

CHAPTER 25 — BIOCHEMISTRY

Notes · Chemistry-10 Full Chapter

i. The Importance of Nutrition

ii. Carbohydrates

iii. Proteins

iv. Lipids

v. Vitamins

vi. Nucleic Acids

vii. Applications of Biochemistry

DESCRIPTIVE QUESTIONS

Q.1 Define biochemistry. Which kind of food compounds play vital role in living organisms? [10225001]

Ans. Key points: Biochemistry | Carbohydrates | Proteins | Fats and Oils

Biochemistry

Biochemistry is the study of **chemical substances** which play a vital role in the processes taking place in living organisms.

Classes of food

- Carbohydrates
- Lipids
- Fats

Carbohydrates, lipids or fats and proteins are the three classes of foods which not only provide energy to human beings but are also responsible for their body structures.

Carbohydrates

Carbohydrates are the sources of **quick energy** in human body.

Proteins

Proteins are present in all living organisms. They form skin, hair, muscle, blood and almost all the **organs** of animals. They also play a very important role in all life processes.

Fats and Oils

Lipids provide, on the average, **twice** as much energy as provided by carbohydrates or proteins. Fats and oils come from a variety of **natural sources** like animals, plants and marine organisms. Animal fats are particularly located in tissues cells. **Butter** and **ghee** are a special type of animal fats which are made from milk.

25.1 Quick Check

1. Which two functions are performed by proteins?

Ans. Functions of proteins:

- **Body building and repair:** Protein help in the formation and repair of body tissues such as skin, hair, muscles, blood and organs.
- **Regulation of life processes:** Proteins play a very important role in all living organisms e.g. enzymes and hormones.

2. Is milk a fat, a protein or both?

Ans. Milk is both a fat and a protein. Milk contains:

- Protein (such as casein) which helps in growth and repair of body tissues.
- Fat — milk fat provides energy to the body.
- Milk also contains carbohydrates (lactose), vitamins and minerals like calcium and vitamin D. So, milk is not only a protein or only a fat — it is a complete nutritional diet.

THE IMPORTANCE OF NUTRITION**Q.2 Define nutrients and nutrition. Which nutrients are required for human body?****Nutrition**

Nutrition is the study of the nutrients present in food and how they maintain a healthy body.

Nutrients

Nutrients are the components of food that are needed on a regular basis to maintain health and prevent diseases.

A healthy human body needs the following nutrients:

- (a) Carbohydrates
- (b) Lipids
- (c) Protein
- (d) Vitamins and minerals

(a) Carbohydrates

- They are the main source of energy for the human body. They also help the body use protein and fat efficiently.
- A healthy adult needs 225 to 325 grams of carbohydrates per day for a standard 2000-calorie diet.
- Individuals with higher activity levels may need more carbohydrates to meet their daily needs.

(b) Lipids

- They are also essential nutrients because they act as major energy reserves for our body.
- They also provide insulation and protection for vital organs of our body.
- A daily intake of fats for an adult is roughly between 44 to 78 grams.

(c) Protein

- They also supply energy to our body.
- They are needed to build new cells and repair the injured ones.
- An adult should consume 60 grams of proteins per day.

(d) Vitamins and minerals

- They help in growth, reproduction, and the operation and maintenance of the body.
- A balanced diet rich in fruits, vegetables and grains can provide most of the vitamins and minerals needed daily.

Q.3 What are the basics of healthy eating? What is the role of healthy diet in our life? [10225005]

Ans. Key points: Basics of Healthy Eating | Functions of Healthy Eating

Basics of healthy eating

The following are basics of healthy eating:

- (i) A healthy eating means to consume a wide range of foods including fruits, vegetables, whole grains, lean proteins, and healthy fats.
- (ii) They are full of nutrients which are required by our body.
- (iii) Eat less and stay hydrated.
- (iv) Reduce intake of saturated fats, sugar, and sodium.
- (v) Avoid eating processed and poor-quality foods.

Functions of healthy eating

A healthy and balanced diet performs the following functions:

- (i) It prevents diseases like heart disease, diabetes, some cancers and osteoporosis.
- (ii) Adequate nutrition provides fuel for healthy growth and development, leading to maintaining a healthy weight.
- (iii) A balanced diet can positively impact brain function and supports a strong immune system.

25.2 Quick Check

1. What is a balanced diet?

Ans. A balanced diet is a diet that contains all essential nutrients in proper amounts which are required for growth. A balanced diet must contain all the necessary components of nutrients like carbohydrates, proteins, lipids, vitamins and minerals. Adequate water consumption is also part of our balanced diet.

2. Name any three nutrients.

Ans. Names of three important nutrients are: (i) Carbohydrates (ii) Proteins (iii) Lipids (fats)

CARBOHYDRATES

Q.4 Define carbohydrates. Classify carbohydrates into different categories by giving examples.

Ans. Key points: Carbohydrates | Classes of Carbohydrates

Carbohydrates

Carbohydrates are the most **abundant** naturally occurring compounds on earth. They contain the elements carbon, hydrogen and oxygen.

- Because of the sweet taste of some carbohydrates, they are commonly called "sugars".
- Apart from a number of hydroxyl groups, they also contain aldehyde or ketonic functional groups based on the difference in their properties.

Interesting Information

S.Q. What is acesulfame potassium? Give its use. [10225009]

Ans. Acesulfame potassium is the most recently approved sweetener. It is used in soft drinks.

