

BSN Generic 1st Semester Biochemistry

Complete Notes & 50 MCQs

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TOPIC 1: CARBOHYDRATES (★★★★★)

Definition

Carbohydrates are organic compounds composed of carbon, hydrogen, and oxygen with the general formula $C_n(H_2O)_n$. They are the most abundant biomolecules on earth.

Classification of Carbohydrates

Carbohydrates are classified into three main groups:

1. Monosaccharides (Simple Sugars)

- These are the simplest form of carbohydrates
- Cannot be hydrolyzed into simpler sugars
- General formula: $C_nH_{2n}O_n$
- Examples:

- Glucose (blood sugar, dextrose)
- Fructose (fruit sugar)
- Galactose (milk sugar component)
- Ribose (found in RNA)
- Deoxyribose (found in DNA)

2. Disaccharides (Double Sugars)

- Formed by combining two monosaccharides
- Joined by glycosidic bond
- Examples:
 - Sucrose = Glucose + Fructose (table sugar)
 - Lactose = Glucose + Galactose (milk sugar)

- Maltose = Glucose + Glucose (malt sugar)

3. Polysaccharides (Complex Sugars)

- Formed by combining many monosaccharides
- Examples:
 - Starch (storage form in plants)
 - Glycogen (storage form in animals, stored in liver and muscles)
 - Cellulose (structural component of plant cell walls)
 - Chitin (found in exoskeleton of insects)

Functions of Carbohydrates

1. Primary source of energy (4 kcal/gram)
2. Structural function (cellulose in plants, chitin in insects)
3. Storage of energy (glycogen in animals, starch in plants)
4. Component of nucleic acids (ribose in RNA, deoxyribose in DNA)
5. Cell recognition and signaling (glycoproteins)
6. Protein sparing action
7. Required for fat metabolism

TOPIC 2: PROTEINS (★★★★★)

Definition

Proteins are complex organic compounds made up of amino acids linked together by peptide bonds. They contain carbon, hydrogen, oxygen, nitrogen, and sometimes sulfur.

Basic Unit

The basic unit of protein is amino acid. There are 20 standard amino acids.

Essential and Non-Essential Amino Acids

Essential Amino Acids (9) - Cannot be synthesized by the body, must be obtained from diet:

1. Histidine
2. Isoleucine

3. Leucine
4. Lysine
5. Methionine
6. Phenylalanine
7. Threonine
8. Tryptophan
9. Valine

Memory trick: PVT TIM HALL (Phenylalanine, Valine, Threonine, Tryptophan, Isoleucine, Methionine, Histidine, Arginine, Leucine, Lysine)

Non-Essential Amino Acids (11) - Can be synthesized by the body:

- Alanine, Asparagine, Aspartic acid, Cysteine, Glutamic acid, Glutamine, Glycine, Proline, Serine, Tyrosine, Arginine

Structure of Proteins

1. Primary Structure

- Linear sequence of amino acids in a polypeptide chain
- Held together by peptide bonds

2. Secondary Structure

- Folding of polypeptide chain into alpha helix or beta pleated sheet
- Held together by hydrogen bonds

3. Tertiary Structure

- Three-dimensional folding of the entire polypeptide chain
- Held together by hydrogen bonds, disulfide bonds, ionic bonds, and hydrophobic interactions

4. Quaternary Structure

- Association of two or more polypeptide chains
- Example: Hemoglobin (4 subunits)

Classification of Proteins

Based on Function:

1. Structural proteins (collagen, keratin)
2. Enzymatic proteins (amylase, lipase)

3. Transport proteins (hemoglobin, albumin)
4. Hormonal proteins (insulin, growth hormone)
5. Defensive proteins (antibodies, immunoglobulins)
6. Contractile proteins (actin, myosin)
7. Storage proteins (ferritin, casein)

Based on Shape:

1. Fibrous proteins (collagen, keratin) - insoluble
2. Globular proteins (hemoglobin, albumin) - soluble

Based on Composition:

1. Simple proteins - contain only amino acids (albumin)
2. Conjugated proteins - contain amino acids plus a non-protein group (hemoglobin)
3. Derived proteins - obtained by degradation of simple or conjugated proteins

Functions of Proteins

1. Growth and repair of tissues
2. Enzyme formation
3. Hormone production
4. Transport of substances (hemoglobin transports oxygen)
5. Defense mechanism (antibodies)
6. Energy source (4 kcal/gram)
7. Maintain fluid balance (albumin)
8. Muscle contraction (actin and myosin)
9. Buffering action

TOPIC 3: ENZYMES (★★★★★)

Definition

Enzymes are biological catalysts that are protein in nature. They speed up chemical reactions in the body without being consumed in the reaction. They lower the activation energy required for a reaction.

