6 CHAPTER

MOLECULAR BIOLOGY

6.1 BIOMOLECULES

LONG ANSWER QUESTIONS

Q.1 Define biomolecules. Explain some major biomolecules of living organisms. (K.B)

Ans:

BIOMOLECULES

Definition:

The molecules produced by **organisms** are called biomolecules or biological molecules.

Examples:

- They include **carbohydrates**, **lipids**, **proteins**, and **nucleic acids** (DNA and RNA).
- They are mostly large in size and are called **macromolecules**.

Major Biomolecules:

Biomolecule	Location in the cell	Main Functions
Carbohydrates	• Cytoplasm • Cell membrane	• Act as source of **energy** • Act as energy **storage** molecules
Proteins	• Cell membrane • Cytoplasm • Endoplasmic reticulum • Golgi apparatus • Lysosome, mitochondria	• Many proteins act as **enzymes** • Some **hormones** are proteins • Make **membranes** and many other structures in cells • Control cellular traffic
Lipids	• Cell membrane • Cytoplasm	• Act as **energy storage** molecules • Act as heat **insulators** • Make structure of cell membrane
DNA (Deoxyribonucleic Acid)	• Nucleus (eukaryotes) • Nucleoid region (prokaryotes) • Mitochondria • Chloroplasts	• Carries **genetic information** for the development, functioning, and characteristics of organism
RNA (Ribonucleic Acid)	• Nucleus • Ribosomes • Cytoplasm	• Carries genetic information from DNA to **ribosome** for protein synthesis

6.2 CARBOHYDRATES

LONG ANSWER QUESTIONS

Q.1 Write a comprehensive note on the structures and roles of the three classes of carbohydrates. (K.B)

Ans:

CARBOHYDRATES

Definition:

"Carbohydrate" means "**hydrated carbons**". They are the **organic compounds** in which the ratio of H and O is 2:1 (same as in water).

Other Name:

They are also known as "**Saccharides**" (meaning sugar).

General Formula:

They have the general formula **$Cn(H_2O)n$** where n is the number of carbon atoms.

Classes of Carbohydrates:

There are three classes of carbohydrates: monosaccharides, disaccharides, and polysaccharides.

1. **Monosaccharides**

   Monosaccharides (**simple sugars**) are made of single sugar molecule.

   Characteristics:

   - They are easily soluble in water and have **sweet taste**.

- They may have 3 to 7 carbon atoms.
- **Pentoses** (5C) and **hexoses** (6C) are most common.

Examples:

- **Ribose** ($C_5H_{10}O_5$) and **deoxyribose** ($C_5H_{10}O_4$) are pentoses.
- **Glucose**, **fructose**, and **galactose** are hexoses ($C_6H_{12}O_6$).

Structures:

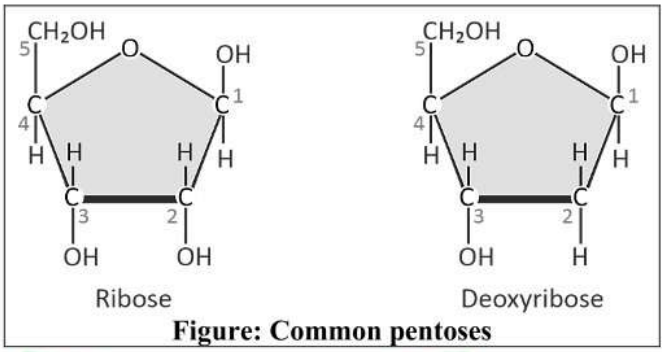


Figure: Common pentoses

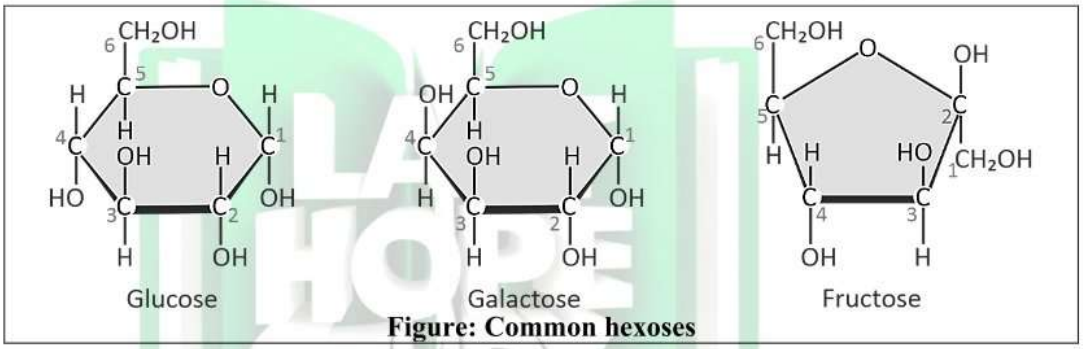


Figure: Common hexoses

2. Disaccharides

They are made of **two monosaccharides units**.

Characteristics:

They are less soluble in water and are less sweet in taste.

Examples:

- **Sucrose** (table sugar) is made of two monosaccharides i.e., glucose and fructose.
- **Maltose** is made of two glucose molecules.

Structures:

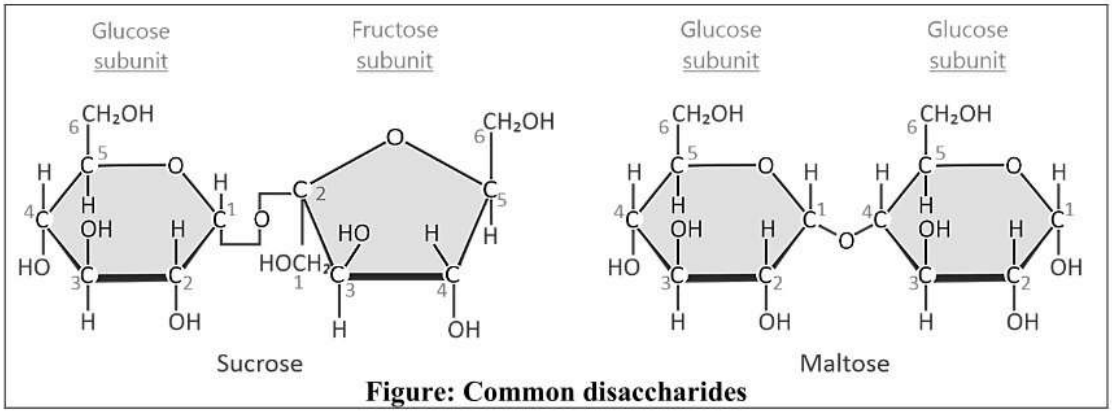


Figure: Common disaccharides

3. **Polysaccharides**

Polysaccharides are **large molecules** composed of hundreds to thousands of monosaccharides units.

Characteristics:

They are **insoluble** in water and are **tasteless**.

Examples:

i. **Starch**
- Starch is a **storage polysaccharide** found in plants.
- It is composed of straight as well as branched chains of **glucose units**.

ii. **Glycogen**
- Glycogen is the **animal starch** mainly stored in **liver** and **muscles**.
- It consists of highly branched chains of glucose which are broken down when energy is needed.

iii. **Cellulose**
- Cellulose is a polysaccharide that also consists of **straight chains** of glucose units.
- It is found in the **cell walls** of plants.

iv. **Chitin**
- Chitin is a **modified** form of cellulose.
- It is found in the **exoskeletons** of crabs, lobsters and insects.
- It also makes the cell wall of **fungi**.

Structures:

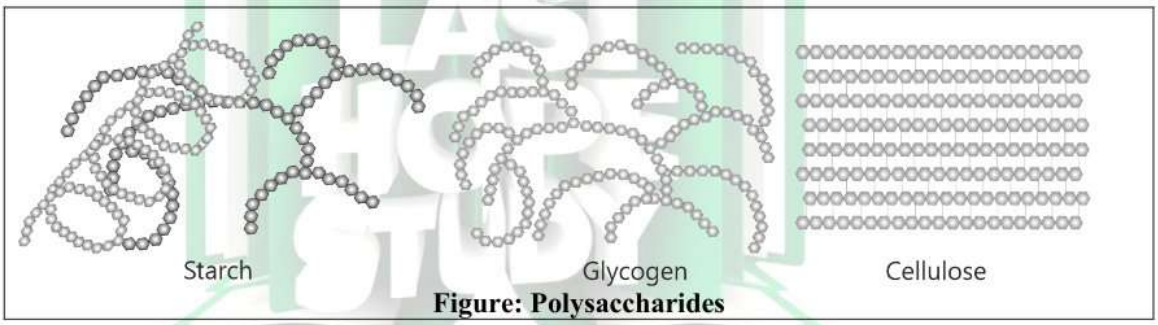


Figure: Polysaccharides

Functions of Carbohydrates:

1. **Source of Energy**
   - Carbohydrates are the primary **source of energy**.
   - Glucose is used by cells to produce energy through **cellular respiration**.
2. **Dietary fibre**
   - Dietary fibre contains **undigestible** carbohydrates e.g., cellulose.
   - It helps to maintain the proper **bowel movements**.
3. **Nucleic Acids**

   Pentoses (ribose and deoxyribose) are essential parts of nucleic acids (RNA and DNA respectively).
4. **Transportation in Plants**

   Plants convert their monosaccharides to disaccharides like **sucrose** to transport monosaccharides between body parts.
5. **Cell Wall of Plants**
   - Cellulose is the most **abundant** carbohydrate.
   - It provides **support** to plant cells and ultimately to the whole plant.
6. **Cell Wall of Fungi**
   - Chitin is a polysaccharide found in the **exoskeleton of insects** and in the cell walls of fungi.

- It provides strength and support to these organisms.

SHORT ANSWER QUESTIONS

Q.1 Define biomolecules. **(K.B)**

Ans:

BIOMOLECULES

Definition:

The molecules produced by **organisms** are called biomolecules or biological molecules.

