greater than the reverse rate constant.

B) The forward rate constant is 3 times greater than reverse rate constant.

C) The forward rate constant is 1000 times smaller than the reverse rate constant.

D) The forward rate constant is 3 times smaller than the reverse rate constant.

E) There is not enough information given to compare the forward and reverse rate constants.

Answer: A
*Page Ref: Section 4*

6) The study of the energy changes during metabolic reactions is called _____.

A) bioinformatics

B) metabodynamics

C) thermometrics

D) bioenergetics

E) biological heat dynamics

Answer: D
*Page Ref: Section 4*

7) A spontaneous chemical reaction always has a _____ change.

A) positive Gibb's free energy

B) negative Gibb's free energy

C) positive enthalpy

D) negative enthalpy

E) positive entropy

Answer: B
*Page Ref: Section 4*

8) Prokaryotes are valuable tools for biochemists because

A) *E. coli* is well–studied and typical of prokaryotes.

B) they contain as many genes as eukaryotic cells.

C) many of their chromosomes are sequenced.

D) they are not very diverse organisms.

E) All of the above

Answer: C
*Page Ref: Section 6*

9) Which cellular component carries out oxidation reactions, some of which produce hydrogen peroxide?

A) peroxisomes

B) mitochondria

C) chloroplasts

D) lysosomes

E) vacuoles

Answer: A
*Page Ref: Section 8*

10) Why is it important that the enzymes in lysosomes are more active at acidic pH than at neutral pH?

A) Since lysosomes are primarily found in the stomach acid of mammals, their pH dependence allows for maximum efficiency for the digestion of foodstuffs.

B) It prevents their diffusion out of the lysosomes.

C) It maximizes the interaction with their substrates which are always bases.

D) It prevents them from accidentally degrading the macromolecules in the cytosol.

E) It allows for regulation of their uptake by the mitochondria.

Answer: D
*Page Ref: Section 8*

11) Molecules from living cells cannot be synthesized outside of living cells.

Answer: FALSE
*Page Ref: Section 1*

12) Fermentation in the absence of cells demonstrated that metabolic processes were chemical in nature.

Answer: TRUE
*Page Ref: Section 1*

13) Enzymes are protein catalysts that form an intermediate with a substrate that fits into it.

Answer: TRUE
*Page Ref: Section 1*

14) The modified lock–and–key theory of enzyme action proposed by Emil Fischer has been completely replaced by more modern ideas of catalysis.

Answer: FALSE
*Page Ref: Section 1*

15) Enzymes are not as efficient as most catalysts used in organic chemistry, since they must function at body temperature.

Answer: FALSE
*Page Ref: Section 1*

16) Bioinformatics has permitted rapid advances in our understanding of structural macromolecules from living cells.

Answer: TRUE
*Page Ref: Section 1*

17) The role of DNA as the genetic material was confirmed by transforming *Streptococci* in experiments performed several years after the famous Watson and Crick description of DNA structure.

Answer: FALSE
*Page Ref: Section 1*

18) Crick referred to the flow of information from nucleic acid to protein as the Central Dogma.

Answer: TRUE
*Page Ref: Section 1*

19) Functional groups describe one or more portions of organic compounds found in living cells.

Answer: TRUE
*Page Ref: Section 2*

20) A phosphate ester contains a phosphate functional group.

Answer: TRUE
*Page Ref: Section 2*

21) Under most biological conditions, acid groups and amino groups are fully protonated.

Answer: FALSE
*Page Ref: Section 2*

22) Removal of water from residues of a macromolecule results in the formation of that macromolecule.

Answer: TRUE
*Page Ref: Section 3*

23) $M_r$ is the mass of a molecule relative to 1/12 the mass of an atom of the most common isotope of carbon.

Answer: TRUE
*Page Ref: Section 3*

24) Biochemists describing the molecular weight of a protein really mean the atomic weight in grams.

Answer: FALSE
*Page Ref: Section 3*

25) The absolute molecular mass of macromolecules is given in daltons, where 1 dalton = 1 atomic mass unit.