Characteristics of Enzymes

1. Protein in nature
2. Highly specific in action
3. Not consumed in the reaction
4. Required in small amounts
5. Affected by temperature and pH
6. Can work in both directions (reversible reactions)
7. Have an active site where substrate binds

Classification of Enzymes (6 Classes)

1. **Oxidoreductases** - Catalyze oxidation-reduction reactions (Example: Lactate dehydrogenase)
2. **Transferases** - Transfer functional groups from one molecule to another (Example: Transaminases/ALT, AST)
3. **Hydrolases** - Catalyze hydrolysis reactions using water (Example: Lipase, Amylase, Protease)
4. **Lyases** - Remove groups without hydrolysis (Example: Aldolase)
5. **Isomerases** - Catalyze isomerization reactions (Example: Phosphoglucose isomerase)
6. **Ligases** - Join two molecules using ATP energy (Example: DNA ligase)

Factors Affecting Enzyme Activity

1. Temperature

- Enzyme activity increases with temperature up to optimum temperature (37°C for human enzymes)
- Above optimum temperature, enzyme gets denatured
- Below optimum temperature, enzyme activity decreases

2. pH

- Each enzyme has an optimum pH
- Pepsin works best at pH 2 (acidic)
- Trypsin works best at pH 8 (alkaline)
- Most enzymes work best at pH 7.4

3. Substrate Concentration

- Enzyme activity increases with substrate concentration until all active sites are occupied (saturation point)

4. Enzyme Concentration

- More enzyme molecules mean more reactions per unit time

5. Inhibitors

- Competitive inhibitors: compete with substrate for active site
- Non-competitive inhibitors: bind to a site other than active site and change enzyme shape

6. Activators

- Some metal ions activate enzymes (Mg^{2+} , Zn^{2+} , Mn^{2+})

7. Coenzymes and Cofactors

Coenzymes and Cofactors

Cofactors: Non-protein components required by enzymes for their activity. They can be:

- Metal ions (Zn^{2+} , Mg^{2+} , Fe^{2+} , Cu^{2+})

Coenzymes: Organic molecules that assist enzymes. Many are derived from vitamins.

- NAD⁺ (from Niacin/Vitamin B3)
- FAD (from Riboflavin/Vitamin B2)
- Coenzyme A (from Pantothenic acid/Vitamin B5)
- TPP (from Thiamine/Vitamin B1)
- PLP (from Pyridoxine/Vitamin B6)

Holoenzyme = Apoenzyme (protein part) + Cofactor/Coenzyme

EDUCATIONAL HUB

TOPIC 4: VITAMINS (★★★★★)

Definition

Vitamins are organic compounds required in small amounts for normal growth, development, and metabolism. They cannot be synthesized by the body in sufficient amounts and must be obtained from diet.

Classification

A. Fat-Soluble Vitamins (A, D, E, K)

- Absorbed with fats
- Stored in liver and fatty tissues
- Not excreted easily, can cause toxicity

B. Water-Soluble Vitamins (B-Complex, C)

- Absorbed with water
- Not stored in body (except B12)
- Excreted through urine
- Must be taken daily

CARE LINK

FAT-SOLUBLE VITAMINS

Vitamin A (Retinol)

- Sources: Liver, fish oil, carrots, spinach, milk, eggs
- Functions: Vision (night vision), growth, immune function, skin health
- Deficiency: Night blindness, Xerophthalmia (dry eyes), Keratomalacia, Bitot's spots
- Toxicity: Hypervitaminosis A (headache, liver damage)

Vitamin D (Cholecalciferol)

- Sources: Sunlight, fish oil, egg yolk, fortified milk
- Functions: Calcium and phosphorus absorption, bone formation
- Deficiency: Rickets (in children), Osteomalacia (in adults)
- Also called "Sunshine Vitamin"

Vitamin E (Tocopherol)

- Sources: Vegetable oils, nuts, green leafy vegetables, wheat germ
- Functions: Antioxidant, protects cell membranes from oxidative damage, fertility
- Deficiency: Hemolytic anemia in newborns, infertility, muscle weakness
- Also called "Anti-sterility Vitamin"

