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CH. 2 – The Biochemistry of Macromolecules

MEDIUM
1. Proteins, carbohydrates, lipids and nucleic acids are the 4 major groups of organic macromolecules that are necessary for living cells whether they are Prokaryotes or Eukaryotes. What major characteristics do these 4 groups share?
a. all have a carbon atom as their backbone
b. each group has nonspecific monomers that are joined together by covalent bonds
c. monomers are bonded to each other via hydrolysis reactions
d. all of these is correct

EASY
2. Match the macromolecule with the correct examples:

Macromolecule	*Examples*
Proteins C	a. nucleotide monomers
Carbohydrates D	b. fatty acid monomers
Lipids B	c. amino acid monomers
Nucleic Acids A	d. monosaccharide monomers

2.1 Proteins

EASY
3. What are the major characteristics of a protein?
a. made of amino acid monomers that contain nitrogen
b. each of the 20 naturally occurring amino acids has an amino group, a carboxyl group and a "R=residue" or side chain
c. the side chain is different for each of the 20 amino acids
D. all of these is correct

MEDIUM
4. How are amino acids classified?
a. names may be abbreviated with five letter words
b. 4 groups of amino acids according to amino group: basic, acidic, nonpolar or uncharged polar
C. names may be abbreviated with a single capital letter
d. all of these is correct

EASY
5. Match the protein structure with the correct description

Protein Structure	*Description*
Primary D	a. stable 3-dimensional conformation
Secondary C	b. 2 or more tertiary polypeptides joined together
Tertiary A	c. alpha helix or beta pleated sheet
Quaternary B	d. linear sequence of amino acids joined by peptide bonds

MEDIUM
6. Which of the following correctly describes the two basic biochemical reactions in cells
a. dehydration synthesis and hydrolysis
b. dehydration synthesis adds a molecule of water and hydrolysis removes one
c. dehydration polymerization and hydrolytic degradation
d. oxidation and reduction

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HARD
7. The structure of a secondary or higher protein is dependent upon _____. Thus this determines the functionality of the protein.
a. the hydrophobic or hydrophilic nature of the amino acids in the primary structure
b. the electrostatic attractions between the R or side chains of the amino acids in the primary structure
c. the interaction of the sulfhydryl groups that produce disulfide bridges
D. all of these is correct

EASY
8. Denaturation of the secondary or tertiary structure of a protein may be caused by
a. changes in environmental conditions such as temperature or pH
b. may be temporary as in the use of a curling iron on human hair
c. may be permanent as in the use of chemical solutions on human hair
d. usually involves ligands
E. only a, b, and c are correct

MEDIUM
9. Match the protein with its function

Protein	*Function*
Antibody C	a. protein in RBCs that transports oxygen throughout the body
Insulin D	b. contractile protein needed in muscle cells
Myosin B	c. produced by immune system and initiates destruction of pathogens
Hemoglobin A	d. hormone that facilitates glucose uptake in cells

2.2 Enzymes

EASY
10. Which of the following statements about enzymes is NOT true?
a. special class of tertiary structure proteins that act as catalysts in biochemical reactions
B. increase the activation energy (E_a) needed to make a normally occurring reaction happen faster
c. when hydrolysis reactions are catalyzed by enzymes, energy needed for cell survival is released
d. living cells cannot use heat to speed up reactions because it would denature proteins so enzymes are used instead
e. enzymes are highly specific to the substrate to which they can bind

MEDIUM
11. What is the correct order of steps in the use of an enzyme in a biochemical reaction?
1. Induced fit distorts the substrate making it more reactive and lowering E_a
2. Substrate binds to active site of enzyme like a lock and key
3. Substrate converted to product because of change in shape, size and charge
4. Enzyme-substrate binding energy contributes to catalysis

a. 1, 2, 4, 3 B. 2, 1, 4, 3 c. 1, 2, 3, 4 d. 2, 4, 1, 3 e. 2, 3, 1, 4

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MEDIUM
12. Match the enzyme to the reaction catalyzed:

Enzyme	*Catalyzed Reaction*
Amylase B	a. joins 2 DNA strands together
Catalase D	b. digests starch
DNA ligase A	c. breaks down peptidoglycan in bacterial cell walls
Lysozyme C	d. degrades hydrogen peroxide into water and oxygen

HARD
13. What factor is not true and will NOT influence the rate of enzymatic reactions?
A. a prosthetic group is another protein that binds to the enzyme and makes it work better
b. higher temperatures will increase enzymatic reactions up to the point of denaturation
c. lower temperatures will decrease enzymatic reactions down to the point of freezing
d. enzyme regulation by substrate availability
e. competitive inhibition of enzymes

EASY
14. Regulation of enzymes allows a cell to be responsive to physiological needs. This may be accomplished by these processes:
a. negative feedback inhibition loop
b. noncompetitive enzyme inhibition
c. competitive enzyme inhibition
D. all of these are correct

2.3 Carbohydrates

EASY
15. The characteristics of carbohydrates includes
a. monosaccharides serve as the building blocks for these polymers
b. monosaccharides are joined together by covalent bonds known as glycosidic links
c. monosaccharides are joined by hydrolytic reactions
d. all of these are correct
E. only a and b are correct