Classes of carbohydrates

Carbohydrates can be classified into three groups:

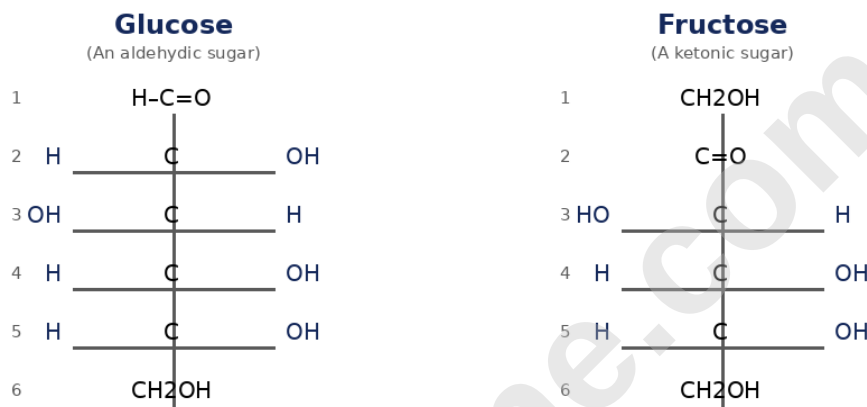
- Monosaccharides
- Oligosaccharides
- Polysaccharides

- **(a) Monosaccharides:** These are the simplest carbohydrates and cannot be broken down into a simpler sugar. They contain one sugar unit.

Examples: Glucose, fructose, galactose etc.

- **(i) Glucose:** Glucose, the most abundant carbohydrate, is also called **grape sugar** or dextrose. It is present in fruits such as grapes, in honey and also in the sap of plants. It is the main source of energy for all animals and is thus present in their blood and urine.
- **(ii) Fructose:** Fructose is another carbohydrate which is present in sweet fruit juices and honey.

Both glucose and fructose have the same molecular formula, **C₆H₁₂O₆**. Their open-chain structures are shown below.



Both glucose and fructose share the molecular formula C₆H₁₂O₆

Fig. 25.1 — Open-chain (Fischer) structures of Glucose (aldehydic sugar) and Fructose (ketonic sugar)

- **(b) Oligosaccharides:** These carbohydrates contain 2–10 monosaccharide units. Its most common type is disaccharides (two sugar units).

Examples: Sucrose, lactose, maltose etc. Sucrose, lactose and maltose are important carbohydrates. All these carbohydrates have the same molecular formula **C₁₂H₂₂O₁₁**.

Sources

- (i) Sucrose is present in sugar cane and sugar beets.
- (ii) Maltose is found in breads and other cereals while lactose is present in milk.

Interesting Information

S.Q. Where is the lactose used in our life? [10225010]

Ans. Lactose is widely used in baking and in commercial milk used for infants. Unlike sucrose, it is a reducing sugar.

- **(c) Polysaccharides:** These are complex carbohydrates made of many monosaccharide units joined together.

Examples: Starch, cellulose, glycogen etc. Starch and cellulose are the two examples of important polymeric carbohydrates; they have a common formula **(C₆H₁₀O₅)_n**.

Sources: Starch is found in foods like potatoes, rice and grains, whereas cellulose sources include plant materials like wood, cotton etc.

Interesting Information

S.Q. What is the role of glycogen in animal body? [10225011]

Ans. Glycogen is a carbohydrate that serves the same energy-storage function in animals that starch serves in plants.

25.3 Quick Check

1. Name any two sources of starch. [10225012]

Ans. Sources of starch: Starch is commonly found in foods like rice and grains. Other sources include wheat, corn (maize) and barley etc.

2. Are all carbohydrates equally beneficial for our health? [10225013]

Ans. No, all carbohydrates are not equally beneficial for our health. Carbohydrates are of two main types: simple carbohydrates and complex carbohydrates.

- Simple carbohydrates (sugar and sweets) give quick energy and should be consumed in limited amounts, because they cause blood spikes, inflammation and health issues.
- Complex carbohydrates (such as starch and fibres) found in whole grains, fruits and vegetables are higher in fibre and support long-term health by managing energy levels.

PROTEINS

Q.5 What are proteins? Describe their functions in the human body. [10225014]

Ans. Key points: Proteins | Functions of Proteins

Proteins

Proteins are very large molecules containing C, H, O, N and sulphur atoms.

The human body contains thousands of different types of proteins where they perform a large number of functions.

Functions of proteins

- There are fibrous proteins that are found in muscles, hair, nails, skin and connective tissues.
- Besides these, hormones and enzymes are also protein in nature. **Example:** The hormone insulin controls the level of sugar in the blood stream.
- Enzymes are the catalysts which speed up the biochemical reactions taking place in our body.
- **Hemoglobin** which carries oxygen in the blood stream and delivers it to different parts of the body is also a protein.

Q.6 Construct peptide linkage and explain the structure of a polypeptide. / Explain how proteins are formed by peptide bonds. [10225015]

Ans. Key point: Formation of Proteins

Formation of proteins

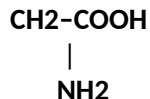
Despite their wide range of functions, all proteins are formed by linking together molecules called amino acids.

Amino acid: An amino acid has two functional groups:

- A carboxyl group – COOH

- An amino group – NH₂

The simplest amino acid is called glycine and its structural formula is:



Linking of amino acids: Although the number of proteins present in the human body runs into thousands, they are all formed by linking together only twenty amino acids.

- **Elimination of water:** The basic reaction which leads to the formation of long chains of proteins involves the elimination of water from two molecules of the same or different amino acids.

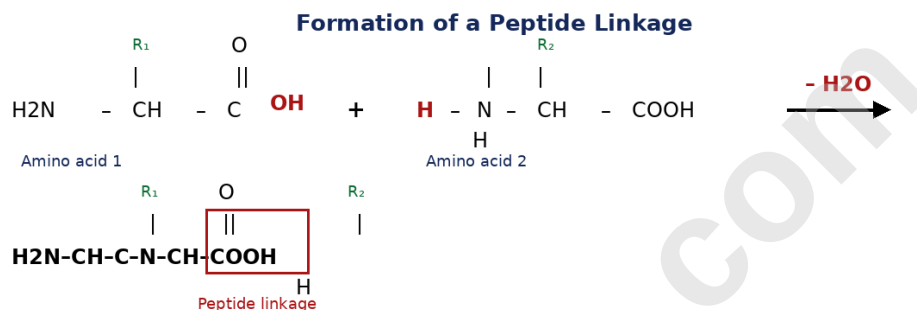


Fig. 25.2 — Formation of a peptide linkage by elimination of water between two amino acids

- **Peptide linkage:** The molecule which is formed as a result of this reaction is called a **peptide** and it contains a **peptide linkage** as shown above. This peptide molecule has a carboxyl group and an amino group at its two ends.
- **Polypeptide chain:** A peptide molecule is capable of reacting further with two molecules of amino acids to give ultimately a long chain composed of many acid molecules called a **polypeptide**.
- **Formation of protein:** This polypeptide chain then undergoes twists and turns and assumes a three-dimensional structure. It is called a **protein** (see Fig. 25.1 — Ball and stick model of a polypeptide, showing an α -helix, in the original text).