Vitamin K (Phylloquinone)

- Sources: Green leafy vegetables, liver, synthesized by intestinal bacteria

- Functions: Blood clotting (synthesis of clotting factors II, VII, IX, X), bone metabolism
- Deficiency: Bleeding disorders, hemorrhagic disease of newborn
- Also called "Coagulation Vitamin"

WATER-SOLUBLE VITAMINS

Vitamin B1 (Thiamine)

- Sources: Whole grains, pork, legumes
- Functions: Carbohydrate metabolism, nerve function
- Deficiency: Beriberi (wet beriberi - cardiac; dry beriberi - neurological), Wernicke-Korsakoff syndrome
- Coenzyme form: TPP (Thiamine Pyrophosphate)

Vitamin B2 (Riboflavin)

- Sources: Milk, eggs, meat, green vegetables
- Functions: Energy metabolism, growth
- Deficiency: Cheilosis (cracking of lips), Glossitis (inflammation of tongue), Dermatitis
- Coenzyme form: FAD, FMN

Vitamin B3 (Niacin/Nicotinic Acid)

- Sources: Meat, fish, legumes, whole grains
- Functions: Energy metabolism, DNA repair
- Deficiency: Pellagra (3 Ds - Dermatitis, Diarrhea, Dementia; if untreated - Death/4th D)
- Coenzyme form: NAD⁺, NADP⁺

Vitamin B5 (Pantothenic Acid)

- Sources: Widely available in foods (meat, vegetables, grains)
- Functions: Part of Coenzyme A, fatty acid metabolism
- Deficiency: Burning feet syndrome, fatigue

Vitamin B6 (Pyridoxine)

- Sources: Meat, fish, potatoes, bananas
- Functions: Amino acid metabolism, hemoglobin synthesis

- Deficiency: Anemia, peripheral neuropathy, convulsions
- Coenzyme form: PLP (Pyridoxal Phosphate)

Vitamin B7 (Biotin)

- Sources: Eggs, liver, nuts, synthesized by gut bacteria
- Functions: Fatty acid synthesis, gluconeogenesis
- Deficiency: Dermatitis, hair loss, depression (rare)

Vitamin B9 (Folic Acid)

- Sources: Green leafy vegetables, liver, legumes
- Functions: DNA synthesis, RBC formation, neural tube development in fetus
- Deficiency: Megaloblastic anemia, Neural tube defects (spina bifida) in fetus

Vitamin B12 (Cobalamin/Cyanocobalamin)

- Sources: Meat, fish, eggs, dairy (NOT found in plant sources)
- Functions: RBC formation, DNA synthesis, nerve function
- Deficiency: Pernicious anemia (Megaloblastic anemia), Neurological disorders
- Only water-soluble vitamin stored in liver
- Requires intrinsic factor for absorption

Vitamin C (Ascorbic Acid)

- Sources: Citrus fruits, tomatoes, green peppers, strawberries
- Functions: Collagen synthesis, antioxidant, iron absorption, immune function, wound healing
- Deficiency: Scurvy (bleeding gums, loose teeth, poor wound healing, bruising)
- Also important for immune system support

TOPIC 5: LIPIDS (★★★★★)

Definition

Lipids are a group of organic compounds that are insoluble in water but soluble in organic solvents (ether, chloroform, benzene). They contain carbon, hydrogen, and oxygen.

Classification of Lipids

1. Simple Lipids

- Esters of fatty acids with alcohol
- Examples: Fats, Oils, Waxes
- Fats (solid at room temperature - animal origin)
- Oils (liquid at room temperature - plant origin)

2. Compound/Complex Lipids

- Esters of fatty acids with alcohol plus other groups
- Phospholipids (contain phosphate group) - Example: Lecithin
- Glycolipids (contain carbohydrate) - Example: Cerebrosides
- Lipoproteins (contain protein) - Example: HDL, LDL

3. Derived Lipids

- Obtained by hydrolysis of simple and compound lipids
- Examples: Fatty acids, Glycerol, Cholesterol, Steroid hormones, Prostaglandins

Types of Fatty Acids

Saturated Fatty Acids: No double bonds (e.g., Palmitic acid, Stearic acid)