Answer: TRUE
*Page Ref: Section 3*

26) A peptide bond is formed by the condensation of different functional groups from two amino acids.

Answer: TRUE
*Page Ref: Section 3*

27) The conformation of a protein enzyme determines whether it is functional or not.

Answer: TRUE
*Page Ref: Section 3*

28) Lysozyme is an enzyme with a cleft or depression at its active site.

Answer: TRUE
*Page Ref: Section 3*

29) The Haworth projection of the ring form of a monosaccharide always shows a flat plane with one edge projecting out of the page (using thicker lines).

Answer: TRUE
*Page Ref: Section 3*

30) Sugars with six carbons are the only ones capable of forming a ring structure as shown in a Haworth projection.

Answer: FALSE
*Page Ref: Section 3*

31) ATP contains both phosphoester and phosphoanhydride linkages.

Answer: TRUE
*Page Ref: Section 3*

32) A phosphodiester linkage in DNA contains two phosphorous atoms.

Answer: FALSE
*Page Ref: Section 3*

33) Lipids aggregate to form bilayers because some lipid molecules are hydrophobic and other lipid molecules are hydrophilic.

Answer: FALSE
*Page Ref: Section 3*

34) Thermodynamics and its laws are obeyed by living cells.

Answer: TRUE
*Page Ref: Section 4*

35) The tendency of a metabolic reaction to proceed is due to the free energy of both the reactants and products as well as the change in randomness of that reaction.

Answer: TRUE
*Page Ref: Section 4*

36) Biochemical reactions are more likely to proceed if the reaction has an increase in enthalpy ( $\triangle$H) and a decrease in entropy ($\triangle$S).

Answer: FALSE
*Page Ref: Section 4*

37) All prokaryotic cells are about 1/10 the size of an average eukaryotic cell or smaller.

Answer: FALSE
*Page Ref: Section 5*

38) All cells have kept the same general patterns of metabolism, a very similar genetic code and the same monomers or residues.

Answer: TRUE
*Page Ref: Section 5*

39) Eukaryotes include plants, animals and bacteria.

Answer: FALSE
*Page Ref: Section 5*

40) The only reason phages are not considered to be cells is because they do not contain a plasma membrane.

Answer: FALSE
*Page Ref: Section 6*

41) Diffusion is an adequate means of distributing nutrients in prokaryotic cytoplasm because they have more surface area than volume compared to most eukaryotes.

Answer: TRUE
*Page Ref: Section 7*

42) Eukaryotic cells are distinguished from prokaryotes by their usually larger size, a complex cytoskeleton and membrane–bounded organelles.

Answer: TRUE
*Page Ref: Section 7*

43) Chloroplasts are organelles found in plants, algae and some protists and are the site of photosynthesis.

Answer: TRUE
*Page Ref: Section 7*

44) The endoplasmic reticulum is the major site of RNA synthesis and the site of assembly of ribosomes.

Answer: FALSE
*Page Ref: Section 8*

45) The nuclear envelope is a membrane that surrounds the nucleus and is continuous with the endoplasmic reticulum.

Answer: TRUE
*Page Ref: Section 8*

46) Ribosomes on the surface of rough endoplasmic reticulum are the site of ATP synthesis.

Answer: FALSE
*Page Ref: Section 8*

47) The Golgi apparatus consists of flattened, fluid–filled, membranous sacs and is responsible for chemical modification and sorting of some biomolecules.

Answer: TRUE
*Page Ref: Section 8*

48) Mitochondria are the main sites of energy transduction in aerobic eukaryotic cells.

Answer: TRUE
*Page Ref: Section 8*

49) The mitochondria and Golgi apparatus are two organelles which originated from bacteria and were incorporated into eukaryotic cells via symbiosis.

Answer: FALSE
*Page Ref: Section 8*

50) In an animal cell, DNA can be found only in the nucleus.