Examples:

- They include **carbohydrates**, **lipids**, **proteins**, and **nucleic acids** (DNA and RNA).
- They are mostly large in size and are called **macromolecules**.

Q.2 Enlist some major biomolecules of living organisms. **(K.B)**

Ans:

BIOMOLECULES

Some major biomolecules of living organisms are:

- Carbohydrates
- Proteins
- Lipids
- DNA
- RNA

Q.3 Where are proteins found in the body's cells? **(K.B)**

Ans:

PROTEINS

Location:

In living cells, proteins are present in

- Cell membrane
- Cytoplasm
- Endoplasmic reticulum
- Golgi apparatus
- Lysosome
- Mitochondria

Q.4 What are the functions of proteins in the body? **(K.B)**

Ans:

FUNCTIONS OF PROTEINS

Functions:

The proteins in human body performs various functions, including

- Many proteins act as **enzymes**
- Some **hormones** are proteins
- Make **membranes** and many other structures in cells
- Control cellular traffic

Q.5 What are the functions of lipids in the body? **(K.B)**

Ans:

FUNCTIONS OF LIPIDS

Functions:

Some important functions of lipids are:

- Act as **energy storage** molecules
- Act as heat **insulators**
- Make structure of cell membrane

Q.6 Define metabolism and its types. **(K.B)**

Ans:

METABOLISM

Definition:

All the chemical reactions that occur in an organism are collectively called metabolism.

Types of Metabolism:

Metabolism can be divided into two main categories: anabolism and catabolism.

1. **Anabolism**

Anabolism is the type of metabolism in which simpler substances are combined to form complex substances.

Energy:

Energy is used in these reactions.

Example:

Photosynthesis

2. **Catabolism**

Catabolism is the type of metabolism in which complex molecules are broken down into simpler ones.

Energy:

Energy is released in these reactions.

Example:

Respiration

Q.7 What are carbohydrates? (K.B)

Ans:

CARBOHYDRATES

Definition:

"Carbohydrate" means "**hydrated carbons**". They are the **organic compounds** in which the ratio of H and O is 2:1 (same as in water).

Other Name:

They are also known as "**Saccharides**" (meaning sugar).

General Formula:

They have the general formula $\mathbf{Cn(H_2O)n}$ where n is the number of carbon atoms.

Examples:

- Glucose
- Sucrose
- Lactose
- Cellulose

Q.8 Differentiate between monosaccharides and disaccharides. (K.B)

Ans:

DIFFERENTIATION

Monosaccharides	Disaccharides
DEFINITION	
Made of a single sugar molecule.	Made of two monosaccharide units.
SOLUBILITY	
Easily soluble in water.	Less soluble in water.
TASTE	
Sweet	Less sweet
CARBON ATOMS	
Contain 3 to 7 carbon atoms	Formed by the combination of two hexoses or pentoses
EXAMPLES	
Ribose, Glucose, Fructose	Sucrose, Maltose

Q.9 What are polysaccharides? Explain its various examples. (K.B)

Ans:

POLYSACCHARIDES

Definition:

Polysaccharides are **large molecules** composed of hundreds to thousands of monosaccharides units.

Examples:

Polysaccharides	Occurrence	Functions

Starch	Starch is a **storage polysaccharide** found in plants.	It gives glucose units upon hydrolysis.
Glycogen	Glycogen is the **animal starch** mainly stored in **liver** and **muscles**.	It consists of highly branched chains of glucose which are broken down when **energy** is needed.
Cellulose	It is found in the **cell walls** of plants.	Component of plant cell wall.
Chitin	Chitin is a **modified** form of cellulose which is found in the **exoskeletons** of crabs, lobsters and insects.	It makes the cell wall of **fungi**.

Q.10 Give some functions of carbohydrates. (K.B)

Ans:

FUNCTIONS OF CARBOHYDRATES

Functions:

1. **Source of Energy**
   - Carbohydrates are the primary **source of energy**.
   - Glucose is used by cells to produce energy through **cellular respiration**.
2. **Dietary fibre**
   - Dietary fibre contains **undigestible** carbohydrates e.g., cellulose.
   - It helps to maintain the proper **bowel movements**.
3. **Nucleic Acids**
   Pentoses (ribose and deoxyribose) are essential parts of nucleic acids (RNA and DNA respectively).
4. **Transportation in Plants**
   Plants convert their monosaccharides to disaccharides like **sucrose** to transport monosaccharides between body parts.

Q.11 Define biochemistry and molecular biology. (K.B)

Ans:

DEFINITION

Biochemistry:
Biochemistry is the study of the chemical processes that occur within living organisms.
Examples:
Photosynthesis, cellular respiration
Molecular Biology:
Molecular biology is the study of the structure and function of the biomolecules.
Examples:
Carbohydrates, proteins, nucleic acids.

MULTIPLE CHOICE QUESTIONS

1. DNA is studies in the discipline: (K.B)
(A) Microbiology (B) Molecular biology
(C) Enzymology (D) Taxonomy

2. It is not a biomolecule: (U.B)
(A) RNA (B) Glucose
(C) Iron (D) Proteins

3. Controlling cellular traffic is the function of: (K.B)
(A) DNA (B) Glucose
(C) RNA (D) Proteins

4. The molecules act as insulator: (K.B)
(A) Lipids (B) Glucose
(C) RNA (D) Carbohydrates

5. This molecule acts as a carrier during protein synthesis: (K.B)

(A) Ribosome (B) DNA
(C) RNA (D) Amino acids

6. **Proteins constitute _____ of dry mass of protoplasm.** **(K.B)**
(A) 10 % (B) 50 %
(C) 65 % (D) 90 %

7. **Lipids constitute _____ of dry mass of protoplasm.** **(K.B)**
(A) 10 % (B) 50 %
(C) 65 % (D) 90 %

8. **The process in which complex substances are formed.** **(U.B)**
(A) Cellular respiration (B) Anabolism
(C) Catabolism (D) Oxidation

9. **It is NOT true about carbohydrates.** **(K.B)**
(A) Hydrated carbons (B) Sugars
(C) All are sweet (D) Saccharides

10. **The simplest carbohydrates are:** **(K.B)**
(A) Monosaccharides (B) Disaccharides
(C) Polysaccharides (D) Tetrasaccharides

11. **It is a pentose sugar:** **(K.B)**
(A) Glucose (B) Fructose
(C) Ribose (D) Galactose

12. **Sucrose is a:** **(K.B)**
(A) Monosaccharides (B) Disaccharides
(C) Polysaccharides (D) Tetrasaccharides

13. **Number of carbons in hexoses are:** **(K.B)**
(A) 3 (B) 5
(C) 6 (D) 7

14. **The most abundant carbohydrates in nature are:** **(K.B)**
(A) Monosaccharides (B) Disaccharides
(C) Polysaccharides (D) Glucose

15. **A modified cellulose that is found in the cell wall of fungi is:** **(K.B)**
(A) Actin (B) Chitin
(C) Pectin (D) Cellulose

16. **Primary source of energy for living organisms is/are:** **(K.B)**
(A) Carbohydrates (B) Proteins
(C) Nucleic acids (D) Lipids

17. **It is present in the exoskeleton of insects:** **(K.B)**
(A) Chitin (B) Cellulose
(C) Actin (D) Lipids

18. **The disaccharide present in milk is:** **(K.B)**
(A) Glucose (B) Cellulose
(C) Lactose (D) Lipid

6.3 PROTEINS

LONG ANSWER QUESTIONS

Q.1 Define proteins. Explain the structure of proteins. **(K.B)**

Ans: **PROTEINS**

Definition:

Proteins are the most abundant biomolecules in cell. They are defined as the **polymers of amino acids**.

Structure of Proteins:

- Proteins are made up of **monomers** called amino acids.
- Different proteins contain different numbers of amino acids.
- **Insulin** protein has 51 amino acids and **haemoglobin** has 574 amino acids.

Amino Acids:

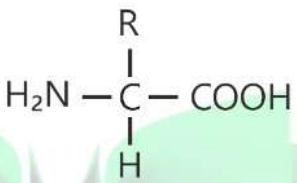
Amino acids are the **organic molecules** that join in specific number and sequence to make proteins.

Types of Amino Acids:

- About **170 types** of amino acids occur in organisms.
- However, 20 types of amino acids participate in making most of the proteins.

Structure of Amino Acid:

- An amino acid is an organic molecule made of an **amino group** (NH_2), a **carboxyl group** (COOH), a **hydrogen group** (H) and a **side group** (R) are attached to a central carbon atom.



Amino acid - general structure

- Different amino acids contain different R groups.
- For example, in amino acid **glycine** the R group is H and in amino acid **alanine**, the R group is CH_3.

Glycine Alanine

Q.2 Discuss the functions of proteins. (K.B)

Ans:

FUNCTIONS OF PROTEINS

Functions:

Proteins perform various functions in our bodies, including:

1. **Structural Role**
   - Proteins are an important part of all cell membranes.
   - Some proteins e.g. **collagen** and **keratin** make almost whole structures of **cartilage**, **hair**, and **nails**.
   - **Actin** and **myosin** proteins are the main components of muscle cells. They are responsible for **muscular contractions**.
2. **Enzymes**
   Enzymes are proteins that catalyse all biochemical reactions occurring in organisms.
3. **Hormones**
   Some proteins are **hormones**. They regulate body processes.
4. **Transport**
   Haemoglobin protein transports oxygen in the blood.
5. **Blood Clotting**
   Fibrin is a blood clotting protein that makes **blood clot** to prevent the loss of blood after an injury.

6. Antibodies

Some proteins called **antibodies** (part of our immune system) defend the body against harmful pathogens.

SHORT ANSWER QUESTIONS

Q.1 What are proteins? Give their structure. (K.B)

Ans:

PROTEINS

Definition:

Proteins are the most abundant biomolecules in cell. They are defined as the **polymers of amino acids**.