- Found in animal fats, butter, ghee

Unsaturated Fatty Acids: Have one or more double bonds

- Monounsaturated: One double bond (e.g., Oleic acid)
- Polyunsaturated: Multiple double bonds (e.g., Linoleic acid, Linolenic acid)

Essential Fatty Acids: Cannot be synthesized by body

- Linoleic acid (Omega-6)
- Linolenic acid (Omega-3)
- Arachidonic acid

Cholesterol

- A steroid lipid
- Synthesized in the liver
- Functions:

- Component of cell membranes
- Precursor for bile acids
- Precursor for steroid hormones (cortisol, estrogen, testosterone)
- Precursor for Vitamin D synthesis

- Normal blood cholesterol: Less than 200 mg/dL
- Types of lipoproteins:

- HDL (High Density Lipoprotein) - "Good cholesterol" - removes cholesterol from arteries
- LDL (Low Density Lipoprotein) - "Bad cholesterol" - deposits cholesterol in arteries
- VLDL (Very Low Density Lipoprotein) - carries triglycerides

Triglycerides

- Most common form of fat in the body
- Composed of glycerol + 3 fatty acids
- Functions: Energy storage, insulation, organ protection
- Normal blood triglycerides: Less than 150 mg/dL

Functions of Lipids

1. Energy source (9 kcal/gram - highest energy yielding nutrient)
2. Energy storage (adipose tissue)
3. Structural component of cell membranes (phospholipids)
4. Insulation and protection of organs
5. Absorption of fat-soluble vitamins (A, D, E, K)
6. Hormone synthesis (steroid hormones)
7. Electrical insulation of nerves (myelin sheath)
8. Precursor for prostaglandins

TOPIC 6: CELL STRUCTURE AND CELL MEMBRANE

(★★★★)

Cell Structure

The cell is the basic structural and functional unit of life.

Major Components:

1. **Cell Membrane (Plasma Membrane):** Outer boundary, selectively permeable
2. **Nucleus:** Contains genetic material (DNA), controls cell activities
3. **Cytoplasm:** Gel-like substance containing organelles
4. **Mitochondria:** Powerhouse of the cell, produces ATP
5. **Ribosomes:** Site of protein synthesis
6. **Endoplasmic Reticulum:**
 - Rough ER (has ribosomes) - protein synthesis
 - Smooth ER (no ribosomes) - lipid synthesis
7. **Golgi Apparatus:** Packaging and secretion of proteins
8. **Lysosomes:** Contain digestive enzymes, "Suicide bags of cell"
9. **Centrioles:** Involved in cell division

Cell Membrane

- Composed of phospholipid bilayer with embedded proteins
- **Fluid Mosaic Model** (Singer and Nicolson, 1972)
- Components:
 - Phospholipids (bilayer)
 - Cholesterol (stability)
 - Proteins (integral and peripheral)
 - Carbohydrates (glycoproteins and glycolipids)
- Functions:
 - Selective permeability
 - Protection
 - Cell recognition
 - Transport of substances
 - Cell signaling

TOPIC 7: ACID-BASE BALANCE, pH AND BUFFERS (★★★★)

pH

- pH is a measure of hydrogen ion concentration in a solution
- $\text{pH} = -\log [\text{H}^+]$
- pH scale ranges from 0 to 14
- pH 7 = Neutral
- pH below 7 = Acidic
- pH above 7 = Basic/Alkaline
- Normal blood pH = 7.35 to 7.45

Buffers

- Buffers are solutions that resist changes in pH when small amounts of acid or base are added
- They maintain constant pH in body fluids

Important Buffer Systems in the Body:

1. Bicarbonate Buffer System (Most important in blood)

- $\text{H}_2\text{CO}_3/\text{NaHCO}_3$ (Carbonic acid/Sodium bicarbonate)
- Ratio: 1:20 (H_2CO_3 : NaHCO_3)
- Most important buffer in extracellular fluid

2. Phosphate Buffer System

- $\text{NaH}_2\text{PO}_4/\text{Na}_2\text{HPO}_4$
- Important in intracellular fluid and renal tubules

3. Protein Buffer System

- Hemoglobin in RBCs
- Plasma proteins (albumin)

Acid-Base Balance

The body maintains blood pH between 7.35 and 7.45 through:

1. Buffer systems (immediate response)
2. Respiratory system (minutes) - regulates CO_2
3. Renal system (hours to days) - regulates HCO_3^-