Answer: FALSE
*Page Ref: Section 8*

51) Actin has been shown to be one of the most evolutionarily conserved proteins. It is present in all eukaryotic cells and frequently is the most abundant protein in the cell.

Answer: TRUE
*Page Ref: Section 8*

52) The mitotic spindles are formed from microtubule proteins.

Answer: TRUE
*Page Ref: Section 8*

53) The filament fibers in the cytoskeleton are composed primarily of carbohydrate molecules.

Answer: FALSE
*Page Ref: Section 8*

54) The diffusion of large molecules such as enzymes is significantly slowed by the presence of the cytoskeleton.

Answer: TRUE
*Page Ref: Section 8*

55) In eukaryotic cells lysosomes are specialized digestive vesicles with a highly acidic interior.

Answer: TRUE
*Page Ref: Section 8*

56) The process of cell division that occurs in the tissues is called mitosis.

Answer: TRUE
*Page Ref: Section 8*

57) Photosynthesis involves capturing energy from light that is then used to drive the formation of carbohydrates from carbon dioxide and water.

Answer: TRUE
*Page Ref: Section 8*

58) The chemical name for ATP is alanine triphosphate.

Answer: FALSE
*Page Ref: Section 8*

59) Absolute zero is equal to 0 °C.

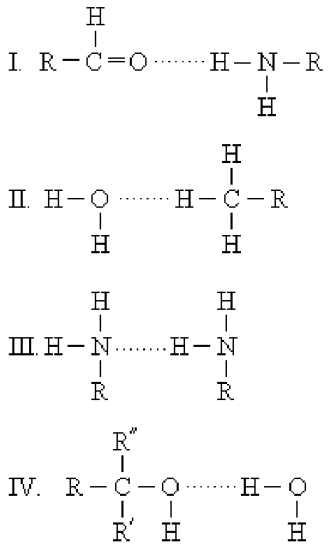
Answer: FALSE
*Page Ref: Appendix*

60) One Angstrom is equal to $1 \times 10^{-10}$ meters.

Answer: TRUE
*Page Ref: Appendix*

# Chapter 2 Water

1) Which is not a proper way to form a hydrogen bond? (The symbol "R" represents a general organic group. The hydrogen bonding is represented by dashed lines.)



A) I B) II C) III D) IV

Answer: B
*Page Ref: Section 1*

2) Which statement does <u>not</u> explain the polarity of water?

A) Oxygen is more electronegative than hydrogen.

B) Water molecules have a bent geometry (V–shaped).

C) The oxygen in water has $sp^2$ hybrid orbitals.

D) In water the hydrogen carries a partial positive charge (δ+).

Answer: C
*Page Ref: Section 1*

3) Which substance do you expect to be most soluble in water?

A) ammonia, $NH_3$ B) methane, $CH_4$

C) carbon dioxide, $CO_2$ D) nitrogen, $N_2$

Answer: A
*Page Ref: Section 1*

4) What is the maximum number of hydrogen bonds that one water molecule can have with neighboring water molecules?

A) 1 B) 2 C) 3 D) 4

Answer: D
*Page Ref: Section 2*

5) The abundance of water in the cells and tissues helps to minimize temperature fluctuations. This is due to what property of water?

A) density B) viscosity C) specific heat D) boiling point

Answer: C
*Page Ref: Section 2*

6) Compounds that ionize when dissolved in water are called _____.

A) electrolytes B) polar compounds

C) hydrophobic compounds D) amphipathic compounds

Answer: A
*Page Ref: Section 3*

7) Electrolytes dissolve readily in water because

A) they are held together by electrostatic forces.

B) they are hydrophobic.

C) water molecules can cluster about cations.

D) water molecules can cluster about anions.

E) water molecules can cluster about cations and anions.

Answer: E
*Page Ref: Section 3*

8) A molecule or ion is said to be hydrated when it _____.