Q.7 What is denaturation of protein? Give examples. [10225016]

Ans. Key point: Denaturation of Protein

Denaturation of protein

Complex changes in proteins occur when they are subjected to **heat**, a change in **pH** or an attack by **oxidizing and reducing agents**. The phenomenon is called **denaturation of proteins**.

Examples

- (i) A familiar example is the frying or boiling of an egg which involves the denaturation of egg albumin (protein), the principal component of egg white.
- (ii) Curdling of milk — adding acid or bacteria causes milk proteins to denature and form curd.

Interesting Information

S.Q. Which age group of people needs proteins and why? [10225017]

Ans. Everyone, from infants to adults, needs protein. Children need large amounts of protein for proper growth, and adults need protein to replace what is lost each day by the body's normal biochemical reactions.

25.4 Quick Check

1. What are hormones made of? [10225018]

Ans. Hormones are chemical messengers mainly made of proteins or amino acids (the building block of proteins). Examples: Insulin, growth hormones etc. Some hormones are also steroid hormones which are made of lipids (cholesterol).

2. What is denaturation of protein? [10225019]

Ans. Complex changes in proteins occur when they are subjected to heat, a change in pH or an attack by oxidizing and reducing agents. The phenomenon is called denaturation of proteins. Examples: A familiar example is the frying or boiling of an egg and curdling of milk.

LIPIDS

Q.8 Fatty acids serve as building block of lipids just like amino acids are for proteins. Comment on this statement. [10225020]

Ans. Key points: Lipids | Location of Fats in Plants and Animals

Lipids

Most lipids are composed of simpler substances called **fatty acids** which serve as their building blocks, as amino acids are building blocks of proteins.

Fatty acids are long chain carboxylic acids containing from 12 to 28 carbon atoms.

Examples: Examples of simple fatty acids along with their sources are given in Table 25.1.

Fatty Acid	Source	Structure
Lauric acid	Coconut oil	$\text{CH}_3(\text{CH}_2)_{10}\text{COOH}$
Stearic acid	Animal fats	$\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$
Palmitic acid	Palm oil	$\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$
Oleic acid	Olive oil	$\text{CH}_3(\text{CH}_2)_7\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$

Fatty acids react with an alcohol called glycerol through ester bonds to give a triester, which is called a fat.

Example: Stearic acid reacts with glycerol to form **tristearin** which is a fat. A triester of glycerol is also called a **triglyceride**.

So we can say amino acids are the basic units of proteins while fatty acids are the basic units of fats.

Formation of a Fat (Esterification of Glycerol)

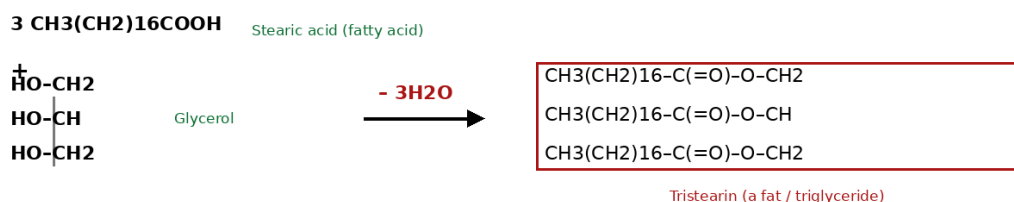


Fig. 25.3 — Formation of tristearin (a fat) from glycerol and three molecules of stearic acid

Location of fats in plants and animals

Animal fats are located particularly in **adipose tissue** cells whereas vegetable oils are present in seeds and roots of plants. Lipids mainly serve as an **energy-rich** source in animals.

Interesting Information

S.Q. What is a soap chemically? Describe how it was prepared in the past. [10225021]

Ans. 1. Soap: Chemically, soap is a mixture of sodium salts of long chain fatty acids produced by hydrolysis of animal fat with alkali.

2. History: Soap has been known since at least 600 BC when it was prepared by boiling goat fat with extracts of wood ash. The cleansing properties of soap did not become widespread until the 18th century.

25.5 Quick Check

1. What is the role of lipids in our body? [10225022]

Ans. Lipids (fats and oils) perform several important functions in the human body.

- **Energy storage:** Lipids provide, on the average, twice as much energy as provided by carbohydrates or proteins.
- **Protection of organs:** They provide cushion and protect vital organs such as heart and kidneys.
- **Insulation:** Lipids maintain body temperature by providing insulation.
- **Cell Structure:** They are an important component of cell membranes.
- **Hormone production:** Some lipids are used to produce hormones.

2. Which is an unsaturated fatty acid? [10225023]

Ans. An unsaturated fatty acid is a fatty acid that contains one or more double bonds (C=C) in its hydrocarbon chain.

Example: Oleic acid $\text{CH}_3(\text{CH}_2)_7\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$. It is usually found in vegetable oils, nuts and seeds.

VITAMINS

Q.9 What are vitamins? Why are they called so? Discuss importance of some useful vitamins. [10225024]

Ans. Key points: Vitamins | Importance of Vitamins

Vitamins

These are organic substances which do not directly serve the purpose of providing energy and building cells of our body like carbohydrates, lipids and proteins. They are, however, necessary to maintain normal health and growth of our body.

Function as catalyst: These compounds are known to function as catalysts for the biological processes going on in our body.

Vital amines or vitamins: Since the first such compound discovered was an amine, they were named vital amines or vitamins. Over the years, scientists have prepared 13 vitamins needed by the human body.

Importance of vitamins

- **Vitamin A:** Vitamin A is present in milk, egg, fish and liver and its deficiency causes night blindness and dry skin.