Acid-Base Disorders:

1. **Respiratory Acidosis** - pH below 7.35, increased CO₂ (hypoventilation)
2. **Respiratory Alkalosis** - pH above 7.45, decreased CO₂ (hyperventilation)
3. **Metabolic Acidosis** - pH below 7.35, decreased HCO₃⁻ (diabetic ketoacidosis, renal failure)
4. **Metabolic Alkalosis** - pH above 7.45, increased HCO₃⁻ (excessive vomiting)

TOPIC 8: WATER AND ELECTROLYTE BALANCE (★★★★)

Water

- Makes up 60-70% of total body weight
- Essential for all metabolic reactions

Functions of Water:

1. Universal solvent
2. Temperature regulation
3. Transport medium
4. Participates in chemical reactions (hydrolysis)
5. Lubricant (synovial fluid, tears)
6. Maintains blood volume and pressure

Electrolytes

Electrolytes are minerals that carry an electrical charge when dissolved in water.

Major Electrolytes:

Electrolyte	Normal Range	Location	Function
Sodium (Na ⁺)	135-145 mEq/L	Extracellular	Fluid balance, nerve impulse

Electrolyte	Normal Range	Location	Function
Potassium (K ⁺)	3.5-5.0 mEq/L	Intracellular	Muscle contraction, nerve function
Calcium (Ca ²⁺)	8.5-10.5 mg/dL	Extracellular	Bone formation, blood clotting, muscle contraction
Chloride (Cl ⁻)	98-106 mEq/L	Extracellular	Fluid balance, HCl formation
Bicarbonate (HCO ₃ ⁻)	22-26 mEq/L	Extracellular	Acid-base balance
Phosphate (PO ₄ ³⁻)	2.5-4.5 mg/dL	Intracellular	Bone formation, ATP synthesis
Magnesium (Mg ²⁺)	1.5-2.5 mEq/L	Intracellular	Enzyme activation, muscle function

TOPIC 9: NUCLEIC ACIDS - DNA AND RNA (★★★★)

Definition

Nucleic acids are macromolecules that store and transmit genetic information. They are polymers of nucleotides.

Components of Nucleotides

Each nucleotide consists of:

1. Nitrogenous base
2. Pentose sugar (5-carbon sugar)
3. Phosphate group

DNA vs RNA Comparison

Feature	DNA	RNA
Full Name	Deoxyribonucleic Acid	Ribonucleic Acid
Sugar	Deoxyribose	Ribose
Strands	Double stranded	Single stranded
Bases	A, T, G, C	A, U, G, C
Unique Base	Thymine (T)	Uracil (U)
Location	Nucleus	Nucleus and Cytoplasm
Function	Stores genetic information	Protein synthesis

Feature	DNA	RNA
Types	Only one type	mRNA, tRNA, rRNA
Stability	More stable	Less stable
Self-replication	Can self-replicate	Cannot self-replicate
Base Pairing	A=T, G≡C	A=U, G≡C

Types of RNA

1. **mRNA (Messenger RNA):** Carries genetic message from DNA to ribosome
2. **tRNA (Transfer RNA):** Transfers amino acids to ribosome during protein synthesis
3. **rRNA (Ribosomal RNA):** Structural component of ribosomes

Nitrogenous Bases

Purines (double ring): Adenine (A), Guanine (G)
Pyrimidines (single ring): Cytosine (C), Thymine (T - in DNA), Uracil (U - in RNA)

Memory trick: **PY**rimidines are **CUT** (Cytosine, Uracil, Thymine)

TOPIC 10: METABOLISM AND ATP (★★★★)

Metabolism

Metabolism is the sum of all chemical reactions occurring in the body.

Types:

1. **Anabolism:** Building up of complex molecules from simpler ones (requires energy)
 - Example: Protein synthesis from amino acids
2. **Catabolism:** Breaking down of complex molecules into simpler ones (releases energy)
 - Example: Glucose breakdown in glycolysis

ATP (Adenosine Triphosphate)

- ATP is the energy currency of the cell
- Composed of: Adenine + Ribose + 3 Phosphate groups
- Energy is stored in high-energy phosphate bonds
- When ATP is hydrolyzed: $\text{ATP} \rightarrow \text{ADP} + \text{P}_i + \text{Energy (7.3 kcal/mol)}$

Energy Production from Glucose

Complete oxidation of one glucose molecule produces approximately 36-38 ATP.