Structure of Proteins:

- Proteins are made up of **monomers** called amino acids.
- Different proteins contain different numbers of amino acids.
- **Insulin** protein has 51 amino acids and **haemoglobin** has 574 amino acids.

Q.2 What is an amino acid? Explain its structure. (K.B)

Ans:

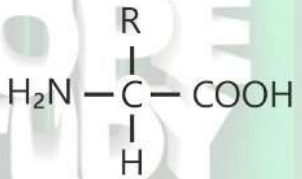
AMINO ACID

Definition:

Amino acids are the **organic molecules** that join in specific number and sequence to make proteins.

Structure of Amino Acids:

- An amino acid is an organic molecule made of an **amino group** (NH_2), a **carboxyl group** (COOH), a **hydrogen group** (H) and a **side group** (R) are attached to a central carbon atom.
- Different amino acids contain different R groups.



Amino acid - general structure

Q.3 What are the structural roles of proteins. (K.B)

Ans:

FUNCTIONS OF PROTEINS

Some major proteins of the body with their functions are:

Structural Role:

- Proteins are an important part of all cell membranes.
- Some proteins e.g. **collagen** and **keratin** make almost whole structures of **cartilage**, **hair**, and **nails**.
- **Actin** and **myosin** proteins are the main components of muscle cells. They are responsible for **muscular contractions**.

Q.4 Write some functions of proteins. (K.B)

Ans:

FUNCTIONS OF PROTEINS

Enzymes:

Enzymes are proteins that catalyse all biochemical reactions occurring in organisms.

Hormones:

Some proteins are **hormones**. They regulate body processes.

Transport:

Haemoglobin protein transports oxygen in the blood.

Blood Clotting:

Fibrin is a blood clotting protein that makes **blood clot** to prevent the loss of blood after an injury.

Antibodies:

Some proteins called **antibodies** (part of our immune system) defend the body against harmful pathogens.

Q.5 Explain essential and non-essential amino acids. (K.B)

Ans:

FUNCTIONS OF PROTEINS

Essential Amino Acids:

There are the 09 amino acids which cannot be synthesized by our body and are supplied by foods. These are called essential amino acids.

Non-essential Amino Acids:

There are 11 amino acids that can be synthesized in our bodies. So, are called non-essential amino acids.

MULTIPLE CHOICE QUESTIONS

1. Proteins are made up of: (K.B)

(A) C,H,O (B) C,H,O,N
(C) C,H,O,P (D) C,O

2. Which is not linked with central carbon of an amino acid? (U.B)

(A) Carboxyl group (B) Amino group
(C) Oxygen atom (D) Hydrogen atom

3. Two amino acids join via: (K.B)

(A) Peptide bond (B) Covalent bond
(C) Glycosidic bonds (D) Hydrogen bond

4. A protein found in RBCs: (K.B)

(A) Histone (B) Haemoglobin
(C) Antibody (D) Fibrinogen

5. A plant source of protein is: (K.B)

(A) Fish liver oil (B) Mushroom
(C) Nuts (D) Both B and C

6. Which is not an animal protein? (K.B)

(A) Milk (B) Eggs
(C) Beef (D) Beans

7. How many amino acids are present in insulin protein? (K.B)

(A) 27 (B) 51
(C) 250 (D) 574

8. How many amino acids are present in haemoglobin protein? (K.B)

(A) 27 (B) 51
(C) 250 (D) 574

9. Major types of amino acids that make proteins in our body. (K.B)

(A) 09 (B) 15
(C) 11 (D) 20

10. The simplest amino acid is: (K.B)

(A) Glycine (B) Alanine
(C) Methionine (D) Aspartate

11. In alanine, the R group is: (K.B)

(A) H (B) OH
(C) CH_3 (D) COOH

12. Proteins catalyse biological reactions, in the form of: (U.B)

(A) Haemoglobin (B) Vitamins
(C) Enzymes (D) Actin and myosin

13. A blood clotting protein is: **(K.B)**

(A) Fibrin (B) Albumin
(C) Antibody (D) Pepsin

14. Proteins regulate body processes, in the form of: **(K.B)**

(A) Hormones (B) Vitamins
(C) Enzymes (D) Actin and myosin

15. It is a good source of proteins: **(K.B)**

(A) Butter (B) Beef
(C) Honey (D) Coconut oil

6.4 LIPIDS

LONG ANSWER QUESTIONS

Q.1 What are fatty acids? Explain their types. **(K.B)**

Ans:

FATTY ACIDS

Definition:

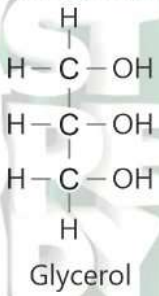
Lipids are organic compounds that are **insoluble in water** but are **soluble in organic solvents** (e.g., alcohol, ether, benzene).

Composition:

They are composed of **glycerol** and **fatty acids**.

Glycerol:

Glycerol is an alcohol having 3 carbon atoms. Each carbon has a **hydroxyl group**.



Glycerol

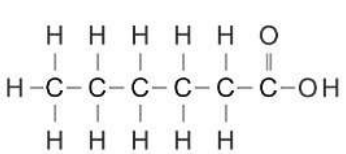
Fatty Acids:

Fatty acids are **long hydrocarbon chains** with carboxyl group (COOH) at the end.

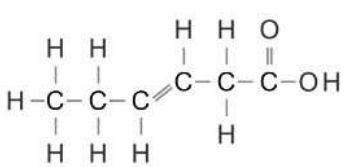
Types of Fatty Acids:

There are two types of fatty acids:

1. **Saturated Fatty Acids**
   - Saturated fatty acids have internal carbon atoms bonded with **maximum** number of hydrogen atoms.
   - They do not have double bonds between carbon atoms.
   - Saturated fatty acids are **solid** at room temperature.
2. **Unsaturated Fatty Acids**
   - Unsaturated fatty acids have one or more double bonds between carbon atoms.
   - They are **liquid** at room temperature.



Saturated fatty acid



Unsaturated fatty acid

Q.2 Explain some major groups of lipids with their structure.

OR

Describe the basic structure of fats and oils. Explain how lipids play role in energy storage. (K.B)

Ans: **MAJOR GROUPS OF LIPIDS**

Major Groups of Lipids:

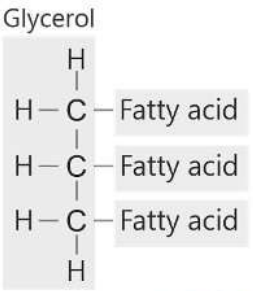
There are two major groups of lipids.

1. **Fats and Oils**

   Fats and oils are the most familiar lipids.

   Structure:

   They contain one glycerol and three fatty acids.



Fats and oils
General structure

   Saturated Fats:

   Fats contain **saturated fatty acids** and so are solid at room temperature e.g., animal fats.

   Unsaturated Fats:

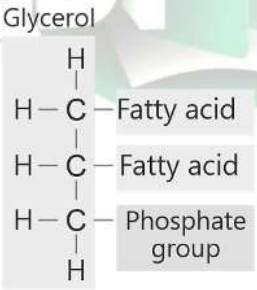
   Oils contain **unsaturated fatty acids** and so are liquid at room temperature e.g., plant oils such as olive oil, corn oil, and coconut oil.

2. **Phospholipids**

   These lipids make the core of all membranes.

   Structure:

   A phospholipid molecule consists of one glycerol, two fatty acids and a phosphate group.



Phospholipids
General structure

Energy Storage:

- Lipids are the most **energy-rich** biomolecules.
- They serve as a long-term energy reserve in the form of fats in **adipose tissues**.
- When the body requires energy, these stored lipids are broken down to release fatty acids and glycerol, which can be used as **fuel** for energy.

Q.3 Write down sources and functions of lipids. (K.B)

Ans: **SOURCES AND FUNCTIONS OF LIPIDS**

Sources:

1. **Animal Sources**
   Sources of lipids from animals are **meat** and **dairy products**.
2. **Plant Sources**
   - The sources of lipids from plants are **nuts**, **seeds**, **olive oil** etc.
   - Plants synthesize oils and store them in **seeds**, such as sunflower oil, coconut oil, groundnut oil and corn oil.

Functions:

1. **Energy Storage**
   - Lipids are the most **energy-rich** biomolecules.
   - They serve as a long-term energy reserve in the form of fats in **adipose tissues**.
   - When the body requires energy, these stored lipids are broken down to release fatty acids and glycerol, which can be used as fuel for energy.
2. **Structural Role**
   Lipids are essential components of cell membranes.
3. **Insulation**
   Lipids act as **insulators** and protect vital organs.
   Example:
   Adipose tissue surrounding organs provides **cushioning** and **heat insulation**.
4. **Hormones**
   Some lipids help in the synthesis of **hormones**.
   Examples:
   Steroid hormones are derived from a lipid i.e., cholesterol.
5. **Absorption of Vitamins**
   Lipids help in the absorption of **fat-soluble vitamins** (A, D, E, and K) in the digestive system.

SHORT ANSWER QUESTIONS

Q.1 What are lipids? **(K.B)**

Ans:

LIPIDS

Definition:

Lipids **are organic compounds that** are insoluble in water but are soluble in organic solvents (e.g., alcohol, ether, benzene).

Composition:

They are composed of glycerol and fatty acids.

Q.2 What are fatty acids? **(K.B)**

Ans:

FATTY ACIDS

Definition:

Fatty acids are **long hydrocarbon chains** with carboxyl group (COOH) at the end.