A) is neutralized by water

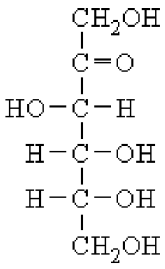
B) is surrounded by water molecules

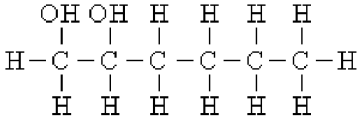
C) reacts and forms a covalent bond to water

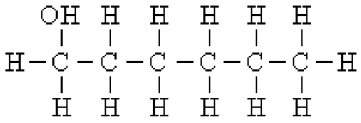
D) aggregates with other molecules or ions to form a micelle in water

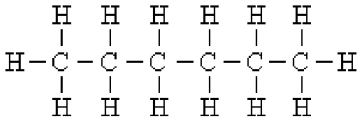
Answer: B
*Page Ref: Section 3*

9) Which would you expect to be most soluble in water?

I.  D - fructose

II.  1, 2 - hexanediol

III.  1 - hexanol

IV.  hexane

A) I B) II C) III D) IV

Answer: A
*Page Ref: Section 3*

10) Solutes diffuse more slowly in cytoplasm than in water because of

A) the higher viscosity of water.

B) the higher heat of vaporization of water.

C) the presence of many crowded molecules in the cytoplasm.

D) the absence of charged molecules inside cells.

Answer: C
*Page Ref: Section 3*

11) The _____ pressure is the pressure required to prevent the flow of solvent through a solvent–permeable membrane that separates two solutions of different solute concentration.

A) hydrostatic B) electromotive C) osmotic D) partial

Answer: C
*Page Ref: Section 3*

12) Which is true about the solubility of electrolytes in water?

A) They are all insoluble in water.

B) They are usually only sparingly soluble in water.

C) They often form super–saturated aqueous solutions.

D) They readily dissolve and ionize in water.

Answer: D
*Page Ref: Section 3*

13) What is the difference between a particle being hydrated versus being solvated?

A) A hydrated particle is surrounded by a shell of water. A solvated molecule is surrounded by a shell of solvent molecules, not necessarily water.

B) The terms hydrated and solvated mean exactly the same thing.

C) A hydrated particle has reacted with hydrogen. A solvated particle is dissolved in a solvent.

D) The word hydrated is used only when the solute is an electrolyte.

Answer: A
*Page Ref: Section 3*

14) The osmotic pressure of an aqueous solution depends on

A) the chemical nature of the solute.

B) the molar concentration of solute.

C) the hydrophobic effect of the solute.

D) All of the above.

E) None of the above.

Answer: B
*Page Ref: Section 3*

15) The osmotic pressure of a 0.010 *M* sucrose ($C_{12}H_{22}O_{11}$) solution at 25 °C is 0.24 atm. How does the osmotic pressure of a 0.010 *M* glucose ($C_6H_{12}O_6$) solution at 25 °C compare to this? Note that neither solute is volatile or ionizable.

A) The glucose solution has a lower osmotic pressure because its molar mass is lower than sucrose.

B) The glucose solution has a higher osmotic pressure because its molar mass is lower than sucrose.

C) The osmotic pressures are equal because the solutions have the same molar concentration.

D) Nothing can be said about the osmotic pressure of the glucose solution without more information.

Answer: C
*Page Ref: Section 3*

16) Oil and water do not form a solution due to _____.

A) the hydrophobic effect

B) the inability of oil to hydrogen bond with water

C) the nonpolarity of oil

D) All of the above (A–C)

E) A and C only

Answer: D
*Page Ref: Section 4*

17) Molecules that are both hydrophobic and hydrophilic are _____.

A) amphipathic B) amphoteric C) bipolar D) not possible

Answer: A
*Page Ref: Section 4*

18) Which molecule or ion below is amphipathic?

A) $H_2NCH_2COOH$ (glycine) B) $H_2O$

C) $CH_3(CH_2)_{14}COO^-$ D) $CH_3CH_2CH_2CH_2CH_3$

Answer: C
*Page Ref: Section 4*

19) Which statement explains the cleaning action of soap on greasy dishes?