- **Vitamin D:** Vitamin D may be obtained from butter and fish liver oils. Our skin can also prepare vitamin D directly in the presence of sunlight. This vitamin is related to normal teeth and bone development and its deficiency causes a disease called rickets.
- **Vitamin C:** Vitamin C, also called ascorbic acid, is found in citrus fruits, green pepper and tomatoes. Its deficiency in our body causes scurvy.
- **Vitamins B1 and B2:** Vitamins B1 and B2 are distributed widely in nature. They are present in red meat, nuts and leafy vegetables. Deficiency of vitamin B1 leads to fatigue and depression, whereas lack of vitamin B2 causes inflammation of the lips and dryness and burning of eyes.

25.6 Quick Check

1. Which vitamin is present in lemon? [10225025]

Ans. Vitamin C (Ascorbic acid) is present in lemon.

2. Compare the roles played by vitamins and carbohydrates in our body. [10225026]

Vitamins	Carbohydrates
Vitamins help to regulate body processes and maintain good health.	Carbohydrates are the main source of energy for the body.
They are needed in small amounts.	They are required in larger amounts.
They help in growth, immunity and proper functioning of organs.	They provide fuel for daily activities and body function.
They do not provide energy directly.	They provide energy when broken down in the body.

NUCLEIC ACIDS

Q.10 What are DNA and RNA? Describe the role played by them in our body. [10225027]

Ans. Key points: Nucleic acids | DNA – Molecules | RNA – Molecules

Nucleic acids

Carbohydrates, proteins and fats together with water constitute about **99%** of the most living organisms. The remaining **1%** represents some compounds of vital importance which include two nucleic acids:

- Deoxyribonucleic acid (DNA)
- Ribonucleic acid (RNA)

These compounds are responsible for the existence, development and reproduction of all forms of life. Both DNA and RNA are chemically similar compounds which play different roles within the cell.

DNA - molecules

Molecules of DNA are very large as compared to those of RNA. A DNA molecule may have a molecular mass of up to **660 Da** (unit to measure small molecular mass) and lengths of up to **12 cm** when stretched out. They are mostly found in the nucleus of the cells.

RNA - molecules

RNA molecules, on the other hand, are much smaller (molecular mass 340 Da) and are mostly found outside the cell nucleus.

Interesting Information

S.Q. Which unit is used to measure molecular mass of polymers? [10225028]

Ans. Molecular mass of polymers is often expressed in millions or billions of Daltons (Da).

Function of DNA and RNA

- The function of DNA is to store information and pass it on to RNA, at the proper time.
- The function of RNA, in turn, is to read, decode and use the information to make proteins.

25.7 Quick Check

1. What is the function of RNA? [10225029]

Ans. RNA (Ribonucleic acid) plays an important role in protein synthesis in cells.

Main functions:

- (i) The function of RNA, in turn, is to read, decode and use the information to make proteins.
- (ii) Carries genetic information from DNA to ribosomes.
- (iii) Works with ribosomes to assemble amino acids into proteins.

2. What are the basic differences between DNA and RNA? [10225030]

DNA	RNA
DNA stands for deoxyribose nucleic acid.	RNA stands for ribonucleic acid.
It contains deoxyribose sugar.	It contains ribose sugar.
DNA molecule has molecular mass up to 660 Da.	RNA molecule has molecular mass up to 340 Da.
DNA is mostly found in the nucleus.	RNA is mostly found in cytoplasm outside the nucleus.
It stores information and passes it on to RNA.	It helps in protein synthesis.
Double-stranded molecule.	Single-stranded molecule.

APPLICATIONS OF BIOCHEMISTRY

Q.11 How is biochemistry playing a key role in diagnosis of diseases and other health issues? / Write applications of biochemistry. [10225031]

Ans. Key point: Applications of Biochemistry

Blood tests (Biochemistry in diagnosis)

Doctors use blood tests to identify various health conditions including infections, diabetes, anemia, organ failure and much more. Basic blood chemistry tests check the amount of electrolytes, fats, proteins, glucose and enzymes. These tests give important information about how well a person's kidneys, liver, and other organs are working.

(a) Pregnancy test

- A pregnancy test checks the urine or blood to see if a woman is pregnant or not. **HCG** is a hormone produced in the body when a woman gets pregnant.
- Doctors usually perform two tests to check pregnancy.
- Quantitative blood tests can measure the exact amount of HCG present in the blood.
- It can also give information about how far the pregnancy has progressed.

(b) Blood test for cancer screening

A specific type of blood test called the **Galleri test** is performed to detect cancer in early stages. It uses DNA sequencing to find characteristic patterns which may tell whether a person is suffering from cancer or not.

(c) Parental genetic testing

Genetic tests are often performed by taking a sample of blood or saliva. Persons get genetic testing to know if they have genetic changes themselves or if they can pass on genetic changes to their children.

Q.12 What do you know about genetic engineering? Write its various fields of application. [10225032]

Ans. Key points: Genetic Engineering | Gene Therapy | Cloning

Genetic engineering

- Genetic engineering is a method for changing an organism's genome.
- An organism's genome can be changed by changing one single DNA base or can involve deleting or inserting a whole region of DNA. It is done to modify the genes to enhance the capabilities of the organism beyond what is normal.
- Plants can be made to fight diseases or pollution by changing them through genetic engineering.

Gene therapy

In gene therapy, doctors fix a faulty gene or replace it with a healthy gene in order to cure a disease or enable the body to fight the disease in a better way. This technique may be helpful in future to fight a wide range of diseases like diabetes, AIDS, cancer and haemophilia.

Cloning

Cloning describes the methods used to create an exact genetic replica of a cell, a tissue or the whole organism. The copied material is called a clone and it will have the same genetic characteristics as the original one.