Types of Fatty acids:

There are two types of fatty acids:

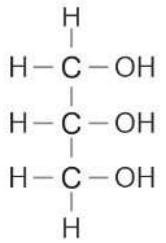
- Saturated fatty acids
- Un-saturated fatty acids

Q.3 Give the structure of glycerol and fatty acids? **(K.B)**

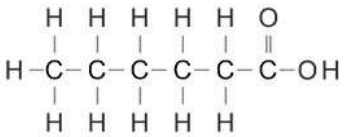
Ans:

STRUCTURE

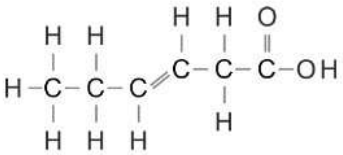
Glycerol	Fatty Acids



Glycerol



Saturated fatty acid



Unsaturated fatty acid

Q.4 Differentiate the types of fatty acids. (K.B)

Ans:

DIFFERENTIATION

The differentiation between types of lipids is given below.

Saturated Fatty Acids	Unsaturated Fatty Acids
DEFINITION	
Saturated fatty acids have internal carbon atoms bonded with maximum number of hydrogen atoms.	Unsaturated fatty acids have one or more double bonds between carbon atoms.
AT ROOM TEMPERATURE	
They are solid at room temperature.	They are liquid at room temperature.
EXAMPLES	
These are of mainly animal sources, like • Cheese • Butter • Ghee	These are mainly of plant derived. Like • Soybean oil • Coconut oil • Mustard oil • Olive oil

Q.5 What are fats and oils? (K.B)

Ans:

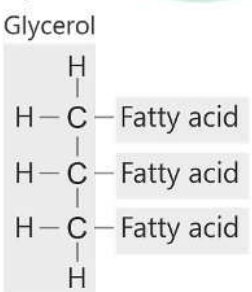
FATS AND OILS

Explanation:

Fats and oils are the most familiar lipids.

Structure:

They contain one glycerol and three fatty acids.



Fats and oils
General structure

Saturated Fats:

Fats contain **saturated fatty acids** and so are solid at room temperature e.g., animal fats.

Unsaturated Fats:

Oils contain **unsaturated fatty acids** and so are liquid at room temperature e.g., plant oils such as olive oil, corn oil, and coconut oil.

Q.6 What are phospholipids? **(K.B)**

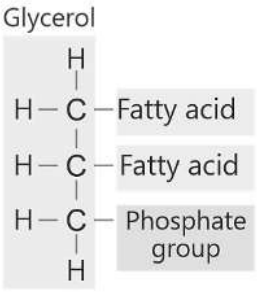
Ans:

PHOSPHOLIPIDS

These lipids make the core of all membranes.

Structure:

A phospholipid molecule consists of one glycerol, two fatty acids and a phosphate group.



Phospholipids
General structure

Q.7 What are the sources of lipids? **(K.B)**

Ans:

SOURCES OF LIPIDS

Animal Sources:

Sources of lipids from animals are **meat** and **dairy products**.

Plant Sources:

- The sources of lipids from plants are **nuts**, **seeds**, **olive oil** etc.
- Plants synthesize oils and store them in **seeds**, such as sunflower oil, coconut oil, groundnut oil and corn oil.

Q.8 Enlist some functions of lipids? **(K.B)**

Ans:

FUNCTIONS OF LIPIDS

1. **Energy Storage**
   - Lipids are the most **energy-rich** biomolecules.
   - They serve as a long-term energy reserve in the form of fats in **adipose tissues**.
2. **Structural Role**
   Lipids are essential components of cell membranes.
3. **Insulation**
   Lipids act as **insulators** and protect vital organs.
   Example:
   Adipose tissue surrounding organs provides **cushioning** and **heat insulation**.
4. **Hormones**
   Some lipids help in the synthesis of **hormones**.
   Examples:
   Steroid hormones are derived from a lipid i.e., cholesterol.

MULTIPLE CHOICE QUESTIONS

1. Lipids are composed of: **(K.B)**

(A) C, H (B) C, H, O
(C) C, H, O, N (D) C, O, P

2. Lipids are composed of: **(K.B)**

(A) Glycerol (B) Fatty acids
(C) Amino acids (D) Both A and B

3. Number of carbons in a glycerol molecule are: **(K.B)**

(A) 1 (B) 2
(C) 3 (D) Many

4. The fatty acids with all single C-C bonds are: **(K.B)**

(A) Saturated (B) Unsaturated
(C) Supersaturated (D) Hydrolyzed

5. At room temperature, unsaturated fatty acids are: **(K.B)**

(A) Gaseous (B) Liquid
(C) Ionized (D) Solid

6. Which is not related to lipids? **(K.B)**
(A) Some of them acts as insulators (B) They are a part of plasma membrane
(C) They can act as channels in the membranes (D) Some vitamins are also lipids in nature

7. Unsaturated fatty acids mostly come from: **(K.B)**
(A) Animals (B) Plants
(C) Microorganisms (D) Earth

8. Olive oil contains: **(K.B)**
(A) Saturated fatty acids (B) Unsaturated fatty acids
(C) Both A and B (D) Glycerol only

9. Fats act as energy reservoirs in the form of: **(K.B)**
(A) Adipose tissues (B) Connective tissues
(C) Muscle tissues (D) Large blocks

10. It is not a fat-soluble vitamin: **(K.B)**
(A) Vitamin A (B) Vitamin E
(C) Vitamin C (D) Vitamin D

6.5 NUCLEIC ACIDS

LONG ANSWER QUESTIONS

Q.1 Explain the double helix structure of DNA, and discuss the base pairing in this structure. **(K.B)**

Ans:

STRUCTURE OF DNA

Full Form:

DNA stands for **Deoxyribonucleic acid**.

Definition:

DNA is made of **deoxyribonucleotides**. In this nucleotide, the **pentose sugar** is deoxyribose while the **nitrogenous base** may be adenine (A), thymine (T), cytosine (C), or guanine (G).

Structure of DNA:

In 1953, US biologist **James Watson** and British biologist **Francis Crick** proposed the double helix model of DNA. According to this model:

- DNA is a **double helix** molecule. It is made of two strands of nucleotides.
- Both strands are **coiled** around each other.
- The nitrogenous bases of one strand make **hydrogen bonds** with the nitrogenous bases of the opposite strand.

Pairing of Nitrogenous Bases:

- The paring of nitrogenous bases is **specific** i.e., **adenine** of one strand forms a pair with **thymine** of opposing strand.
- Similarly, **cytosine** forms a pair with **guanine**.
- There are two hydrogen bonds between adenine and thymine and three hydrogen bonds between cytosine and guanine.

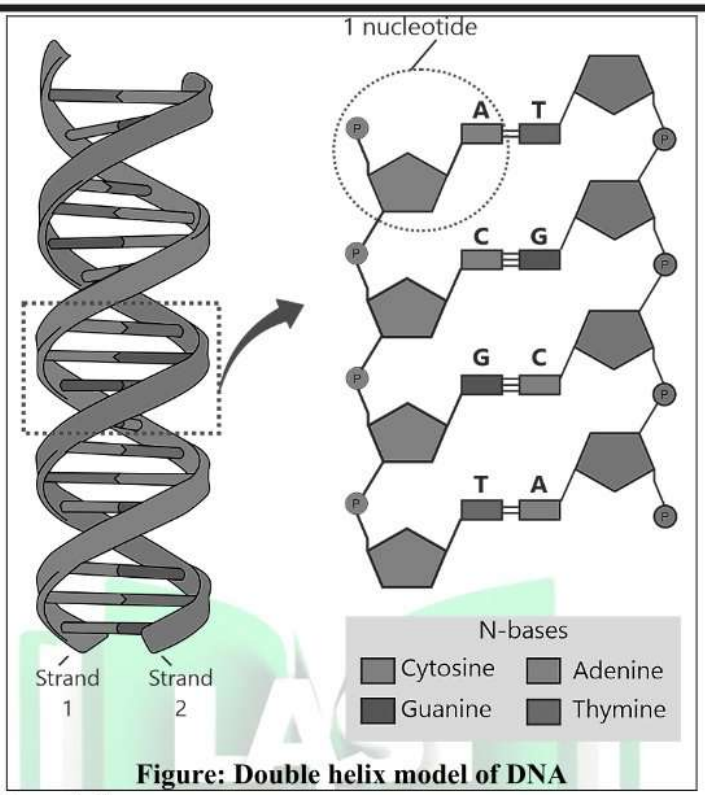


Figure: Double helix model of DNA

Q.2 How the DNA works? (K.B)

Ans:

FUNCTION OF DNA

Hereditary Information:

- DNA contains the **hereditary information**.
- This information is in the form of a **sequence of nucleotides**.
- This sequence determines the order of amino acids during protein synthesis.

Gene:

The segment of DNA in which the sequence of nucleotides determines the synthesis of a protein (polypeptide chain) is called a **gene**.

Transfer of Information:

- During reproduction, DNA is passed from one **generation** to the next.
- In this way, DNA carries the heredity information to the next generation.

Q.3 Define RNA. Also explain its types. (K.B)

Ans:

RNA AND ITS TYPES

Full Form:

RNA stands for "**Ribonucleic Acid**".

Structure:

- RNA is **single-stranded**.
- Its strand consists of **ribonucleotides**.
- A ribonucleotide contains ribose sugar instead of deoxyribose.
- In a ribonucleotide, the nitrogenous base may be adenine (A), uracil (U), cytosine (C), or guanine (G).