EASY
16. Match the term with the correct definition:

Term	*Definition*
Monosaccharide D	a. three to 20 monomers
Disaccharide C	b. long chains of simple sugars
Oligosaccharide A	c. two monomers covalently bouynd
Polysaccharide B	d. found predominantly in stable ring structure

MEDIUM
17. Why are carbohydrates such excellent molecules for energy storage?
a. they are composed of three basic atoms: carbon, hydrogen and oxygen
B. hydrolysis of glycosidic links releases energy used in many parts of the cell
c. energy is easily stored in their covalent bonds
d. carbon may form bonds with up to four different chemicals

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HARD
18. What is the correct sequence of events in the maintenance of homeostasis in blood glucose levels?
1. Hypoglycemia stimulates glucagon production -> 3. glucagon makes liver and muscle cells release glucose -> 4. hyperglycemia stimulates insulin production -> 2. insulin makes body cells take up glucose -> 5. blood glucose levels fall below homeostasis level
a. 1, 2, 3, 4, 5 B. 1, 3, 4, 2, 5 c. 5, 1, 2, 3, 4 d. 3, 4, 2, 5, 1

HARD
19. Emergency injection of _____ into a diabetic with severe hypoglycemia will revive the patient.
a. glucose b. glycogen c. insulin D. glucagon

EASY
20. While polysaccharides such as starch serve as storage for energy, other polysaccharides like _____serve as structural materials in cells.
a. cellulose b. chitin c. keratin D. a and b are correct e. b and c are correct

2.4 Lipids

EASY
21. The most important forms of lipids in living cells include
A. steroids, triglycerides and phospholipids
b. steroids, phospholipids and waxes
c. phospholipids, triglycerides and waxes
d. triglycerides, steroids and waxes

MEDIUM
22. The covalent bond created by dehydration synthesis that links the three fatty acids with a glycerol molecule is called _____.
a. peptide bond b. hydrolytic bond C. ester bond d. nonpolar bond

EASY
23. Examples of unsaturated fats include _____ that are liquid at room temperature.
a. olive oil b. corn oil c. canola oil D. all of these are correct

MEDIUM
24. Saturated fats are not a healthy choice in human diets because
a. they are solid at room temperature
b. every binding site on the carbons is occupied by hydrogens that result is a solid straight chain
C. they result in an increased chance of heart disease
d. they are usually found in animal fats
e. all of these are correct

HARD
25. The lipase excreted by the bacterium commonly responsible for acne breaks down the sebum naturally produced by the glandular cells in the hair follicles and is a good example of _____.
a. triglyceride b. fatty acid chain c. steroid D. tertiary structure protein

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MEDIUM
26. The androgen sex hormones produced in high amounts in adolescents belong to this group of lipids:
a. phospholipids B. steroids c. waxes d. triglycerides

EASY
27. Phospholipids are called _____molecules because one part is attracted to water and the other part isn't.
A. amphipathic b. bipathic c. hydrophilic d. hydrophobic

HARD
28. If you had a measuring cup of phospholipids and poured this into a bowl of water, what would you expect to see form?
a. individual phospholipids surrounds by water molecules
B. spheres made of phospholipid bilayers floating in the water
c. phospholipid sheets floating on the water
d. phospholipid double helices hanging in the water

EASY
29. Phospholipids are formed when a _____ is substituted for one of the fatty acid tails of a triglyceride.
a. phosphorus B. phosphate group c. phosphorus/sterol d. phosphorus/hydroxyl

MEDIUM
30. The fluidity of cell membranes can be attributed to presence of some
A. unsaturated fatty acids b. saturated fatty acids c. phosphate groups d. sterols

EASY
31. One of the more common sterols is _____ , that can be both beneficial to cells but also implicated in heart disease because of the arterial plaque formations.
a. wax b. cortisol C. cholesterol d. triglycerides

MEDIUM
32. Waxes have many functions in multicellular organisms including:
a. waterproof coating on surfaces that inhibit water evaporation
b. waterproof coating on surfaces that inhibits water penetration
c. waterproof compounds that strengthen bacterial cell walls
D. all of these are correct
e. only a and b are correct

EASY
33. The basic structure of steroids includes
a. 2 fatty acid tails with a sterol hydrocarbon ring attached
b. 3 fatty acid tails with a sterol hydrocarbon ring attached
C. four fused hydrocarbon rings
d. three fused hydrocarbon rings

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MEDIUM
34. Mycolic acid is a waxy material that gets its name "myco-" from fungi and means fungus-like. It is particularly found in members of the Genus Mycobacterium. Because of the waterproof nature of mycolic acid, which staining technique must be used to identify these bacteria under the microscope?
a. Gram stain B. Ziehl-Neelson Acid-fast stain c. Endospore stain d. capsule stain

HARD
35. Steroids and their derivatives serve important functions in human physiology. Match the steroid with its function.