MULTIPLE CHOICE QUESTIONS (EXERCISE)

A. Choose and tick the correct answer from the given choices.

1. Functional groups present in fructose are: [10225033]

- (a) Hydroxyl and aldehyde (b) Hydroxyl and Ketone (c) Hydroxyl and ester (d) Hydroxyl and amide

2. Which functional group is present in a fat? [10225034]

- (a) Carboxyl group (b) Ester group (c) Carbonyl group (d) Hydroxyl group

3. Which function is not performed by proteins in our body? [10225035]

- (a) Chemical messengers (b) Storage of energy-rich fuel (c) Store genetic information (d) Catalysts for biochemical reactions

4. Which functional groups react to produce a peptide linkage in proteins? [10225036]

- (a) Carboxyl & hydroxyl group (b) Carboxyl & amino group (c) Hydroxyl & amino group (d) Ester & amino group

5. The test performed to detect cancer in early stages is: [10225037]

- (a) Genetic test (b) Urine test (c) Galleri test (d) Electrolyte test

6. Fatigue and depression are caused by deficiency of: [10225038]

- (a) Vitamin A (b) Vitamin C (c) Vitamin D (d) Vitamin B1

SLO Based Multiple Choice Questions

The Importance of Nutrition

7. Biochemistry is the study of: [10225039]

- (a) Plants (b) Chemical substances in living organisms (c) Rocks (d) Animals

8. Which nutrient is the main source of energy for the human

11. Glucose is also called: [10225043]

- (a) Fruit sugar (b) Milk sugar (c) Grape sugar (d) Cane sugar

12. Carbohydrates contain the elements: [10225044]

body? [10225040]

- (a) Proteins (b) Vitamins (c) Carbohydrates (d) Minerals

9. Lipids mainly act as: [10225041]

- (a) Body builders (b) Energy reserves (c) Hormones (d) Enzymes

10. Proteins help in: [10225042]

- (a) Digestion only (b) Building and repairing tissues (c) Producing vitamins (d) Making fats

- (a) Carbon, hydrogen, oxygen (b) Carbon, nitrogen, oxygen
(c) Hydrogen, oxygen, nitrogen (d) Carbon and oxygen only

13. A balanced diet helps to: [10225045]

- (a) Cause diseases (b) Maintain health (c) Reduce oxygen (d) Stop digestion

14. Vitamins and minerals help in: [10225046]

- (a) Growth and body maintenance (b) Producing energy only (c) Digestion only (d) Making proteins

Carbohydrates

15. Carbohydrates commonly taste: [10225047]

- (a) Bitter (b) Sour (c) Sweet (d) Salty

16. Carbohydrates are commonly called: [10225048]

- (a) Salts (b) Sugars (c) Oils (d) Minerals

17. Carbohydrates are classified into: [10225049]

- (a) Two groups (b) Three groups (c) Four groups (d) Five groups

18. The other name of grape sugar is: [10225050]

- (a) Dextrose (b) Maltose (c) Fructose (d) Sucrose

19. Fructose is mainly found in: [10225051]

- (a) Meat (b) Fruits and honey (c) Milk (d) Rice

20. Glucose contains which functional group? [10225052]

- (a) Ketone (b) Ester (c) Aldehyde (d) Amide

21. Fructose is a: [10225053]

- (a) Aldehyde sugar (b) Ketone sugar (c) Acid sugar (d) Amide sugar

22. Sucrose, lactose and maltose are examples of: [10225054]

- (a) Monosaccharides (b) Oligosaccharides (c) Polysaccharides (d) Proteins

23. Lactose is present in: [10225055]

- (a) Fruits (b) Bread (c) Milk (d) Honey

24. Starch and cellulose are: [10225056]

- (a) Disaccharides (b) Polysaccharides (c) Proteins (d) Lipids

25. Starch is commonly found in: [10225057]

- (a) Milk (b) Meat (c) Potatoes (d) Honey

26. Cellulose is mainly found in: [10225058]

- (a) Milk (b) Fruits (c) Cotton (d) Honey

27. The common formula of polysaccharides like starch is: [10225059]

- (a) $C_6H_{12}O_6$ (b) $C_{12}H_{22}O_{11}$ (c) $(C_6H_{10}O_5)_n$ (d) $(C_2H_6O)_n$

Proteins

28. Proteins are made up of: [10225060]

- (a) Fatty acids (b) Amino acids (c) Glucose (d) Vitamins

29. Proteins contain which elements? [10225061]

- (a) C, H, O, Na (b) C, H, Cl (c) C, H, O, N, S (d) C, H, He

30. The simplest amino acid is: [10225062]

- (a) Alanine (b) Valine (c) Glycine (d) Lysine

31. The bond that links amino acids together is called:

[10225063]

- (a) Ionic bond (b) Hydrogen bond (c) Peptide bond (d) Ester bond

32. Haemoglobin is responsible for: [10225064]

- (a) Digestion (b) Transport of oxygen in blood (c) Energy storage (d) Hormones production

33. Peptide bond formation involves removal of: [10225065]

- (a) Oxygen (b) Hydrogen (c) CO_2 (d) H_2O

34. Denaturation of proteins occurs due to: [10225066]

- (a) Heat (b) Change in volume (c) Change in catalyst (d) All of these

35. Egg white mainly contains: [10225067]

- (a) Glucose (b) Albumin (c) Starch (d) Cellulose

Lipids

36. Lipids are mainly composed of: [10225068]

- (a) Amino acids (b) Fatty acids and glycerol (c) Proteins (d) Vitamins

37. Fats are formed when fatty acids react with: [10225069]

- (a) Alcohol (b) Glycerol (c) Water (d) Proteins

38. A triester of glycerol is called: [10225070]

- (a) Glycerine (b) Triglyceride (c) Amino acid (d) Peptide

41. $CH_3(CH_2)_7CH=CH(CH_2)_7COOH$ is the formula of: [10225073]

- (a) Lauric acid (b) Stearic acid (c) Oleic acid (d) Palmitic acid

42. Animal fats are mainly stored in: [10225074]

- (a) Blood (b) Adipose tissue (c) Muscles (d) Bones

43. Vegetable oils are mainly present in: [10225075]

- (a) Soil (b) Seeds (c) Flowers (d) Stem

39. Source of lauric acid is: [10225071]

- (a) Animal fats (b) Palm oil (c) Coconut oil (d) Olive oil

40. Stearic acid is found in: [10225072]

- (a) Coconut oil (b) Palm oil (c) Olive oil (d) Animal fat

44. Lipids mainly serve as: [10225076]

- (a) Enzymes (b) Energy source (c) Hormones (d) Vitamins

Vitamins

45. Vitamins help the body by: [10225077]

- (a) Providing energy (b) Acting as catalysts (c) Forming fats (d) Producing oxygen

