

3 | BIOLOGICAL MACROMOLECULES

REVIEW QUESTIONS

1 Dehydration synthesis leads to the formation of what?

- A Monomers
- B Polymers
- C Carbohydrates only
- D Water only

Solution The solution is (B). Polymers are formed through dehydration synthesis, during which monomers combine to release a water molecule.

2 What is removed during the formation of nucleic acid polymers?

- A Carbon
- B Hydroxyl groups
- C Phosphates
- D Amino acids

Solution The solution is (C). Unlike proteins, carbohydrates, and lipids, the molecule that is released in the formation of nucleic acid polymers is pyrophosphate (two phosphate groups bound together).

3 During the breakdown of polymers, which reaction takes place?

- A Condensation
- B Covalent bond
- C Dehydration
- D Hydrolysis

Solution The solution is (D). Hydrolysis is a reaction in which a water molecule is used during the breakdown of another compound or a polymer.

4 Energy is released as a result of which chemical reaction?

- A Condensation
- B Dehydration synthesis
- C Hydrolysis
- D Dissolution

Solution The solution is (C). Hydrolysis reactions typically release energy that can be used to power cellular processes.

- 5 In the metabolism of the cell, why is hydrolysis used?
- A Hydrolysis is used to break down polymers.
 - B Hydrolysis is used to form linkages in DNA.
 - C Hydrolysis is used to produce proteins.
 - D Hydrolysis is used to synthesize new macromolecules.

Solution The solution is (A). Polymers can be broken down by hydrolysis, or the addition of water.

- 6 Plant cell walls contain what in abundance?
- A Cellulose
 - B Glycogen
 - C Lactose
 - D Starch

Solution The solution is (A). The cell walls of plants are mostly made of cellulose, which provides structural support to the cell.

- 7 What makes up the outer layer of some insects?
- A Carbohydrate
 - B Protein
 - C RNA
 - D Triglyceride

Solution The solution is (A). Arthropods like insects have an outer skeleton, called the exoskeleton, which protects their internal body parts. The exoskeleton is mainly made up of chitin, a nitrogen-containing polysaccharide.

- 8 What is an example of a monosaccharide?
- A Cellulose
 - B Fructose
 - C Lactose
 - D Sucrose

Solution The solution is (B). Fructose is a simple ketose monosaccharide found in many plants.

- 9 Cellulose and starch are examples of —
- A disaccharides
 - B lipids

- C monosaccharides
- D polysaccharides

Solution The solution is (D). A long chain of monosaccharides linked by glycosidic bonds is known as a polysaccharide, which can contain the same or different monosaccharides. Starch is the stored form of sugars in plants and is made up of a mixture of amylose and amylopectin, while cellulose is made up of glucose monomers that are linked by β -1-4 glycosidic bonds.

- 10** What type of bond joins the molecules in the disaccharide lactose, and what molecule is joined with glucose to form lactose?
- A A glycosidic bond between glucose and lactose
 - B A glycosidic bond between glucose and galactose
 - C A hydrogen bond between glucose and sucrose
 - D A hydrogen bond between glucose and fructose

Solution The solution is (B). Lactose is a disaccharide consisting of the monomers glucose and galactose, which are joined together by a glycosidic bond.

- 11** What is structurally different about cellulose when compared to starch?
- A An extra hydrogen atom is left on the monomer.
 - B β -1,4 glycosidic linkages are used.
 - C α -1,6 glycosidic linkages are used.
 - D An extra hydroxyl group is removed during synthesis.

Solution The solution is (B). Starch is made up of glucose monomers that are joined by α -1-4 or α -1-6 glycosidic bonds. Cellulose is made up of glucose monomers that are linked by β -1-4 glycosidic bonds only.

- 12** What are classified as lipids?
- A Disaccharides and cellulose
 - B Essential amino acids
 - C mRNA and DNA
 - D Oils and waxes

Solution The solution is (D). Lipids are a group of naturally occurring molecules that include oils, waxes, and other hydrophobic substances.

- 13** What is cholesterol specifically classified as?
- A A lipid
 - B A phospholipid

- C A steroid
- D A wax

Solution The solution is (C). Cholesterol is a steroid having four linked carbon rings with a short tail. It is mainly synthesized in the liver and is the precursor to many steroid hormones.

14 Which fat serves as an animal's major form of energy storage?

- A Cholesterol
- B Glycerol
- C Phospholipid
- D Triglycerides

Solution The solution is (D). Triglycerides, stored in adipose tissue, are a major form of energy storage in animals. Fat cells are designed for continuous synthesis and breakdown of triglycerides in animals.