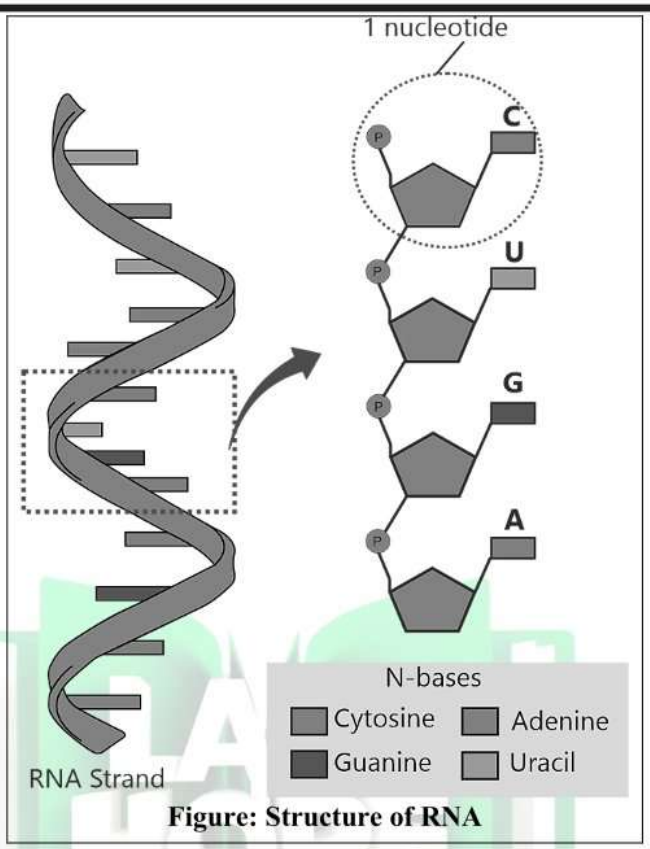


Figure: Structure of RNA

Types of RNA:

There are three types of RNA:

a. **Messenger RNA (mRNA)**
   It carries the **genetic information** from DNA to the ribosomes during protein synthesis.
b. **Transfer RNA (tRNA)**
   It **transfers** specific amino acids to the ribosomes, ensuring the correct sequence during protein synthesis.
c. **Ribosomal RNA (rRNA)**
   Constitutes the structural and functional components of ribosomes, the **cellular machinery** for protein synthesis.

6.6 THE WORKING OF DNA AND RNA

LONG ANSWER QUESTIONS

Q.1 Explain how the information in DNA is converted to information on RNA and then into proteins. (U.B)

Ans:

DENTRAL DOGMA OF LIFE

Gene:

- The DNA molecule in a **chromosome** consists of thousands of nucleotides.
- Along the length of DNA molecule, there are specific segments called **genes**.
- Each gene consists of **specific sequence** of nucleotides that carries information for the synthesis of a specific protein.

Working of DNA:

1. **DNA to mRNA**

- During the working of a gene, the specific sequence of DNA nucleotides is copied in the form of **messenger RNA** (mRNA).
- This process is called **transcription**.

2. mRNA to Protein

- The mRNA carries the sequence of its nucleotides to the ribosome.
- The ribosome **reads** this sequence and joins specific amino acids, according to it, to form protein.
- This step is known as **translation**.

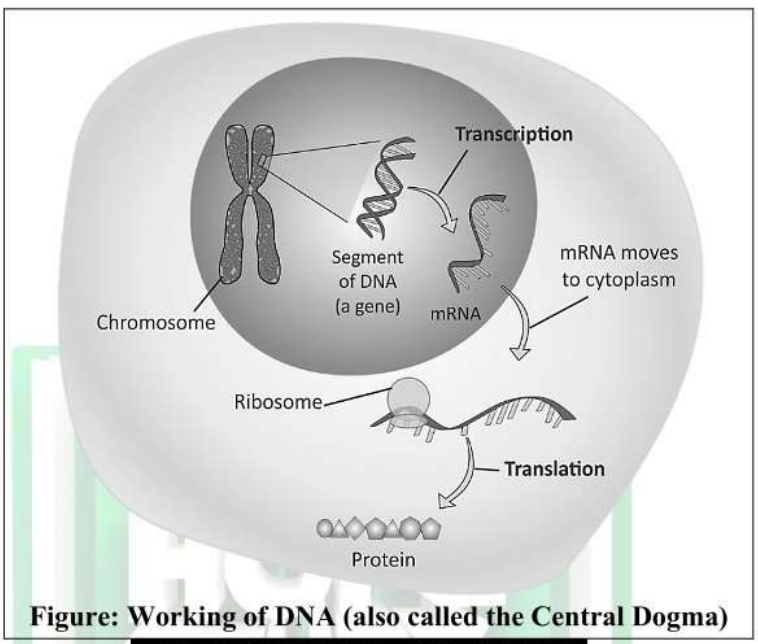


Figure: Working of DNA (also called the Central Dogma)

SHORT ANSWER QUESTIONS

Q.1 Define nucleic acids. **(K.B)**

Ans:

NUCLEIC ACIDS

Definition:

Nucleic acids are the biomolecules that are composed of units called nucleotides.

Types of Nucleic Acids:

There are two main types of nucleic acids.

- Deoxyribonucleic Acid (DNA)
- Ribonucleic Acid (RNA)

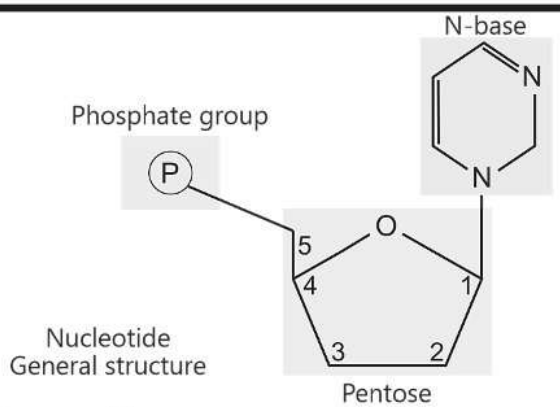
Q.2 What are the components of a nucleotide structure? **(K.B)**

Ans:

STRUCTURE OF NUCLEOTIDE

A nucleotide is made up of three components:

- Pentose sugar (ribose or deoxyribose)
- Nitrogenous base
- Phosphate group (PO_4)



Q.3 How nucleic acid was discovered? (K.B)

Ans:

DISCOVERY

Isolation:

Swiss physician Friedrich Miescher isolated a whitish material from nucleus of human pus cells.

Etymology:

- He named this material as nuclein as it was isolated from nucleus.
- Later on, on the basis of its acidic properties, nuclein was called nucleic acid.

Q.4 Give a comparison between DNA and RNA. (K.B)

Ans:

COMPARISON

A comparison between DNA and RNA is given in the table below.

	DNA	RNA
Sugar	Deoxyribose	Ribose
Occurrence	Nucleus and Mitochondria	Nucleus and Cytoplasm
Nucleotides	A, T, C, G	A, U, C, G
Form	Double stranded	Single stranded
Stability	Very stable (Long life)	Less stable (Short life)
Functions	Stores RNA and protein encoding information	Carries protein encoding information

Q.5 What does the Watson-Crick model of DNA say about nitrogen bases? (K.B)

Ans:

NITROGEN BASES

The DNA model proposed by **Watson and Crick** highlights some important points about the nitrogenous bases, that are:

- The paring of nitrogenous bases is **specific** i.e., **adenine** of one strand forms a pair with **thymine** of opposing strand.
- Similarly, **cytosine** forms a pair with **guanine**.
- There are two hydrogen bonds between adenine and thymine and three hydrogen bonds between cytosine and guanine.

Q.1 What is a gene? (K.B)

Ans:

GENE

Definition:

The **segment of DNA** in which the sequence of nucleotides determines the synthesis of a protein (polypeptide chain) is called a **gene**.

Q.2 Define RNA and its structure. (K.B)

Ans:

RNA AND ITS STRUCTURE

Definition:

The RNA is a **polynucleotide helical chain** like DNA, but it is **single stranded** nucleic acid.

Structure:

- RNA is **single-stranded**.
- Its strand consists of **ribonucleotides**.
- A ribonucleotide contains ribose sugar instead of deoxyribose.
- In a ribonucleotide, the nitrogenous base may be adenine (A), uracil (U), cytosine (C), or guanine (G).

Q.3 Discuss the functions of different types of RNA molecules. (K.B)

Ans:

TYPES OF RNA

There are three types of RNA.

1. **Messenger RNA (mRNA)**
   It carries the **genetic information** from DNA to the ribosomes during protein synthesis.
2. **Transfer RNA (tRNA)**
   It **transfers** specific amino acids to the ribosomes, ensuring the correct sequence during protein synthesis.
3. **Ribosomal RNA (rRNA)**
   Constitutes the structural and functional components of ribosomes, the **cellular machinery** for protein synthesis.

Q.4 What is the function of gene? (K.B)

Ans:

FUNCTION OF GENE

Gene:

- The DNA molecule in a **chromosome** consists of thousands of nucleotides.
- Along the length of DNA molecule, there are specific segments called **genes**.
- Each gene consists of **specific sequence** of nucleotides that carries information for the synthesis of a specific protein.

Q.5 What is central dogma of life? (K.B)

Ans:

CENTRAL DOGMA OF LIFE

Definition:

The flow of biological information, from DNA to RNA and from RNA to protein is known as the "central dogma of molecular biology" or "central dogma of life".

Processes Involved:

There are two basic processes involved in central dogma of life.

1. **Transcription**
   It is the conversion of DNA to RNA (basically mRNA).
2. **Translation**
   It is the process of converting RNA to proteins.