46. Deficiency of vitamin A causes: [10225078]

- (a) Rickets (b) Night blindness (c) Scurvy (d) Anaemia

47. Vitamin D can be produced in the body with: [10225079]

- (a) Sunlight (b) Water (c) Air (d) Food

48. Deficiency of vitamin C causes: [10225080]

- (a) Rickets (b) Night blindness (c) Scurvy (d) Anaemia

49. Vitamin B1 and B2 are found in: [10225081]

- (a) Fruits only (b) Red meat (c) Honey (d) Fish oil

Nucleic Acids

50. DNA stands for: [10225082]

- (a) Deoxyribose nucleic acid (b) De nuclear acid (c) Dynamic nucleic acid (d) Deoxynatural acid

51. Molecular mass of DNA is upto ____ and length is upto ____: [10225083]

- (a) 660Da and 12cm (b) 560Da and 12cm (c) 660Da and 10cm (d) 460Da and 120cm

52. DNA is mainly found in: [10225084]

- (a) Cytoplasm (b) Cell membrane (c) Nucleus (d) Ribosome

53. RNA mainly helps in: [10225085]

- (a) Energy production (b) Protein synthesis (c) Fat storage (d) Oxygen transport

Application of Biochemistry

54. Biochemistry helps doctors mainly through: [10225086]

- (a) Blood tests (b) Weather reports (c) Agriculture only (d) Transportation

55. A pregnancy test detects the hormone: [10225087]

- (a) Insulin (b) HCG (c) Thyroxine (d) Adrenaline

56. The Galleri test is used to detect: [10225088]

- (a) Diabetes (b) Cancer (c) Fever (d) Allergy

57. Genetic testing is performed using samples of: [10225089]

- (a) Nails (b) Blood (c) Skin (d) Bones

58. Genetic engineering involves: [10225090]

- (a) Changing DNA of an organism (b) Heating chemicals (c) Mixing acids (d) Burning fuels

59. Genetic engineering in plants helps them: [10225091]

- (a) Grow smaller (b) Fight diseases (c) Lose colour (d) Stop growing

60. Gene therapy may help treat: [10225092]

- (a) Diabetes (b) AIDS (c) Cancer (d) All of these

Answer Key (Q. 1 - 60)

1	b	2	b	3	c	4	b	5	c	6	d	7	b	8	c	9	b	10	b
11	c	12	a	13	b	14	a	15	c	16	b	17	b	18	a	19	b	20	c
21	b	22	b	23	c	24	b	25	c	26	c	27	c	28	b	29	c	30	c
31	c	32	b	33	d	34	a	35	b	36	b	37	b	38	b	39	c	40	d
41	c	42	b	43	b	44	b	45	b	46	b	47	a	48	c	49	b	50	a
51	a	52	c	53	b	54	a	55	b	56	b	57	b	58	a	59	b	60	d

SHORT ANSWER QUESTIONS (EXERCISE)

B. Write Short Answers.

1. What is the difference between glucose and fructose? [10225093]

Glucose	Fructose
Glucose is also called grape sugar or dextrose.	It is also called fruit sugar.
It is found in fruits such as grapes, sap of plants and blood.	It is mainly found in fruit juices and honey.
It contains an aldehyde group ($-CHO$).	It contains a ketone group ($>C=O$).

2. Give two examples of denaturation of proteins. [10225094]

- (i) A familiar example is the frying or boiling of an egg which involves the denaturation of egg albumin (protein), the principal component of egg white.
- (ii) Curdling of milk — adding acid or bacteria causes milk proteins to denature and form curd.

3. What are the sources of vitamin D? [10225095]

Vitamin D may be obtained from butter and fish liver oils. Our skin can also prepare vitamin D directly in the presence of sunlight. This vitamin is related to normal teeth and bone development and its deficiency causes a disease called rickets.

4. What is the role of enzymes in our body? [10225096]

Enzymes are biological catalysts, which means they speed up biochemical reactions in our body without being consumed in the process. They are essential for nearly all metabolic activities like digestion, regulation of chemical reactions taking place in our body, hormone activities and detoxification.

5. Which commercial products are obtained from oils and fats? [10225097]

- Soap
- Detergents
- Cosmetics
- Cooking oils and margarine
- Candles
- Lubricants
- Paints and varnishes
- Pharmaceuticals

6. Which vitamin helps in blood clotting? [10225098]

Vitamin K helps in blood clotting. It is essential for the synthesis of a protein prothrombin which helps in blood clotting. It is naturally found in green leafy vegetables, broccoli and cabbage.

SLO Based Short Answer Questions**Introduction and Importance of Nutrition****7. Define biochemistry. Give its applications.** [10225099]

Ans. Biochemistry is the study of chemical substances and processes occurring in living organisms.

Applications: Biochemistry has various applications like food, pharmaceutical, soil and nutrition etc.

8. Which three classes of foods are responsible for the body structure of humans? [10225100]

Ans. Carbohydrates, lipids or fats and proteins are the three classes of foods which not only provide energy to human beings but are also responsible for their body structure.

9. Which group of food provides maximum energy to the body? [10225101]

Ans. Lipids provide, on the average, twice as much energy as provided by carbohydrates or proteins. So lipids provide maximum energy to the body.

10. What is nutrition and nutrients? [10225102]

Ans. Nutrition is the study of nutrients in food and how they help in maintaining a healthy body.

Nutrients: Nutrients are the components of food that are needed on a regular basis to maintain health and prevent diseases.

11. Name the main nutrients required by the human body. [10225103]

Ans. The main nutrients of the human body are:

- Carbohydrates
- Lipids
- Proteins
- Vitamins
- Minerals

12. What are carbohydrates? [10225104]

Ans. Carbohydrates are organic compounds containing carbon, hydrogen and oxygen. They are the main source of energy.