A) The soap changes the water–solubility of the grease so that it is easily dissolved by the water.

B) The grease is trapped inside the hydrophobic interior of micelles made of soap molecules.

C) The soap chemically breaks down the grease into smaller, more water–soluble molecules.

D) The soap hydrates the grease with its polar head groups and holds it in suspension.

Answer: B
*Page Ref: Section 4*

20) Some ions such as thiocyanate that are poorly solvated in water and can enhance the solubility of nonpolar compounds in water by disordering the water molecules are called _____.

A) azeotropes B) hydrophobic ions

C) zeolytes D) chaotropes

Answer: D
*Page Ref: Section 4*

21) Which of the following is NOT a "weak" interaction?

A) hydrogen bonds

B) van der Waals forces

C) disulfide bonds

D) ionic interactions

E) hydrophobic interactions

Answer: C
*Page Ref: Section 5*

22) Which of the following weak interactions is not an electrostatic interaction?

A) hydrogen bonds

B) charge–charge interactions

C) hydrophobic interactions

D) van der Waals forces

Answer: C
*Page Ref: Section 5*

23) Which of these noncovalent forces in biological systems is usually the strongest?

A) hydrogen bonds

B) London dispersion forces

C) hydrophobic interactions

D) van der Waals forces

Answer: A
*Page Ref: Section 5*

24) Hydrogen bonds can occur when hydrogen is covalently bonded to atoms like nitrogen and oxygen. What property of nitrogen and oxygen is important for this?

A) atomic mass

B) ionizability

C) hydrophobicity

D) electronegativity

Answer: D
*Page Ref: Section 5*

25) Attractions of oppositely charged functional groups of proteins are sometimes called _____.

A) salt bridges or ion pairing

B) disulfide bridges

C) London bridges

D) hydrophilic bridges

Answer: A
*Page Ref: Section 5*

26) Which is true about hydrogen bonding for biological molecules?

A) Hydrogen bonds are strong enough to confer structural stability, for example in DNA.

B) Hydrogen bonds are weak enough to be easily broken (weaker than covalent bonds).

C) They contribute to the water solubility of many macromolecules.

D) All of the above

Answer: D
*Page Ref: Section 5*

27) London dispersion forces are attractive forces that arise due to

A) infinitesimal dipoles generated by the constant random motion of electrons.

B) permanent dipoles of molecules containing covalent bonds between atoms of very different electronegativities.

C) the hydrophobic effect.

D) ion pairing between oppositely charged functional groups.

Answer: A
*Page Ref: Section 5*

28) The aggregation of nonpolar molecules or groups in water is thermodynamically due to the

A) increased entropy of the nonpolar molecules when they associate.

B) decreased enthalpy of the system.

C) increased entropy of the water molecules.

D) very strong van der Waals forces among the nonpolar molecules or groups.

Answer: C
*Page Ref: Section 5*

29) Water clustered about nonpolar molecules contribute to hydrophobic interactions because

A) Their number is minimized to increase the total entropy of water.

B) Nonpolar molecules are more highly organized than polar molecules.

C) Water molecules in the cell are more organized in the regions away from the nonpolar molecule.

D) All of the above

E) B and C

Answer: A
*Page Ref: Section 5*

30) The three dimensional structure of most proteins is largely determined by

A) other proteins which fold them.

B) weak noncovalent interactions.

C) denaturation.

D) hydrogen bonds.

E) All of the above

Answer: B
*Page Ref: Section 5*

31) The oxygen atom of water is nucleophilic because

A) it has a negative oxidation number.

B) it carries a partial positive charge.

C) it has two unshared pair of electrons.

D) it seeks electron–rich molecules.

E) All of the above

Answer: C
*Page Ref: Section 6*

32) Water is a nucleophile, yet it does not usually hydrolyze macromolecules in cells because

A) covalent bonds linking macromolecule subunits are stable at cell pH.

B) covalent bonds linking macromolecule subunits are stable at cell temperature.