MULTIPLE CHOICE QUESTIONS

1. The five-carbon sugar found in DNA is: (K.B)

(A) Ribose (B) Pentose
(C) Deoxyribose (D) Oxyribose

2. Nucleic acid was discovered by: (K.B)

(A) Friedrich Miescher (B) James Watson
(C) Francis Crick (D) Thomas Edisson

3. It is not a part of DNA. (K.B)

(A) Adenine (B) Uracil
(C) Cytosine (D) Guanine

4. It is false about DNA. (K.B)

(A) Double stranded molecule
(B) 2 hydrogen bonds between cytosine and guanine
(C) Adenine and thymine are always in equal amount
(D) Cytosine binds with guanine only

5. How many hydrogen bonds are present between adenine and thymine? (K.B)
(A) One (B) Two
(C) Three (D) Four

6. How many hydrogen bonds are present between cytosine and guanine? (K.B)
(A) One (B) Two
(C) Three (D) Four

7. Guanine always pairs up with: (K.B)
(A) Adenine (B) Uracil
(C) Cytosine (D) Guanine

8. In RNA, adenine pairs up with: (K.B)
(A) Thymine (B) Uracil
(C) Cytosine (D) Guanine

9. It is not a part of RNA N-bases: (K.B)
(A) Adenine (B) Uracil
(C) Thymine (D) Cytosine

10. The sugar of RNA is: (K.B)
(A) Ribose (B) Oxyribose
(C) Deoxyribose (D) Dideoxy-ribose

11. Types of RNA in the cell. (K.B)
(A) One (B) Three
(C) Four (D) Five

12. The function of tRNA is to: (U.B)
(A) Carry message from DNA (B) Synthesize proteins
(C) Makes rRNA (D) Transfers amino acids to ribosomes

13. Central dogma of life can be represented by: (K.B)
(A) DNA → Proteins (B) RNA → Proteins
(C) DNA → RNA → Proteins (D) All of these

14. The site of transcription in the cell is: (K.B)
(A) Nucleus (B) Cytoplasm
(C) Mitochondria (D) Cell membrane

15. The site of translation in the cell is: (K.B)
(A) Nucleus (B) Cytoplasm
(C) Mitochondria (D) Cell membrane

16. Proteins are formed by: (K.B)
(A) Ribosomes (B) Cytoplasm
(C) Mitochondria (D) Chloroplasts

17. The information of amino acids for protein synthesis is present in: (K.B)
(A) rRNA (B) tRNA
(C) cDNA (D) mRNA

TEXTBOOK EXERCISE

MULTIPLE CHOICE QUESTIONS

1. What is the primary function of carbohydrates?
(A) Provide energy (B) Act as enzymes
(C) Regulate processes (D) Make membranes

2. How will you differentiate between monosaccharides and polysaccharides?
(A) Monosaccharides are simple sugars.
(B) Polysaccharides are sweet in taste.
(C) Monosaccharides are present in plant cell wall.
(D) Polysaccharides dissolve easily.

3. What is true about cellulose?
(A) It is sweet in taste.
(B) It is digestible by human digestive system.
(C) It provides structural support in plants.
(D) It is soluble in water.

4. Which of the following proteins is involved in oxygen transport?
(A) Insulin (B) Haemoglobin
(C) Collagen (D) Keratin

5. Which component of an amino acid determines its unique properties?
(A) Amino group (B) Carboxyl group
(C) R group (side chain) (D) Hydrogen group

6. Which proteins are involved in defense against pathogens?
(A) Antibodies (B) Myosin
(C) Fibrinogen (D) Haemoglobin

7. Which of the following is the basic structural unit of most lipids?
(A) Amino acids (B) Fatty acids and glycerol
(C) Nucleotides (D) Simple sugars

8. How do unsaturated fatty acids differ from saturated fatty acids?
(A) They have more hydrogen atoms.
(B) They contain double bonds in their hydrocarbon chains.
(C) They are solid at room temperature.
(D) They are found only in animal fats.

9. Which of the following is NOT a function of proteins?
(A) Transport oxygen in the blood.
(B) Carry genetic information.
(C) Help in digesting food.
(D) Fight against pathogens.

10. Which components make up a nucleotide?
(A) Sugar, phosphate, nitrogenous base
(B) Amino acid, sugar, nitrogenous base
(C) Fatty acid, phosphate, nitrogenous base
(D) Protein, sugar, nitrogenous base

11. Which nitrogenous base is found in RNA but not in DNA?
(A) Adenine (B) Thymine
(C) Uracil (D) Guanine

SHORT ANSWER QUESTIONS

Q.1 What are the main functions of carbohydrates in the body?

Ans: **FUNCTIONS OF CARBOHYDRATES**

The main functions of carbohydrates in the body are:

- Carbohydrates are the primary **source of energy**.
- Glucose is used by cells to produce energy through **cellular respiration**.
- Dietary fibre contains **undigestible** carbohydrates e.g., cellulose. It helps to maintain the proper **bowel movements**.
- **Pentoses** (ribose and deoxyribose) are essential parts of nucleic acids (RNA and DNA respectively).
- Plants convert their monosaccharides to disaccharides like **sucrose** to transport monosaccharides between body parts.

- Cellulose is the most **abundant** carbohydrate. It provides **support** to plant cells and ultimately to the whole plant.
- Chitin is a polysaccharide found in the **exoskeleton of insects** and in the cell walls of fungi.
- It provides strength and support to these organisms.

Q.2 How do the three group of carbohydrates differ in taste?

Ans: **GROUPS OF CARBOHYDRATES**

The three groups of carbohydrates differ in taste as follows:

- **Monosaccharides** have a sweet taste.
- **Disaccharides** are less sweet than monosaccharides.
- **Polysaccharides** are tasteless.

Q.3 Name two common monosaccharides and two disaccharides.

Ans: **EXAMPLES**

The common examples are:

Monosaccharides:

- Ribose
- Glucose

Disaccharides:

- Sucrose
- Maltose

Q.4 Which monosaccharides make a sucrose molecule?

Ans: **SUCROSE**

The monosaccharide glucose and fructose make a sucrose molecule.

Equation:

$Glucose(C_6H_{12}O_6) + Fructose(C_6H_{12}O_6) \rightarrow Sucrose(C_{12}H_{22}O_{11}) + H_2O$

Q.5 Give an example of a storage polysaccharide in plants.

Ans: **STORAGE POLYSACCHARIDE**

Starch is a **storage polysaccharide** found in plants. It is composed of straight as well as branched chains of **glucose units**.

Reason:

Plant converts glucose into sucrose which is then stored in them.

Q.6 Define amino acid and draw its structure.

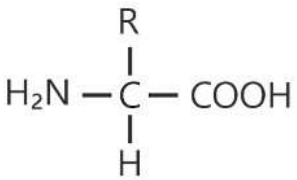
Ans: **AMINO ACID**

Definition:

Amino acid is the **organic molecule** that join in specific numbers and sequence to make proteins.

Structure of Amino Acid:

An amino acid is an organic molecule made of an **amino group** (NH_2), a **carboxyl group** (COOH), a **hydrogen group** (H) and a **side group** (R) are attached to a central carbon atom.



Amino acid - general structure

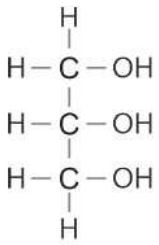
Q.7 What are the basic components of lipids? Draw their structures.

Ans: **COMPONENTS OF LIPIDS**

Lipids are composed of **glycerol** and **fatty acids**.

Glycerol:

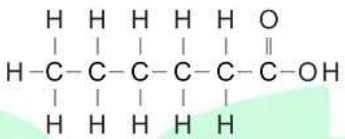
Glycerol is an alcohol having 3 carbon atoms. Each carbon has a **hydroxyl group**.



Glycerol

Fatty Acids:

Fatty acids are **long hydrocarbon chains** with carboxyl group (COOH) at the end.



Q.8 What are the types of RNA? Write their functions.

Ans:

TYPES OF RNA

There are three types of RNA:

1. **Messenger RNA (mRNA)**
   It carries the **genetic information** from DNA to the ribosomes during protein synthesis.
2. **Transfer RNA (tRNA)**
   It **transfers** specific amino acids to the ribosomes, ensuring the correct sequence during protein synthesis.
3. **Ribosomal RNA (rRNA)**
   Constitutes the structural and functional components of ribosomes, the **cellular machinery** for protein synthesis.

Q.9 Briefly describe the function of DNA.

Ans:

FUNCTION OF DNA

DNA contains the **hereditary information**. This information is in the form of a **sequence of nucleotides**. This sequence determines the order of amino acids during protein synthesis. During reproduction, DNA is passed from one **generation** to the next. In this way, DNA carries the heredity information to the next generation.

Q.10 Differentiate between:

i. Biochemistry and Molecular biology

Ans:

DIFFERENTIATION

Biochemistry	Molecular Biology
DEFINITION	
It is the study of chemical processes within living organisms.	It is the study of the structure and function of biomolecules.
MAJOR FOCUS	
Focuses on metabolic pathways and chemical reactions (e.g., photosynthesis).	Focuses on DNA, RNA, and protein synthesis and their regulation.
APPLICATIONS	
Understanding diseases, drug designing and	Genetic engineering, cloning, and studying

metabolism.	genetic disorders.

ii. Structure of DNA and RNA

Ans: **DIFFERENTIATION**

DNA	RNA
STRANDS	
Double-stranded (double helix structure)	Single-stranded
SUGAR	
Contains deoxyribose	Contains ribose
NITROGENOUS BASES	
Adenine (A), Thymine (T), Cytosine (C), Guanine (G)	Adenine (A), Uracil (U), Cytosine (C), Guanine (G)

iii. Composition of DNA and RNA

Ans: **DIFFERENTIATION**

DNA	RNA
STRANDS	
Double-stranded (double helix structure)	Single-stranded
SUGAR	
Deoxyribose (a pentose sugar lacking one oxygen atom at the 2' position)	Ribose (a pentose sugar with an -OH group at the 2' position)
NITROGENOUS BASES	
Adenine (A), Thymine (T), Cytosine (C), Guanine (G)	Adenine (A), Uracil (U), Cytosine (C), Guanine (G)

iv. Monosaccharides and Disaccharides

Ans: **DIFFERENTIATION**

Monosaccharides	Disaccharides
DEFINITION	
Made of a single sugar molecule.	Made of two monosaccharide units.
SOLUBILITY	
Easily soluble in water.	Less soluble in water.
TASTE	
Sweet	Less sweet
CARBON ATOMS	
Contain 3 to 7 carbon atoms	Formed by the combination of two hexoses or pentoses
EXAMPLES	
Ribose, Glucose, Fructose	Sucrose, Maltose

v. Glycogen and Starch

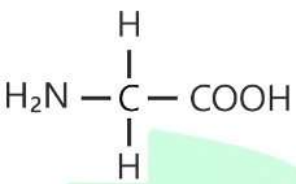
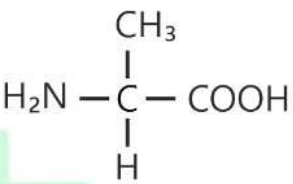
Ans: **DIFFERENTIATION**

Glycogen	Starch
OCCURRENCE	
Found in animals, stored in liver and muscles.	Found in plants as a storage polysaccharide.
STRUCTURE	
Composed of both straight and branched chains of glucose.	Composed of highly branched chains of glucose.
FUNCTION	
Energy storage in plants.	Energy storage in animals, broken down when energy is needed.