Stages:

1. **Glycolysis** (Cytoplasm): $\text{Glucose} \rightarrow 2 \text{ Pyruvate}$ (Net gain: 2 ATP)
2. **Krebs Cycle/TCA Cycle** (Mitochondrial matrix): Produces 2 ATP, NADH, FADH₂
3. **Electron Transport Chain** (Inner mitochondrial membrane): Produces 32-34 ATP

Energy Yield:

- Carbohydrates: 4 kcal/gram
- Proteins: 4 kcal/gram
- Fats: 9 kcal/gram
- Alcohol: 7 kcal/gram

SECTION B: FREQUENTLY ASKED LONG QUESTIONS WITH BRIEF ANSWERS

Q1: Classify and describe the functions of carbohydrates.

Answer: (Covered in detail in Topic 1 above - Classification into monosaccharides, disaccharides, polysaccharides with examples and functions including energy source, structural role, storage, etc.)

Q2: Classify and describe the functions of proteins.

Answer: (Covered in detail in Topic 2 above - Classification based on function, shape, and composition with examples and functions)

Q3: Define enzymes and describe factors affecting enzyme activity.

Answer: (Covered in detail in Topic 3 above - Definition, classification into 6 classes, and 7 factors affecting enzyme activity)

Q4: Describe fat-soluble and water-soluble vitamins with their deficiency diseases.

Answer: (Covered in detail in Topic 4 above - All vitamins with sources, functions, and deficiency diseases)

Q5: Compare DNA and RNA.

Answer: (Covered in detail in Topic 9 above - Comparison table with all differences)

Q6: Describe acid-base balance and buffer systems in the body.

Answer: (Covered in detail in Topic 7 above - pH, buffer systems, and acid-base disorders)

Q7: Classify and describe the functions of lipids.

Answer: (Covered in detail in Topic 5 above - Classification into simple, compound, and derived lipids with functions)

SECTION C: 50 IMPORTANT MCQs

1. The basic unit of carbohydrate is:

- a) Amino acid
- b) Fatty acid
- c) Monosaccharide
- d) Nucleotide

Answer: c) Monosaccharide

2. Sucrose is composed of:

- a) Glucose + Glucose
- b) Glucose + Fructose
- c) Glucose + Galactose
- d) Fructose + Galactose

Answer: b) Glucose + Fructose

3. The storage form of carbohydrate in animals is:

- a) Starch
- b) Cellulose
- c) Glycogen
- d) Chitin

Answer: c) Glycogen

4. Lactose is composed of:

- a) Glucose + Fructose
- b) Glucose + Galactose
- c) Glucose + Glucose
- d) Galactose + Fructose

Answer: b) Glucose + Galactose

5. The basic unit of protein is:

- a) Glucose
- b) Fatty acid
- c) Amino acid
- d) Nucleotide

Answer: c) Amino acid

6. Amino acids are joined together by:

- a) Glycosidic bonds
- b) Hydrogen bonds
- c) Peptide bonds
- d) Ionic bonds

Answer: c) Peptide bonds

7. Hemoglobin has which level of protein structure?

- a) Primary
- b) Secondary
- c) Tertiary
- d) Quaternary

Answer: d) Quaternary

8. How many essential amino acids are there?

- a) 7

- b) 8
- c) 9
- d) 11

Answer: c) 9

9. Which of the following is a fibrous protein?

- a) Hemoglobin
- b) Albumin
- c) Collagen
- d) Insulin

Answer: c) Collagen

10. Enzymes are chemically:

- a) Carbohydrates
- b) Lipids
- c) Proteins
- d) Nucleic acids

Answer: c) Proteins

11. The enzyme that digests starch is:

- a) Lipase
- b) Protease
- c) Amylase
- d) Lactase

Answer: c) Amylase

12. Optimum temperature for human enzymes is:

- a) 25 degrees Celsius
- b) 30 degrees Celsius
- c) 37 degrees Celsius
- d) 45 degrees Celsius