C) the concentration of water is much too small in cells.

D) A and B

Answer: D
*Page Ref: Section 6*

33) Enzymes which condense subunits of macromolecules during their synthesis usually

A) transfer an acyl or carbonyl group to an electrophile.

B) exclude water from the active site.

C) contain inhibitors of hydrolases.

D) are catalyzing thermodynamically favored reactions.

E) All of the above

Answer: B
*Page Ref: Section 6*

34) The ion–product constant for water, $K_W$, is

A) $1 \times 10^{-7}$ $M^2$. B) $1 \times 10^{-7}$ M. C) $1 \times 10^{-14}$ $M^2$. D) $1 \times 10^{-14}$ M.

Answer: C
*Page Ref: Section 7*

35) In pure water hydronium ions are formed by _____ attack of oxygen on a proton in an adjacent water molecule.

A) ionic B) nucleophilic C) electrophilic D) covalent

Answer: B
*Page Ref: Section 7*

36) Pure water has a concentration of

A) 18 g/ml. B) 1 g/ml. C) 1000 g/ml. D) 55 M.

Answer: D
*Page Ref: Section 7*

37) Which statement best characterizes the distribution of charge in the hydronium ion, $H_3O^+$?

A) The positive charge is distributed over all of the atoms in the ion.

B) The positive charge is localized only on the oxygen atom.

C) The positive charge is distributed between the three hydrogen atoms only.

D) The positive charge is localized on only one of the hydrogen atoms.

Answer: A
*Page Ref: Section 7*

38) Which statement below is true about the relative lifetime of a hydrogen bond, compared to the rate of water's ionization to hydroxide ions and hydronium ions?

A) The strength of hydrogen bonding makes its dissociation much slower than the ionization of water.

B) The rate of dissociation of a hydrogen bond is the same order of magnitude as the rate of ionization of water.

C) The two rates are linked in such a way that the more the water is ionized, the stronger and longer lasting hydrogen bonding will be.

D) The lifetime of a water molecule before it is ionized is about $10^9$ greater than the lifetime of a hydrogen bond.

Answer: D
*Page Ref: Section 7*

39) The self–ionization of water is _____.

A) a unimolecular dissociation of a single water molecule to $H^+$ and $OH^-$

B) a biomolecular reaction between two water molecules to yield $H_3O^+$ and $OH^-$

C) a result of hydrophobic interactions

D) a termolecular reaction involving the simultaneous collision of $H_2O$, $H^+$ and $OH^-$

Answer: B
*Page Ref: Section 7*

40) How does the ion–product of water, $K_W$, relate to the equilibrium constant, $K_{eq}$, for the dissociation reaction of water?

A) $K_W$ is found by multiplying $K_{eq}$ by the concentration of water.

B) $K_W$ just another symbol for $K_{eq}$ , so they are equal.

C) $K_W$ is found by dividing $K_{eq}$ by the ideal gas constant.

D) $K_W$ is found by multiplying $K_{eq}$ by the concentrations of hydronium ion and hydroxide ion.

Answer: A
*Page Ref: Section 7*

41) A solution containing $10^{-8}$ M HCl and $10^{-8}$ M acetic acid contains $H^+$ which is supplied mostly by

A) the strong acid.

B) the weak acid.

C) both the strong and the weak acids.

D) water.

E) All of the above

Answer: D
*Page Ref: Section 8*

42) Basic solutions form when chemicals are dissolved in water and remove

A) $OH^-$.

B) $H^+$.

C) $Na^+$.

D) A and B

E) A, B and C

Answer: B
*Page Ref: Section 8*

43) The pH of a $10^{-4}$ M solution of HCl is

A) 3.

B) 3.5.

C) 4.

D) 4.5.

E) greater than 4.5.

Answer: C
*Page Ref: Section 8*

44) Compare solution A with pH = 4 to solution B with pH = 6.

A) The concentration of hydronium ion in solution A is twice that in solution B.

B) Solution A has greater buffering capacity than solution B.