15 Which hormones are made from cholesterol?

- A Estradiol and testosterone
- B Insulin and growth hormone
- C Progesterone and glucagon
- D Prolactin and thyroid hormone

Solution The solution is (A). Cholesterol is the precursor to many steroid hormones such as testosterone and estradiol, which are secreted by the gonads and adrenal endocrine glands.

16 Which characteristic is NOT true for saturated fats?

- A They are solid at room temperature.
- B They have single bonds within the carbon chain.
- C They contain mostly hydrogen and carbon atoms.
- D They tend to dissolve in water easily.

Solution The solution is (D). Saturated fats are solid at room temperature, and have single bonds between carbon and hydrogen atoms. However, they are nonpolar molecules. Water is a polar solvent, so it is not true that saturated fats do not dissolve in water.

17 Which fat has the least number of hydrogen atoms?

- A** Trans fat
- B** Saturated fat
- C** Unsaturated fat
- D** Wax

Solution The solution is (C). Unlike saturated fats, in which extensive hydrogenation leads to close packing of molecules and results in a solid state, unsaturated fats contain the least number of hydrogen atoms, which results in multiple bonds between carbon atoms and loose packing of molecules.

18 Of what are phospholipids important components?

- A** The double bond in hydrocarbon chains
- B** The plasma membrane of animal cells
- C** The ring structure of steroids
- D** The waxy covering on leaves

Solution The solution is (B). Phospholipids are major constituents of the plasma membrane, the outermost layer of animal cells. Phospholipids are responsible for the dynamic nature of the plasma membrane.

19 What is diacylglycerol 3-phosphate?

- A** A phospholipid
- B** A phosphatidylcholine
- C** A phosphatidylserine
- D** A phosphatidate

Solution The solution is (D). A phosphate group alone attached to a diglycerol does not qualify as a phospholipid; it is phosphatidate (diacylglycerol 3-phosphate), the precursor of phospholipids.

20 What is the basic structure of a steroid?

- A** Four fused hydrocarbon rings
- B** Glycerol with three fatty acid chains
- C** Two fatty-acid chains and a phosphate group
- D** Two six-carbon rings

Solution The solution is (A). All steroids have four linked carbon rings and some of them have a short tail. Cholesterol and many hormones such as estrogen and cortisol are steroids.

21 Besides its use in hormone production, for what does the body use cholesterol?

- A** mRNA transport
- B** Production of bile salts
- C** Water reabsorption in the kidney
- D** Wax production

Solution The solution is (B). Cholesterol is also the precursor of bile salts, which help in the emulsification of fats and their subsequent digestion.

22 Where is cholesterol found in cell membranes?

- A** Attached to the inner side of the membrane
- B** Attached to the outer side of the membrane
- C** Floating in the phospholipid tail layer
- D** Penetrating both lipid layers

Solution The solution is (D). Cholesterol is a component of the plasma membrane of animal cells and is found within the phospholipid bilayer. The plasma membrane of each cell is made up of a continuous double layer of phospholipids, interwoven with cholesterol and proteins.

23 Which type of body cell would have a higher amount of cholesterol in its membrane?

- A** A cartilage cell
- B** A liver cell
- C** A red blood cell
- D** A spleen cell

Solution The solution is (C). Blood cells tend to travel all along the blood vessels of the body and therefore require flexibility to travel. The cholesterol embedded in their membrane provides them with the required flexibility.

24 What is a function of proteins in cells?

- A** Energy storage
- B** Gene storage and access
- C** Membrane fluidity
- D** Structure

Solution The solution is (D). Proteins provide structure and support for cells. They also fulfill many other functions. For example, they allow the body to move (e.g., actin), catalyze reactions as enzymes, act as cellular messengers and receptors, and provide defense against pathogens as antibodies.

25 What type of protein facilitates or accelerates chemical reactions?

- A** An enzyme
- B** A hormone
- C** A membrane transport protein
- D** A tRNA molecule

Solution The solution is (A). Enzymes accelerate, or catalyze, chemical reactions. Almost all metabolic processes in the cell need enzymes to occur at rates fast enough to sustain life. Enzymes increase the rate of a reaction by lowering its activation energy.

26 What type of amino acids would you expect to find on the surface of proteins that must interact closely with water?

Solution Amino acids that contain acidic, basic, or polar side groups are most likely to be found on the surface of water-soluble proteins. Proteins with these charged side groups can interact more readily with water than if the protein had a neutral net charge.

