

Contents

Chapter 1	Introduction to Biochemistry	1
Chapter 2	Water	10
Chapter 3	Amino Acids and the Primary Structures of Proteins	27
Chapter 4	Proteins: Three-Dimensional Structure and Function	46
Chapter 5	Properties of Enzymes	65
Chapter 6	Mechanisms of Enzymes	85
Chapter 7	Coenzymes and Vitamins	104
Chapter 8	Carbohydrates	119
Chapter 9	Lipids and Membranes	137
Chapter 10	Introduction to Metabolism	153
Chapter 11	Glycolysis	169
Chapter 12	Gluconeogenesis, The Pentose Phosphate Pathway, and Glycogen Metabolism	185
Chapter 13	The Citric Acid Cycle	199
Chapter 14	Electron Transport and Oxidative Phosphorylation	213
Chapter 15	Photosynthesis	227
Chapter 16	Lipid Metabolism	241
Chapter 17	Amino Acid Metabolism	256
Chapter 18	Nucleotide Metabolism	269
Chapter 19	Nucleic Acids	284
Chapter 20	DNA Replication, Repair, and Recombination	300
Chapter 21	Transcription and RNA Processing	315
Chapter 22	Protein Synthesis	330
Chapter 23	Recombinant DNA Technology	348

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