Steroid	*Function*
Cholesterol B	a. essential for health of skeletal bones
Cortisol D	b. regulates cell membrane fluidity
Vitamin D A	c. development of secondary sex characteristics in males
Testosterone C	d. stress hormone that increase glucose levels in the blood

2.5 Nucleic Acids

EASY
36. DNA may be described as _____
a. a macromolecule made of monomers called nucleotides
b. the hereditary material of cells that is passed one generation to the next
c. a double helix composed of small packets of information called genes
d. a master blueprint for the production of all proteins needed by the cell
E. all of these are correct

EASY
37. The major differences between DNA and RNA are
A. DNA has a deoxyribose sugar while RNA has a ribose sugar
b. The nucleotides used in DNA include adenine, uracil, guanine and cytosine, while those used in RNA include adenine, thymine, guanine and cytosine.
c. DNA is never used in protein synthesis while RNA is used to make proteins on the ribosomes.
d. DNA exists in a double helix while RNA exists either in a single strand or a double helix.

MEDIUM
38. Purines differ from pyrimidines in these characteristics:
a. purines have a double ring structure while pyrimidines have a single ring structure
b. in DNA the purines include cytosine and uracil
c. in RNA the purines include cytosine and thymine
d. in both DNA and RNA the purines are adenine and guanine
E. both a and d are correct

MEDIUM
39. The backbone of the DNA helix is composed of the alternating pentose sugars and phosphates that are bonded from one to the other.
a. these are hydrogen bonds
b. these are covalent bonds called dipeptide bonds
c. these are ionic bonds
D. these are covalent bonds called phosphodiester bonds

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HARD
40. The ladder-like structure of the DNA helix occurs because
A. rails of the ladder are made of alternating pentose and phosphates
b. rungs of the ladder are made of complementary base paired purines
c. adenine pairs with thymine via double hydrogen bonds
d. cytosine pairs with guanine via triple hydrogen bonds
e. the 2 helices run in the same 3' to 5' direction

MEDIUM
41. Adenosine triphosphate has these characteristics:
a. adenine nucleotide bonded with two more phosphate groups
b. because the adjacent phosphate groups carry negative charges, the molecules are unstable and their bond is easily broken
c. the breaking of this bond releases 5 kcal/mol of energy that may be used for cellular "work"
D. only a and b are correct

EASY
42. DNA replication _____ while protein synthesis _____.
a. is semiconservative/occurs in 2 stages
b. makes copies of the chromosomes containing one original strand and one new strand/copies DNA into RNA
c. passes genetic information to the next generation of cells/creates new proteins using DNA as the blueprint
D. all of these are correct

EASY
43. Match the following terms with the correct description.

Term	*Description*
Gene D	a. using template strand of DNA to make a complementary strand of messenger RNA
Transcription A	b. translation of mRNA into appropriate amino acids on a ribosome
Translation B	c. read in three-base sequences of mRNA and code for appropriate amino acid
Genetic Code C	d. specific sequence of DNA that provides the blueprint for making a protein

MEDIUM
44. Which is the best definition of a gene?
a. specific sequence of DNA that provides the blueprint for making a protein using RNA and a ribosome
b. specific sequence of DNA that encodes the hereditary material passed from one generation to the next
c. packet of genetic information that is needed as pattern in protein synthesis
d. packet of genetic information that is part of a cell's chromosome(s)
E. all of these is correct

HARD
45. What is the difference between the events in transcription versus translation?
A. in transcription DNA is rewritten as mRNA, while in translation the language of nucleotides encoded in mRNA is translated into the language of amino acids encoded in the newly built protein
b. in transcription DNA is written as another strand of DNA, while in translation DNA is translated into mRNA
c. in transcription DNA is rewritten as mRNA, while in translation mRNA is rewritten as tRNA

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d. in transcription DNA is written as tRNA, while in translation tRNA is rewritten as mRNA

EASY
46. Transcribe this "gene" into mRNA: TAG GAT TAT CAC
A. AUC CUA AUA GUG
b. ATC CTA ATA GTG

EASY
47. Using semiconservative replication, write the complementary strand of DNA for this segment: TAT GCG GAG CAT
A. ATA CGC CTC GTA
b. AUA CGC CUC GUA

CRITICAL THINKING

48. Why is ATP the ideal macromolecule to serve as the energy currency of the cell?
A. instability of adjacent negatively charged phosphate groups make bonds easy to break
b. phosphate group is an ancient chemical found in fossils
c. more energy can be stored between the 2nd and 3rd phosphate groups
d. release of energy from broken bonds provides energy for cellular processes

49. From an evolutionary hypothesis, why is DNA the hereditary material instead of RNA?
a. double helix is a more stable structure
b. complementary base structure of 2 helices allows for repairing of one strand using the other as a pattern.
c. RNA is single-stranded and cannot easily be repaired
D. all of these are correct

50. Why are proteins said to control everything in the life of a cell?
a. proteins may be either structural or functional in nature
b. proteins may be enzymes that catalyze cellular reactions
c. proteins may be hormones that influence cellular processes
d. proteins may be integral or peripheral and participate in selectivity of the cell membrane
E. all of these are correct

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