C) The concentration of hydronium ion in solution A is 100 times that in solution B.

D) The hydroxide concentrations are equal in the two solutions since pH only measures the concentration of $H^+$.

Answer: C
*Page Ref: Section 8*

45) If human blood is not maintained at close to pH = 7.4, a person can develop

A) acidosis.

B) alkalosis.

C) diabetes.

D) Both A and B

E) None of the above

Answer: D
*Page Ref: Section 8*

46) The Henderson–Hasselbalch equation can be used to calculate

A) the pH of a solution of an organic acid.

B) the amount of salt and acid to add to form a specific buffer.

C) the $pK_a$ of a weak acid.

D) All of the above

E) A and C only

Answer: D
*Page Ref: Section 9*

47) The ratio of the concentration of a _____ over _____ describes the proportions of forms of a weak acid necessary to satisfy the Henderson–Hasselbalch equation.

A) conjugate acid; conjugate base

B) conjugate base; conjugate acid

C) proton donor; proton acceptor

D) proton acceptor; proton donor

E) B and D

Answer: E
*Page Ref: Section 9*

48) At the midpoint of a titration curve

A) the concentration of a conjugate base is equal to the concentration of a conjugate acid

B) the pH equals the $pK_a$

C) the ability of the solution to buffer is best

D) All of the above

E) A and B only

Answer: D
*Page Ref: Section 9*

49) Histidine contains an imidazole group which is titratable. A histidine buffer can be prepared using

A) NaOH and histidine.

B) NaOH and imidazolium ion.

C) imidazolium ion and imidazole (conjugate base).

D) HCl and imidazole.

E) All of the above

Answer: E
*Page Ref: Section 9*

50) The imidazolium ion has a $pK_a = 7.0$. Imidazolium buffers can be prepared for pH values of

A) 6.5 to 7.5. B) 6.1 to 7.1. C) 5.5 to 8.5. D) 6.0 to 8.0. E) 6.0 to 7.5.

Answer: D
*Page Ref: Section 9*

51) Since HCl is a strong acid its value of $K_a$ is _____.

A) effectively equal to infinity
B) equal to $K_W$
C) zero
D) dependent on the concentration of HCl

Answer: A
*Page Ref: Section 9*

52) For a weak acid with a $pK_a = 6.5$, the effective buffering range is usually considered to be

A) pH 6 to pH 7.
B) pH 6.4 to pH 6.6.
C) pH 5.5 to pH 7.5.
D) dependent on the molarity of the acid.
E) B and C

Answer: C
*Page Ref: Section 10*

53) Blood pH is primarily regulated by

A) a protein buffer system.
B) the carbon dioxide – carbonic acid – bicarbonate buffer system.
C) the phosphate buffering system.
D) carbonic acid ($H_2CO_3$).
E) B and C

Answer: B
*Page Ref: Section 10*

54) Intracellular buffers include

A) proteins.
B) inorganic phosphate.
C) hemoglobin.
D) Both A and B
E) A, B and C

Answer: D
*Page Ref: Section 10*

55) $pK_a$ values of phosphoric acid are 2.2, 7.2 and 12.7. A phosphate buffer of pH = 7.4 can be prepared using

A) $H_2PO_4^-$ and $HPO_4^{2-}$.
B) $HPO_4^{2-}$ and $PO_4^{3-}$.
C) $H_3PO_4$ and HCl.
D) None of the above

Answer: A
*Page Ref: Section 10*

56) Acetic acid has a $pK_a$ of 4.8. How many milliliters of 0.2 M acetic acid and 0.1 M sodium acetate are required to prepare 1 liter of 0.1 M buffer solution having a pH of 4.8?