27 What are the monomers that make up proteins called?

- A** Amino acids
- B** Chaperones
- C** Disaccharides
- D** Nucleotides

Solution The solution is (A). Amino acids are organic compounds (monomers) that combine to form proteins. There are 20 amino acids, 10 of which are referred to as essential amino acids in humans because the body cannot synthesize them and they must be supplied by the diet.

28 Where is the linkage made that combines two amino acids?

- A** Between the R group of one amino acid and the R group of the second
- B** Between the carboxyl group of one amino acid and the amino group of the other
- C** Between the six-carbon of both amino acids
- D** Between the nitrogen atoms of the amino groups in the amino acids

Solution The solution is (B). A peptide bond is formed by dehydration between the amino group of one amino acid and the carboxyl group of a second amino group. Each amino acid has the same fundamental structure, which consists of a central carbon atom, also known as the alpha (α) carbon, bonded to an amino group (NH_2), a carboxyl group (COOH), and a hydrogen atom. The fourth position bound to the central carbon is occupied by a side chain that distinguishes the amino acids from each other.

29 The α -helix and the β -pleated sheet are part of which protein structure?

- A The primary structure
- B The secondary structure
- C The tertiary structure
- D The quaternary structure

Solution The solution is (B). The local folding of the polypeptide in some regions gives rise to the secondary structure of the protein. The α -helix and β -pleated sheets are the secondary structure of proteins that forms because of hydrogen bonding between carbonyl and amino groups in the peptide backbone.

30 Which structural level of proteins is most often associated with their biological function?

- A The primary structure
- B The secondary structure
- C The tertiary structure
- D The quaternary structure

Solution The solution is (C). Tertiary structure is generally stabilized by nonlocal interactions, most commonly by the formation of a hydrophobic core, but also through salt bridges, hydrogen bonds, disulfide bonds, and even posttranslational modifications. Therefore, the tertiary structure is what controls the basic function of the protein. Some proteins acquire their biological functions only in their quaternary structures, for example, antibodies.

31 What may cause a protein to denature?

- A Changes in pH
- B High temperatures
- C The addition of some chemicals
- D All of the above

Solution The solution is (D). If the protein is subject to changes in temperature, pH, or exposure to chemicals, the protein structure may change, losing its shape without losing its primary sequence, in a process known as denaturation.

32 What is a protein's chaperone?

- A A chemical that assists the protein in its enzymatic functions
- B A second protein that completes the quaternary structure

- C A chemical that helps the protein fold properly
- D A chemical that functions as a cofactor for the protein

Solution The solution is (C). Proteins receive assistance in the folding process from protein helpers known as chaperones that associate with the target protein during the folding process. They prevent aggregation of polypeptides, and then disassociate themselves from the protein once the target protein is folded.

33 What are the building blocks of nucleic acids?

- A Nitrogenous bases
- B Nucleotides
- C Peptides
- D Sugars

Solution The solution is (B). DNA and RNA are nucleic acids made up of monomers known as nucleotides. Each nucleotide is made up of three components: a nitrogenous base, a pentose sugar, and a phosphate group.

34 What may a nucleotide of DNA contain?

- A Ribose, uracil, and a phosphate group
- B Deoxyribose, uracil, and a phosphate group
- C Deoxyribose, thymine, and a phosphate group
- D Ribose, thymine, and a phosphate group

Solution The solution is (C). Each nucleotide consists of a pentose sugar (deoxyribose in DNA and ribose in RNA), a nitrogenous base (adenine, cytosine, guanine, or thymine), and a phosphate group.

35 What is DNA's structure described as?

- A A step ladder
- B A double helix
- C A tertiary protein-like structure
- D A barber pole

Solution The solution is (B). DNA has a double-helical structure with the two strands running in opposite directions (antiparallel), connected by hydrogen bonds and complementary to each other.

36 What is found in RNA that is NOT in DNA?

- A** Deoxyribose and adenine
- B** Fructose and thymine
- C** Glucose and quinine
- D** Ribose and uracil

Solution The solution is (D). The nucleotide molecule RNA consists of ribose sugar. Also, in RNA, uracil replaces thymine and pairs with adenine (U-A).

37 What is the smallest type of RNA?

- A** mRNA
- B** miRNA
- C** rRNA
- D** tRNA

Solution The solution is (B). MicroRNAs (miRNAs) are the smallest RNA molecules and their role involves the regulation of gene expression.

38 Where is the largest amount of DNA found in a eukaryotic cell?

- A** Attached to the inner layer of the cell membrane
- B** In the nucleus
- C** In the cytoplasm
- D** On ribosomes

Solution The solution is (B). DNA in the form of nucleosomes is found inside the nucleus.