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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 (ΔH) and a decrease in entropy (ΔS).

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.

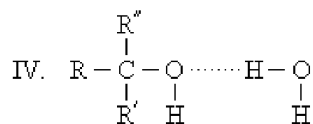
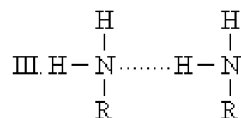
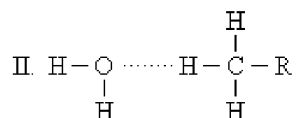
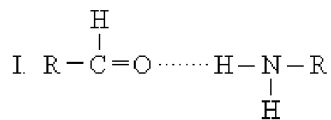
Answer: FALSE
Page Ref: Appendix

60) One Angstrom is equal to 1×10^{-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 not 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

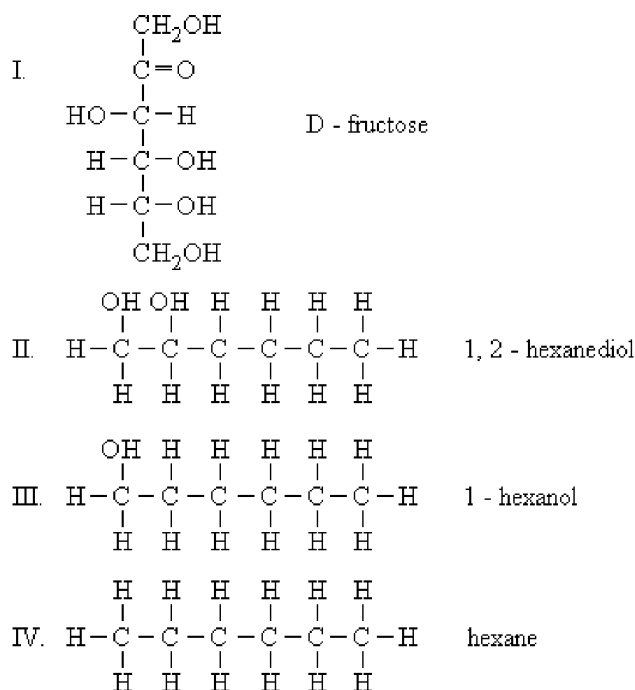
8) A molecule or ion is said to be hydrated when it _____.

- 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?



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) $\text{H}_2\text{NCH}_2\text{COOH}$ (glycine)
- B) H_2O
- C) $\text{CH}_3(\text{CH}_2)_{14}\text{COO}^-$
- D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$

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