Examples: Glucose, fructose, sucrose and starch are common examples of carbohydrates.

13. What are lipids? [10225105]

Ans. Most lipids are composed of fatty acids which serve as their building blocks. Fatty acids and glycerol react to form triesters or triglycerides, which are also called lipids. Lipids are fats and oils that act as energy reserves and protect body organs.

14. What are proteins? [10225106]

Ans. Amino acids are the building blocks of proteins which join together by peptide bonds, giving polypeptides and proteins. Proteins are nutrients that help build and repair body tissues.

15. How many grams of protein should an adult consume per day? [10225107]

Ans. About 60 grams per day of proteins are needed to build new cells and repair injured ones that an adult must consume.

16. What is a balanced diet? [10225108]

Ans. A diet which contains all essential nutrients in proper amounts is called a balanced diet.

17. What are vitamins and minerals? [10225109]

Ans. Vitamins and minerals are nutrients that help in growth, reproduction and maintenance of the human body.

18. What are the basics of healthy eating? [10225110]

Ans. Healthy eating includes consuming fruits, vegetables, whole grains, lean proteins and healthy fats, drinking enough water and avoiding processed foods.

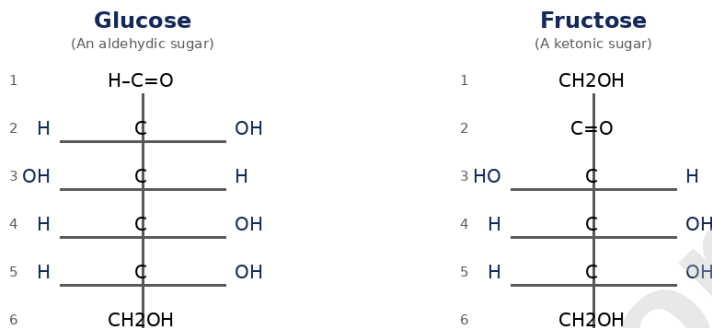
Carbohydrates

19. Name the classification of carbohydrates. [10225111]

Ans. Carbohydrates are divided into three main classes:

- (i) **Monosaccharides:** Glucose, fructose
- (ii) **Oligosaccharides:** Sucrose, maltose, lactose
- (iii) **Polysaccharides:** Starch and cellulose

20. Draw open chain structure of glucose. [10225112]



Both glucose and fructose share the molecular formula C₆H₁₂O₆

Glucose — open chain (Fischer) structure (see Fig. 25.1)

Proteins

21. Write composition of proteins. [10225113]

Ans. Proteins are large biomolecules made of amino acids and contain carbon, hydrogen, oxygen, nitrogen and sometimes sulphur.

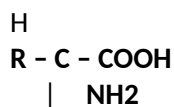
22. What structures of the human body are made of fibrous proteins? [10225114]

Ans. Fibrous proteins are found in muscles, hair, nails, skin and connective tissues of the human body.

23. What is an amino acid? [10225115]

Ans. Amino acids are the building blocks of proteins. There are twenty amino acids which make up the structure of proteins. An amino acid has two functional groups:

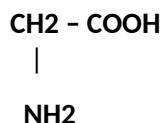
- A carboxyl group – COOH



- An amino group – NH₂

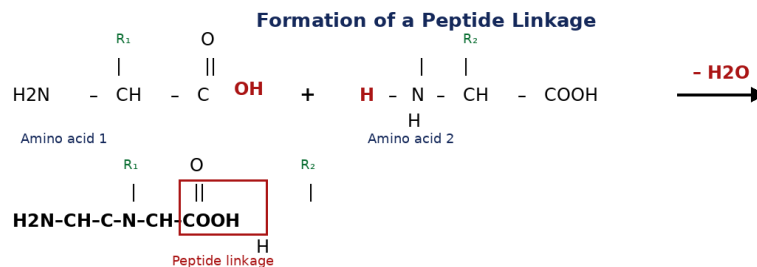
24. What is glycine? Draw its structure. [10225116]

Ans. The simplest amino acid is glycine, its structural formula is:



25. What is a peptide bond? [10225117]

Ans. The bond formed between two amino acids after the removal of a water molecule is called a peptide bond.



Peptide bond formation (see Fig. 25.2)

Lipids

26. What are lipids and fatty acids? [10225118]

Ans. Lipids: Lipids are a group of biological molecules (fats, oils) which are used for energy storage and insulation in the body.

Fatty acids: Fatty acids serve as building blocks of lipids just like amino acids are for proteins.

27. How many carbon atoms are present in fatty acids? [10225119]

Ans. Fatty acids are long chain carboxylic acids containing from 12 to 28 carbon atoms.

28. Write sources of the following fatty acids: Lauric acid, stearic acid, palmitic acid, oleic acid. [10225120]

Ans.

- Lauric acid → Coconut oil
- Stearic acid → Animal fats
- Palmitic acid → Palm oil
- Oleic acid → Olive oil

29. Write formulae of palmitic and stearic acid. [10225121]

Ans. Palmitic acid: $CH_3(CH_2)_{14}COOH$

Stearic acid: $CH_3(CH_2)_{16}COOH$

30. What do you know about the terms triester and triglyceride? [10225122]

Ans. Fatty acids react with an alcohol called glycerol to give a triester. Stearic acid reacts with glycerol to form tristearin, which is a fat. A triester of glycerol is also called a triglyceride.

Vitamins

31. What are vitamins? Why are they called vital amines? [10225123]

Ans. Vitamins: These are organic substances which do not directly serve the purpose of providing energy and building cells of our body like carbohydrates, lipids and proteins.

Vital amines: Since the first compound related to vitamins discovered was an amine, they were named vital amines or vitamins.

32. Name sources of vitamin A. [10225124]

Ans. Vitamin A is present in:

- Milk
- Egg

- Fish
- Liver

33. Write sources of vitamin D. [10225125]

Ans. Sources of vitamin D:

- Butter
- Fish liver oils
- Our skin can also prepare vitamin D directly in the presence of sunlight.

34. What is the role of vitamin D in our body? [10225126]

Ans. Vitamin D is related to normal teeth and bone development. Its deficiency causes a disease called rickets.