Answer: c) 37 degrees Celsius

13. Pepsin works best at which pH?

- a) pH 2
- b) pH 5
- c) pH 7
- d) pH 9

Answer: a) pH 2

14. An enzyme along with its cofactor is called:

- a) Apoenzyme
- b) Holoenzyme
- c) Coenzyme
- d) Isoenzyme

Answer: b) Holoenzyme

15. Which class of enzymes catalyzes hydrolysis reactions?

- a) Oxidoreductases
- b) Transferases
- c) Hydrolases

d) Ligases

Answer: c) Hydrolases

16. Deficiency of Vitamin C causes:

a) Rickets

b) Scurvy

c) Beriberi

d) Pellagra

Answer: b) Scurvy

17. Deficiency of Vitamin D causes:

a) Scurvy

b) Night blindness

c) Rickets

d) Pellagra

Answer: c) Rickets

18. Deficiency of Vitamin A causes:

a) Scurvy

b) Night blindness

c) Rickets

d) Beriberi

Answer: b) Night blindness

19. Which vitamin is known as the sunshine vitamin?

a) Vitamin A

b) Vitamin C

c) Vitamin D

d) Vitamin E

Answer: c) Vitamin D

20. Pellagra is caused by deficiency of:

a) Vitamin B1

b) Vitamin B2

c) Vitamin B3

d) Vitamin B6

Answer: c) Vitamin B3 (Niacin)

21. Beriberi is caused by deficiency of:

a) Thiamine (B1)

b) Riboflavin (B2)

c) Niacin (B3)

d) Pyridoxine (B6)

Answer: a) Thiamine (B1)

22. Which vitamin is essential for blood clotting?

a) Vitamin A

b) Vitamin C

c) Vitamin E

d) Vitamin K

Answer: d) Vitamin K

23. Which vitamin acts as an antioxidant and is called anti-sterility vitamin?

- a) Vitamin A
- b) Vitamin D
- c) Vitamin E
- d) Vitamin K

Answer: c) Vitamin E

24. Megaloblastic anemia is caused by deficiency of:

- a) Vitamin B1
- b) Vitamin B6
- c) Folic acid (B9)
- d) Vitamin C

Answer: c) Folic acid (B9)

25. Which vitamin is required for collagen synthesis?

- a) Vitamin A
- b) Vitamin B12
- c) Vitamin C
- d) Vitamin D

Answer: c) Vitamin C

26. Pernicious anemia is caused by deficiency of:

- a) Vitamin B6
- b) Vitamin B9
- c) Vitamin B12
- d) Vitamin C

Answer: c) Vitamin B12

27. Energy provided by lipids per gram is:

- a) 4 kcal
- b) 7 kcal
- c) 9 kcal
- d) 12 kcal

Answer: c) 9 kcal

28. Which lipoprotein is known as good cholesterol?

- a) LDL
- b) HDL
- c) VLDL
- d) Chylomicron

Answer: b) HDL

29. Which lipoprotein is known as bad cholesterol?

- a) LDL
- b) HDL
- c) VLDL
- d) Chylomicron

Answer: a) LDL

30. Triglycerides are composed of:

- a) Glycerol + 1 fatty acid

- b) Glycerol + 2 fatty acids
- c) Glycerol + 3 fatty acids
- d) Glycerol + 4 fatty acids

Answer: c) Glycerol + 3 fatty acids

31. Cholesterol is a precursor for all EXCEPT:

- a) Bile acids
- b) Steroid hormones
- c) Vitamin D
- d) Vitamin C

Answer: d) Vitamin C

32. Normal blood pH is:

- a) 7.0 to 7.2
- b) 7.35 to 7.45
- c) 7.5 to 7.6
- d) 6.8 to 7.0

Answer: b) 7.35 to 7.45

33. The most important buffer system in blood is:

- a) Phosphate buffer
- b) Protein buffer
- c) Bicarbonate buffer
- d) Acetate buffer

Answer: c) Bicarbonate buffer

34. pH below 7.35 is called:

- a) Alkalosis
- b) Acidosis
- c) Neutral
- d) Normal

Answer: b) Acidosis

35. The energy currency of the cell is:

- a) ADP
- b) ATP
- c) GTP
- d) NAD

Answer: b) ATP

36. ATP stands for:

- a) Adenosine Diphosphate
- b) Adenosine Triphosphate
- c) Adenine Triphosphate
- d) Adenosine Tetraphosphate