A) 500 ml acetic acid and 500 ml sodium acetate
B) 250 ml acetic acid and 250 ml sodium acetate, then 500 ml water
C) 250 ml acetic acid and 500 ml sodium acetate, then 250 ml water
D) 500 ml acetic acid and 250 ml sodium acetate, then 250 ml water

Answer: B
*Page Ref: Section 10*

57) The pH of human blood is maintained at 7.4 by

A) buffering proteins.
B) carbon dioxide–carbonic acid buffer systems.
C) a bicarbonate buffer system.
D) B and C
E) A, B and C

Answer: D
*Page Ref: Section 10*

58) The solubility rule "like dissolves like" refers primarily to similarities in amphipathic nature between the solute and solvent.

Answer: FALSE
*Page Ref: Section 1*

59) The hydrogen bonding between water molecules in ice gives water an unusually low melting point compared to other molecules of similar size and molecular weight that cannot form hydrogen bonds.

Answer: FALSE
*Page Ref: Section 2*

60) The water solubility of alcohols with a single hydroxyl group increases as a function of molecular weight.

Answer: FALSE
*Page Ref: Section 3*

61) A hydrated potassium ion is surrounded by a shell of water molecules oriented primarily with their oxygen atoms toward the potassium ion.

Answer: TRUE
*Page Ref: Section 3*

62) In the detergent, sodium dodecyl sulfate, the sulfate groups are very hydrophobic.

Answer: FALSE
*Page Ref: Section 4*

63) Van der Waals forces are very strongly repulsive at short nuclear distances and very weak at long internuclear distances.

Answer: TRUE
*Page Ref: Section 5*

64) The combined effect of many weak noncovalent interactions can be very significant in determining factors such as three–dimensional structure for large biological molecules.

Answer: TRUE
*Page Ref: Section 5*

65) Water molecules that surround a less polar molecule in solution are immobile and ordered.

Answer: TRUE
*Page Ref: Section 5*

66) The strength of van der Waals forces between two molecules changes as the distance between them changes.

Answer: TRUE
*Page Ref: Section 5*

67) The attractive force between two atoms is maximized when they are separated by the sum of their van der Waals radii.

Answer: TRUE
*Page Ref: Section 5*

68) Salt bridges are often found on the surfaces of proteins where they are stabilized by water.

Answer: FALSE
*Page Ref: Section 5*

69) Hydrogen bonds in the interior of a protein or other macromolecule are stronger than those on the exterior.

Answer: FALSE
*Page Ref: Section 5*

70) Micelles are stabilized in water by interactions of nonpolar molecules with each other.

Answer: TRUE
*Page Ref: Section 5*

71) Hydrophobic interactions are sometimes called "bonds", because each one is as strong as a covalent bond.

Answer: FALSE
*Page Ref: Section 5*

72) Proteins dissolved in water can be hydrolyzed by nucleophilic attack from the water molecules.

Answer: TRUE
*Page Ref: Section 6*

73) An intermediate formed by the enzyme glutamine synthetase, gamma–glutamyl phosphate, is rapidly hydrolyzed by water if the enzyme is not around to protect it.

Answer: TRUE
*Page Ref: Section 6*

74) When acid is added to pure water, $K_W$, the ion–product constant of water, changes.

Answer: FALSE
*Page Ref: Section 7*

75) The equilibrium constant of water ($K_{eq}$) is the rate that dissociation of the molecule occurs at room temperature.

Answer: FALSE
*Page Ref: Section 7*

76) The $H^+$ (or $H_3O^+$) in cells is the same concentration as that of undissociated water.

Answer: FALSE
*Page Ref: Section 8*

77) Hyperventilation can result in alkalosis because there is excessive loss of carbon dioxide and, therefore a loss of carbonic acid.

Answer: TRUE
*Page Ref: Section 8*

78) Since the $pK_a$ of acetic acid is 4.8, it can be used to prepare a buffer to maintain physiological pH.

Answer: FALSE
*Page Ref: Section 9*

79) The buffering capacity of a weak acid and its conjugate base is strongest when the pH = $pK_a$.

Answer: TRUE
*Page Ref: Section 10*

80) Synthetic compounds used as buffers are not as valuable for experiments as naturally occurring compounds used as buffers.

Answer: FALSE
*Page Ref: Section 10*