SOURCE	
Stored in the human body	Potatoes, rice, wheat

vi. Glycine and Alanine

Ans: **DIFFERENTIATION**

Glycine	Alanine
DEFINITION	
It is the simplest amino acid.	It is slightly larger amino acid than glycine.
R GROUP	
Hydrogen (H)	Methyl group (CH_3)
STRUCTURE	
	

vii. Saturated and Unsaturated fatty acids

Ans: **DIFFERENTIATION**

Saturated Fatty Acids	Unsaturated Fatty Acids
DEFINITION	
Saturated fatty acids have internal carbon atoms bonded with maximum number of hydrogen atoms.	Unsaturated fatty acids have one or more double bonds between carbon atoms.
AT ROOM TEMPERATURE	
They are solid at room temperature.	They are liquid at room temperature.
EXAMPLES	
These are of mainly animal sources, like • Cheese • Butter • Ghee	These are mainly of plant derived. Like • Soybean oil • Coconut oil • Mustard oil • Olive oil

viii. Fats and Oils

Ans: **DIFFERENTIATION**

Fats	Oils
OCCURRENCE	
They are solid lipids at room temperature.	They are liquid lipids at room temperature.
TYPE OF FATTY ACID	
Contain saturated fatty acids.	Contain unsaturated fatty acids.
SOURCE	
Typically derived from animals (e.g., butter, cheese).	Typically derived from plants (e.g., olive oil, corn oil).

EXTENSIVE ANSWER QUESTIONS

Q.1 Write a comprehensive note on the structures and roles of the three classes of carbohydrates.
See Q.No.1 of topic 6.2

Q.2 Discuss the functions of proteins.
See Q.No.2 of topic 6.3

Q.3 What are fatty acids? Explain their types.
See Q.No.1 of topic 6.4

Q.4 Describe the basic structure of fats and oils. Explain how lipids play role in energy storage.
See Q.No.2 of topic 6.4

Q.5 Explain the double helix structure of DNA, and discuss the base pairing in this structure.
See Q.No.1 of topic 6.5

Q.6 Explain how the information in DNA is converted to information on RNA and then into proteins.
See Q.No.1 of topic 6.6

INQUISITIVE ANSWER QUESTIONS

Q.1 Evaluate the importance of water in the functioning of biomolecules.

Ans:

IMPORTANCE OF WATER

- Water is essential for biomolecules because it acts as a solvent, enabling chemical reactions to occur.
- It helps stabilize structures, like proteins, through hydrogen bonds.
- Water also participates in key reactions, such as hydrolysis and condensation.
- Its high heat capacity helps regulate temperature.
- It aids in transporting nutrients and waste in cells.
- Without water, biomolecules wouldn't function properly.

Q.2 Find the amount/percentage of carbohydrates, proteins, fats and water in the following food product and compare them with each other.
Roti (40gm), Burger, Cucumber, Egg, Rice (100gm), Potato fries (100gm), Carrot.

Ans:

COMPOSITION OF NUTRIENTS

Here's a comparison:

Food Product	Serving size	Carbohydrates (gm)	Proteins (gm)	Fats (gm)	Water (%)
Roti	40 gm	24	4	1.5	30
Burger	1 Medium (~120gm)	30	12	15	40
Cucumber	100 gm	3.6	0.7	0.1	95
Egg	1 large (~50gm)	0.6	6.3	5	75
Rice	100 gm	28	2.7	0.3	68
Potato fries	100 gm	34	3.4	15	60
Carrot	~ 100 gm	9.6	0.9	0.2	88

EXTRA CONCEPTUAL

MULTIPLE CHOICE QUESTIONS

1. Which of the following is not a molecule studied in molecular biology?
(A) DNA (B) RNA

(C) Proteins (D) Xenon

2. **Which is not a function of carbohydrates?**
   (A) Providing energy
   (B) Serving as building blocks for complex carbohydrates
   (C) Forming the primary structure of cell membranes
   (D) Breaking down into glucose
3. **Cellulose differs from starch and glycogen due to its:**
   (A) Glucose units (B) Bond arrangement
   (C) Sweet taste (D) Solubility in water
4. **Lipids are insoluble in water because they:**
   (A) Have no affinity for water (B) Are primarily made up of hydrocarbons
   (C) Are polar compounds (D) Attract water molecules
5. **Which part of the amino acid structure varies from one amino acid to another?**
   (A) Hydrogen group (B) Carboxylic acid group
   (C) R group (D) Amino group
6. **Which protein provides structure to hair and nails?**
   (A) Collagen (B) Myoglobin
   (C) Keratin (D) Haemoglobin
7. **The type of RNA that brings amino acids to the ribosome is:**
   (A) mRNA (B) rRNA
   (C) tRNA (D) snRNA
8. **Peptide bond is formed between two:**
   (A) Monosaccharides (B) Amino acids
   (C) Nucleotides (D) Fatty acids
9. **During translation, sequence of amino acids in the protein is decided on the basis of sequence of nucleotides in:**
   (A) tRNA (B) rRNA
   (C) mRNA (D) DNA
10. **Different amino acids differ from each other on the basis of their _____ group.**
    (A) Alkyl (B) Carboxylic
    (C) Amino (D) Phosphate
11. **Both strands of DNA are held together by hydrogen bonding. Double hydrogen bonds are present between:**
    (A) Adenine and thymine (B) Cytosine and guanine
    (C) Cytosine and thymine (D) Adenine and guanine
12. **Transcription takes place in the:**
    (A) Cytoplasm (B) Nucleus
    (C) Ribosomes (D) Rough endoplasmic reticulum
13. **All the nucleotides of RNA differ from the nucleotides of DNA in having different:**
    (A) Nitrogen base (B) Pentose sugar
    (C) Phosphate group (D) Carboxylic group
14. **Diameter of DNA is thoroughly uniform and is about:**
    (A) 34 nm (B) 3.4 nm
    (C) 2 nm (D) 1.1 nm
15. **Which of the disaccharide is also called transport sugar?**
    (A) Sucrose (B) Maltose
    (C) Fructose (D) Lactose

SHORT ANSWER QUESTIONS

Q.1 Why lipids are insoluble in water?

Ans:

SOLUBILITY OF LIPIDS IN WATER

Definition:

Lipids have little or no affinity for water (hydrophobic in nature) due to the presence of mostly hydrocarbons. That is why they are insoluble in water but soluble in organic solvents such as alcohol.

Q.2 What is the importance of lipids in our body?

Ans:

IMPORTANCE OF LIPIDS

Lipids serve vital functions in the body.

Functions:

- They store energy more efficiently than carbohydrates and proteins, offering a rich source of energy reserves.
- Phospholipids play a crucial role in cell structure by forming the cell membranes that protect and enclose cell's internal environment from the external surroundings

Q.3 What is a peptide bond?

Ans:

PEPTIDE BOND

Definition:

When amino acids link together, they form a bond known as a peptide bond.

Formation of Peptide Bond:

This bond is created through a dehydration synthesis reaction, where a water molecule is removed.

Q.4 Name two types of proteins that provide structure in the human body.

Ans:

STRUCTURAL PROTEINS

The proteins that provide structure to various parts of the body are:

- Keratin in hair and nails
- Collagen in tissues

Q.5 Considering the variety of functions that proteins perform, why might vegetarians need to be more conscious of their protein sources?

Ans:

PEPTIDE BOND

Explanation:

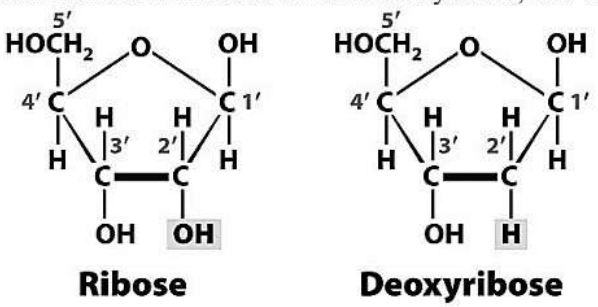
- Vegetarians need to be more conscious of their protein sources because plant-based diets may lack certain essential amino acids that are found in sufficient quantities in animal products.
- They must carefully combine various plant protein sources to ensure they get all necessary nutrients and meet their daily protein requirements effectively.

Q.6 Compare the structures of ribose and deoxyribose sugars.

Ans:

RIBOSE AND DEOXYRIBOSE SUGAR

There is -OH at carbon number 2 in ribose while in deoxyribose, it is -H group.



Q.7 What is a phosphodiester bond?

Ans:

PHOSPHODIESTER BOND

Definition:

A phosphodiester bond is a type of covalent bond that joins two adjacent nucleotides within a nucleic acid strand, such as DNA or RNA.

Formation:

A phosphodiester bond forms when a phosphate group (PO_4) of one nucleotide molecule reacts with the hydroxyl group (-OH) attached to the 3' carbon atom of another nucleotide molecule.