Answer: b) Adenosine Triphosphate

37. The genetic material of the cell is:

- a) RNA
- b) Protein
- c) DNA

d) Lipid

Answer: c) DNA

38. DNA contains which sugar?

a) Ribose

b) Deoxyribose

c) Glucose

d) Fructose

Answer: b) Deoxyribose

39. Which base is found in RNA but not in DNA?

a) Adenine

b) Guanine

c) Uracil

d) Cytosine

Answer: c) Uracil

40. Which base is found in DNA but not in RNA?

a) Adenine

b) Thymine

c) Guanine

d) Cytosine

Answer: b) Thymine

41. DNA is:

a) Single stranded

b) Double stranded

c) Triple stranded

d) No strands

Answer: b) Double stranded

42. The powerhouse of the cell is:

a) Nucleus

b) Ribosome

c) Mitochondria

d) Golgi apparatus

Answer: c) Mitochondria

43. Glycolysis occurs in:

a) Mitochondria

b) Nucleus

c) Cytoplasm

d) Golgi apparatus

Answer: c) Cytoplasm

44. Complete oxidation of one glucose molecule produces approximately:

a) 2 ATP

b) 12 ATP

c) 24 ATP

d) 36-38 ATP

Answer: d) 36-38 ATP

45. The major cation in extracellular fluid is:

- a) Potassium
- b) Sodium
- c) Calcium
- d) Magnesium

Answer: b) Sodium

46. The major cation in intracellular fluid is:

- a) Sodium
- b) Calcium
- c) Potassium
- d) Chloride

Answer: c) Potassium

47. Which organelle is known as the suicide bag of the cell?

- a) Ribosome
- b) Lysosome
- c) Mitochondria
- d) Golgi apparatus

Answer: b) Lysosome

48. Cell membrane is composed of:

- a) Phospholipid bilayer
- b) Carbohydrate layer
- c) Protein layer only
- d) Lipid monolayer

Answer: a) Phospholipid bilayer

49. Normal serum sodium level is:

- a) 98-106 mEq/L
- b) 3.5-5.0 mEq/L
- c) 135-145 mEq/L
- d) 22-26 mEq/L

Answer: c) 135-145 mEq/L

50. Which type of RNA carries amino acids to the ribosome during protein synthesis?

- a) mRNA
- b) tRNA
- c) rRNA
- d) snRNA

Answer: b) tRNA

Quick Revision Table: Vitamins and Deficiency Diseases

Vitamin	Deficiency Disease
Vitamin A	Night Blindness, Xerophthalmia
Vitamin D	Rickets (children), Osteomalacia (adults)
Vitamin E	Hemolytic anemia, Infertility
Vitamin K	Bleeding disorders
Vitamin B1	Beriberi
Vitamin B2	Cheilosis, Glossitis
Vitamin B3	Pellagra (3Ds)
Vitamin B6	Anemia, Neuropathy
Vitamin B9	Megaloblastic anemia, Neural tube defects

Vitamin	Deficiency Disease
Vitamin B12	Pernicious anemia
Vitamin C	Scurvy

Quick Revision: Enzymes and Examples

Enzyme	Substrate	Product
Amylase	Starch	Maltose
Lipase	Fats	Fatty acids + Glycerol
Protease	Proteins	Amino acids
Lactase	Lactose	Glucose + Galactose
Sucrase	Sucrose	Glucose + Fructose

Quick Revision: Carbohydrate Classification

Type	Examples	Function
Monosaccharides	Glucose, Fructose, Galactose	Immediate energy
Disaccharides	Sucrose, Lactose, Maltose	Energy source
Polysaccharides	Starch, Glycogen, Cellulose	Storage, Structure

Quick Revision: Key Normal Values

Parameter	Normal Value
Blood pH	7.35 - 7.45
Sodium	135-145 mEq/L
Potassium	3.5-5.0 mEq/L
Calcium	8.5-10.5 mg/dL
Cholesterol	Less than 200 mg/dL

Parameter	Normal Value
Triglycerides	Less than 150 mg/dL
Bicarbonate	22-26 mEq/L
Blood Glucose (Fasting)	70-100 mg/dL

Quick Facts to Remember

- Energy currency of cell = ATP
- Powerhouse of cell = Mitochondria
- Suicide bags = Lysosomes
- Protein synthesis site = Ribosomes
- Genetic material = DNA
- 1 gram carbohydrate = 4 kcal
- 1 gram protein = 4 kcal
- 1 gram fat = 9 kcal
- Body water content = 60-70%
- Total amino acids = 20
- Essential amino acids = 9
- Enzyme classes = 6

BEST OF LUCK FOR YOUR EXAM!