35. Name the diseases caused by deficiency of the following vitamins: Vitamin A, Vitamin D, Vitamin C and Vitamin B1 and B2. [10225127]

Ans.

- Vitamin A → Night blindness
- Vitamin D → Rickets
- Vitamin C → Scurvy
- Vitamin B1 → Fatigue and depression
- Vitamin B2 → Inflammation of lips, burning of eyes

Nucleic Acids

36. What are nucleic acids? [10225128]

Ans. Nucleic acids are biochemical compounds that store and transmit genetic information.

37. Name the two types of nucleic acids. [10225129]

Ans. DNA (Deoxyribonucleic acid) and RNA (Ribonucleic acid).

38. Where are DNA and RNA mostly found in the cell? [10225130]

Ans. DNA is mostly found in the nucleus of the cell, whereas RNA is found outside the nucleus (in the cytoplasm).

Applications of Biochemistry

39. What is the purpose of blood tests in medicine? [10225131]

Ans. Blood tests help diagnose diseases and check how well organs like the liver and kidneys are working. Doctors use blood tests to identify infections, diabetes, anemia, organ failure and much more.

40. What is HCG hormone? How is it used to check pregnancy in a woman? [10225132]

Ans. HCG is a hormone produced in the body when a woman gets pregnant. Doctors usually perform two tests to check pregnancy. Quantitative blood tests can measure the exact amount of HCG present in the blood.

41. Which test is performed for cancer screening? [10225133]

Ans. A special type of blood test called the Galleri test is performed to detect cancer in early stages. It uses DNA sequencing to find characteristic patterns which may tell whether a person is suffering from cancer or not.

42. What is parental genetic testing? [10225134]

Ans. Genetic tests are often performed by taking a sample of blood or saliva. Persons get genetic testing to know if they have genetic changes themselves or if they can pass on genetic changes to their children.

43. What is genetic engineering? What is its scope? [10225135]

Ans. Genetic Engineering: Genetic engineering is a method for changing one single DNA base, or can involve deleting or inserting a whole region of DNA.

Scope: It is done to modify the genes to enhance the capabilities of the organism beyond the normal limit. Plants of high yield and more resistant to diseases or pollution are being prepared through genetic engineering.

44. What is gene therapy? Name some diseases that gene therapy may help to treat. [10225136]

Ans. Gene therapy: Gene therapy is a treatment in which a faulty gene is repaired or replaced with a healthy gene in order to cure a disease or enable the body to fight the disease in a better way.

Diseases: This technique may be helpful in future to fight a wide range of diseases like diabetes, AIDs, cancer and haemophilia.

45. What do you mean by the term cloning? [10225137]

Ans. Cloning: Cloning describes the methods used to create an exact genetic replica of a cell, a tissue or the whole organism. The copied material is called a clone and it will have the same genetic characteristics as the original one.

CONSTRUCTED RESPONSE QUESTIONS

1. What is the function of DNA? [10225138]

Ans. Function of DNA (Deoxyribose nucleic acid). The major functions of DNA are:

- It stores genetic information.
- It controls cell activities.
- It passes hereditary information from parents to offspring.
- It acts as a template for RNA synthesis.

2. Write down three important functions played by proteins in our body. [10225139]

Ans. Three important functions of proteins in our body are:

- **Build and repair tissues:** Proteins help in growth of new cells and repair of damaged tissues.
- **Act as enzymes and hormones:** Protein in the form of enzymes speed up chemical reactions, and some hormones (insulin) regulate body functions.
- **Transport and storage:** Proteins like hemoglobin transport oxygen in the blood.

3. Fatty acids serve as building blocks of lipids just like amino acids are for proteins. Comment on this statement. [10225140]

Ans. See Q.8 from theory section (Lipids) — fatty acids, being long-chain carboxylic acids, are the fundamental repeating units from which lipids (fats/triglycerides) are built, in the same way amino acids are the repeating units from which proteins are built.

4. Write down about the sources of vitamin C. Which diseases are caused by its deficiency? [10225141]

Ans. Vitamin C: Vitamin C, also called ascorbic acid, is found in citrus fruits, green pepper and tomatoes.

Deficiency of Vitamin C: Its deficiency in our body causes scurvy.

5. Write down the names of two polymeric carbohydrates. [10225142]

Ans. Two common polymeric carbohydrates (polysaccharides) are:

Starch: Found in potatoes, rice and wheat etc.

Cellulose: Found in plant cell walls. Other examples include glycogen (the animal storage form of glucose) etc.

DESCRIPTIVE QUESTIONS (EXERCISE)**1. What are the sources of fructose, maltose and lactose?** [10225143]

Ans. Sources of fructose (Fruit sugar): Fructose is present in fruit juices and honey.

Maltose (Malt sugar): Found in germinating grains and malt (such as barley). It is found in breads and other cereals.

Lactose (Milk sugar): Lactose is milk sugar and is found in milk and dairy products.

2. Draw open chain structures of glucose and fructose. [10225144]

Ans. See Q.4 from theory section (Carbohydrates) — Fig. 25.1 shows the open-chain Fischer projections of both sugars.

3. Construct peptide linkage and explain the structure of a polypeptide. [10225145]

Ans. See Q.6 from theory section (Proteins) — Fig. 25.2 shows the formation of a peptide linkage between two amino acids by elimination of water.

4. What are DNA and RNA? Describe the role played by them in our body. [10225146]

Ans. See Q.10 from theory section (Nucleic Acids).

5. Compare the roles played by carbohydrates, proteins and lipids in our body. [10225147]

Carbohydrates	Proteins	Lipids
They are the main source of energy for the body.	They help in growth and repair of body tissues.	They act as energy reserves and store energy.
They provide quick energy for daily activities.	They form enzymes which act as biocatalysts in our body and hemoglobin for carrying of oxygen.	They protect internal organs and maintain body temperature.
They are found in fruits, vegetables, honey and milk etc.	They are found in meat, eggs, milk and beans etc.	They are found in fats, oils, butter and nuts etc.

— End of Chapter 25: Biochemistry —