Q.8 In which part of cell, RNA is located?

Ans:

LOCATION OF RNA IN CELL

Definition:

- RNA is primarily located in the cytoplasm of the cell, where protein synthesis occurs.
- However, it is initially synthesized in the nucleus before being transported to the cytoplasm.

Q.9 How the process of protein synthesis happens?

Ans:

PROTEIN SYNTHESIS

The process of protein synthesis begins when a cell requires a particular protein.

1. **mRNA Formation:**
   First, the corresponding DNA segment is copied into messenger RNA (mRNA).
2. **mRNA to Ribosomes:**
   The mRNA then transfers the genetic information it has gathered from the DNA to the ribosomes, guiding the production of the needed protein.
3. **Joining of Amino Acids:**
   At ribosomes, tRNA brings the appropriate amino acids, based on the information in the mRNA.
4. **Amino Acids to Proteins:**
   The ribosomes ensure the right alignment of mRNA and tRNA and facilitate the bonding of these amino acids, resulting in the formation of a protein.

Q.10 Which nitrogenous base in RNA replaces thymine found in DNA?

Ans:

NITROGENOUS BASE OF RNA

In DNA molecule, thymine is present with other nitrogenous bases. While in RNA, thymine is replaced with nitrogenous base Uracil.

So, an RNA molecule contains A, U, C and G, as nitrogenous bases.

Q.11 What sugar is found in RNA molecules?

Ans:

SUGAR IN RNA

Ribose sugar is found in the molecules of RNA.

Structure of Ribose:

- Ribose is a pentose (a five-carbon) sugar that forms the backbone of RNA.
- It has the chemical formula $C_5H_{10}O_5$ and differs from deoxyribose (found in DNA) by having a hydroxyl group (-OH) attached to the 2^{nd} carbon atom.

MULTIPLE CHOICE QUESTIONS

1. Unsaturated fats are considered healthier because they:

(A) Are solid at room temperature

(B) Can contribute to lower cholesterol levels

(C) Are found in nuts and seeds

(D) Have at least one double bond in the fatty acid chain

2. The nitrogenous bases in DNA pair as follows:

(A) Adenine with Uracil (B) Adenine with Thymine

(C) Cytosine with Uracil (D) Thymine with Guanine

3. Which process is not related with biochemistry?

(A) Chemical reactions within living organisms
(B) The study of water cycles
(C) Metabolism
(D) Interaction of various molecules like sugars and proteins

4. Proteins can be found in:
(A) Meat (B) Eggs
(C) Fish (D) All of these

5. Animal proteins are considered complete because they:
(A) Are only found in meat (B) Are high in keratin
(C) Contain all essential amino acids (D) Include hemoglobin

6. The functions of nucleic acids include:
(A) Storing genetic information (B) Providing energy for cellular processes
(C) Coordination among body parts (D) Body movement

7. It is not a good source of proteins.
(A) Meat (B) Red meat
(C) Apple (D) Eggs

8. It is found in protein molecules:
(A) Glycosidic bond (B) Phosphodiester bond
(C) Peptide bond (D) Hydrogen bonds

9. It is found in carbohydrate molecules:
(A) Glycosidic bond (B) Phosphodiester bond
(C) Peptide bond (D) Hydrogen bonds

10. Glucose storage molecule in animal cells is:
(A) Starch (B) Sucrose
(C) Glycogen (D) Galactose

11. Cholesterol is a:
(A) Protein (B) Carbohydrate
(C) Lipid (D) Nucleotide

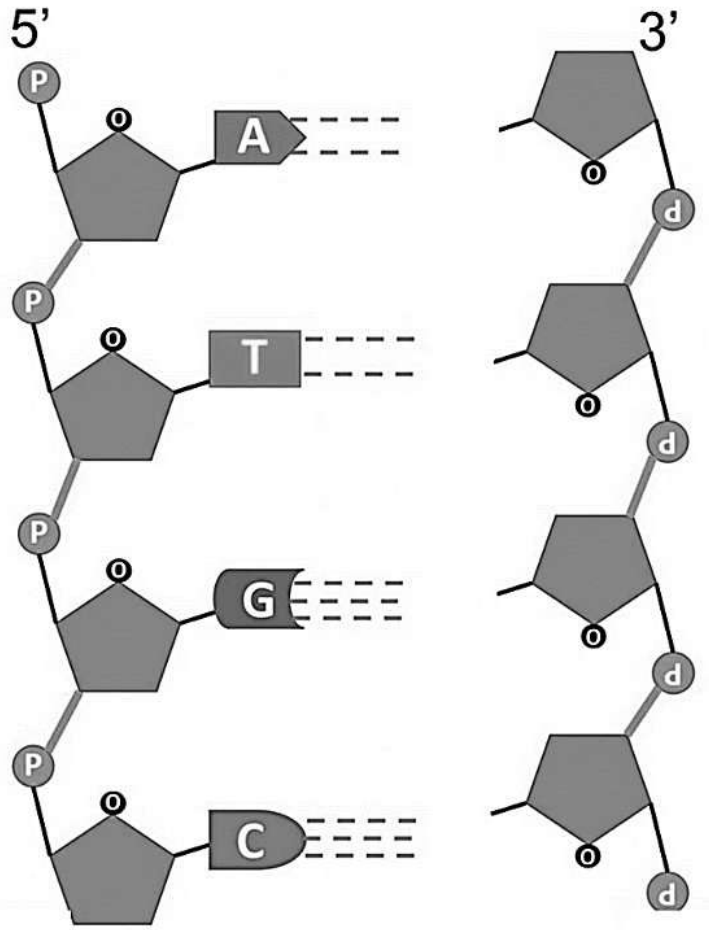
12. These are not synthesized in the body.
(A) Essential amino acids (B) Non-essential amino acids
(C) Energy rich molecules (D) Proteins

13. X-ray based image of DNA was first given by:
(A) Watson and Crick (B) Erwin Chargaff
(C) Rosalind Franklin (D) Friedrich Miescher

ASSIGNMENT

LET'S DRAW AND LABEL

(A) Structure of DNA
Instructions:
Write/make the correct nitrogenous base



(B) Draw the Structures

Instructions:

Draw the following mentioned structures.

Ribose	**Glucose**
Sucrose	**Amino acid**
Glycerol	**Nucleotide**

Terms to Know	
Amino acids	Molecules that are composed of C, H, O, N, and sometimes P, S, Fe, etc.
Biochemistry	The study of different chemical compounds and the chemical processes taking place within living organisms.
Bio elements	Living Organisms are composed of 16 out of 92 naturally occurring elements called biomolecules out of which six are Major and then are Minor biomolecules.
Biomolecules	Different bio-elements combine to form inorganic and organic biomolecules including water, carbohydrates, lipids, proteins, and nucleic acids.
Carbohydrates	Are the compounds of carbon, hydrogen, and oxygen with a ratio of 1:2:1 respectively and literally called "hydrates of carbon".
Central dogma of life	The flow of information, from DNA to RNA and from RNA to protein is known as "central dogma of molecular biology" or "central dogma of life".
Chromatin	The complex of DNA, protein, and RNA that makes up eukaryotic chromosomes.
Chromosomes	Thread like structures in the nucleus, which carry the genes.
Deoxyribonucleic acid (DNA)	Double stranded nucleic acid; contains genetics information coded in specific sequences of its constituent nucleotides.
Gene Expression	Together transcription and translation are known as gene expression.
Glucose	Glucose is a monosaccharide, naturally produced in green plants by the process of photosynthesis using CO_2 from air and water from soil.
Glycerol	A three-carbon alcohol, with a hydroxyl group on each carbon; a component of neutral fats and phospholipids.
Guanine	A nitrogenous purine base that is component of nucleic acids.
Histones	Proteins on which DNA coils to form chromatin fibers and chromosomes.
Lipids	A group of heterogeneous hydrophobic organic compounds including fats, oils, waxes, and steroids found in living organisms, is called lipids.
Messenger RNA (mRNA)	RNA that specifies the amino acid sequence of protein; transcribed from DNA.
Nitrogenous Compounds	Chemicals compounds containing nitrogen, essential for various biology processes in plants and animals.
Nucleoside	Molecule containing of nitrogenous base (purine or pyrimidine) and a pentose sugar.

Answer Key

TOPIC 6.2

1	B	**2**	C	**3**	D	**4**	A	**5**	C
6	B	**7**	A	**8**	B	**9**	C	**10**	A
11	C	**12**	B	**13**	C	**14**	C	**15**	B
		16	A	**17**	A	**18**	C		

TOPIC 6.3

1	B	**2**	C	**3**	A	**4**	B	**5**	C
6	D	**7**	B	**8**	D	**9**	D	**10**	A
11	C	**12**	C	**13**	A	**14**	A	**15**	B

TOPIC 6.4

1	B	**2**	D	**3**	C	**4**	A	**5**	B
6	C	**7**	B	**8**	B	**9**	A	**10**	C

TOPIC 6.6

1	C	**2**	A	**3**	B	**4**	B	**5**	B
6	C	**7**	C	**8**	B	**9**	C	**10**	A
11	B	**12**	D	**13**	C	**14**	A	**15**	B
16	A	**17**	D						

TEXTBOOK EXERCISE MCQs

1	A	**2**	A	**3**	C	**4**	B	**5**	C
6	A	**7**	B	**8**	B	**9**	B	**10**	A
				11	C				

EXTRA CONCEPTUAL MCQs

1	D	**2**	C	**3**	B	**4**	A	**5**	C
6	C	**7**	C	**8**	B	**9**	C	**10**	A
11	A	**12**	B	**13**	B	**14**	C	**15**	A

SLOs MCQs

1	B	**2**	B	**3**	B	**4**	D	**5**	C
6	A	**7**	C	**8**	C	**9**	A	**10**	C
		11	C	**12**	A	**13**	C		