Q1. What is Biochemistry? Discuss its scope in Pharmacy and biochemical organisation of a cell.
Biochemistry is the study of chemical substances and reactions occurring in living organisms.

Scope in Pharmacy:

- Helps understand drug action and metabolism.
- Helps understand diseases and biochemical changes.
- Helps interpret laboratory investigations.

Cell organisation:

- Cell membrane → protection and transport.
- Cytoplasm → metabolic reactions.
- Nucleus → genetic material.
- Mitochondria → ATP/energy production.
- Ribosomes → protein synthesis.
- Endoplasmic reticulum → protein/lipid synthesis.
- Golgi body → modification and packaging.
- Lysosomes → intracellular digestion.

Q2. Define and classify carbohydrates with the number of sugar units, examples and functions.
Carbohydrates are organic compounds mainly containing carbon, hydrogen and oxygen.

Classification according to number of sugar units:

1. **Monosaccharides – 1 sugar unit**
    - Cannot be hydrolysed into simpler sugars.
    - Examples: Glucose, fructose, galactose.
2. **Disaccharides – 2 sugar units**
    - Formed by joining two monosaccharides.
    - Examples: Sucrose, lactose, maltose.
3. **Oligosaccharides – 3–10 sugar units**
    - Examples: Raffinose, stachyose.
4. **Polysaccharides – more than 10 sugar units**
    - Examples: Starch, glycogen, cellulose.

Functions:

- Main source of energy.
- Glycogen acts as energy storage.
- Structural role.
- Components of nucleic acids and other biomolecules.

Q3. Describe glucose, fructose and galactose.

- **Glucose** → aldohexose; 6 carbon atoms.
- **Fructose** → ketohexose; 6 carbon atoms.
- **Galactose** → aldohexose; epimer of glucose.
- They occur in open-chain and cyclic forms.

Q4. Describe maltose, lactose and sucrose.

- **Maltose** = Glucose + Glucose → α(1→4); reducing.
- **Lactose** = Galactose + Glucose → β(1→4); reducing.
- **Sucrose** = Glucose + Fructose; non-reducing.

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Q5. Write the chemical properties of carbohydrates.

- **Oxidation** → sugars form acids.
- **Reduction** → sugars form sugar alcohols.
- **Hydrolysis** → complex sugars break into simple sugars.
- **Mutarotation** → α and β forms change into each other.
- Reducing sugars give Benedict's/Fehling's positive test.

Q6. Write a short note on starch and glycogen.

- Both are polysaccharides made of glucose.
- **Starch** → storage carbohydrate of plants.
- Starch contains **amylose + amylopectin**.
- **Glycogen** → storage carbohydrate of animals.
- Mainly stored in **liver and muscles**.
- Glycogen is highly branched.

Q7. Write important qualitative tests for carbohydrates.

- **Molisch test** → general carbohydrate → violet ring.
- **Benedict test** → reducing sugar → coloured/brick-red precipitate.
- **Fehling test** → reducing sugar → brick-red precipitate.
- **Seliwanoff test** → ketose → red colour.
- **Iodine test** → starch → blue colour.

Q8. Define reducing sugar with examples.
A reducing sugar can reduce Benedict's or Fehling's reagent.

Examples:

- Monosaccharides → glucose, fructose, galactose.
- Disaccharides → maltose, lactose.
- Sucrose → non-reducing.

Q9. What is mutarotation?
Mutarotation is the change between α and β forms of a sugar in water until equilibrium is reached.

Example: α-D-glucose ⇌ β-D-glucose.

Q10. Write the composition and importance of Seliwanoff's reagent.

- Resorcinol + dilute HCl.
- Detects ketose sugars such as fructose.
- Ketose → rapid red colour.
- Aldose → slow/weak reaction.
- Sucrose gives a positive result because it contains fructose.

Q11. Define proteins and classify them based on composition with examples.
Proteins are compounds made of amino acids joined by peptide bonds.

- **Simple proteins** → only amino acids → albumin.
- **Conjugated proteins** → protein + non-protein part → haemoglobin.
- **Derived proteins** → formed by breakdown/modification → peptones.

Q12. Classify proteins based on solubility with examples.

- **Albumins** → water soluble → serum albumin.
- **Globulins** → soluble in dilute salt → serum globulin.
- **Prolamins** → soluble in alcohol → gliadin.

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- **Glutelins** → soluble in dilute acid/alkali → glutenin.
- **Scleroproteins** → insoluble → keratin, collagen.

Q13. Define amino acids and classify them based on chemical nature.
Amino acids contain amino ($–NH_2$) and carboxyl (–COOH) groups.

- **Neutral** → glycine, alanine.
- **Acidic** → aspartic acid, glutamic acid.
- **Basic** → lysine, arginine, histidine.

Q14. Classify amino acids according to nutritional requirement.

- **Essential** → must come from diet → lysine, leucine, valine.
- **Non-essential** → made by body → glycine, alanine.
- **Conditionally essential** → required more in certain conditions → arginine, glutamine.

Q15. Explain the four structures of proteins.

1. **Primary** → sequence of amino acids.
2. **Secondary** → α-helix and β-sheet.
3. **Tertiary** → three-dimensional folding.
4. **Quaternary** → two or more polypeptide chains.

Example: haemoglobin → quaternary structure.

Q16. Write biological roles of proteins and amino acids.

- Growth and tissue repair.
- Formation of enzymes and hormones.
- Formation of antibodies.
- Haemoglobin → oxygen transport.
- Amino acids form proteins and other biomolecules.
- Can provide energy.

Q17. Write qualitative tests for proteins and amino acids.

- **Biuret** → protein → violet.
- **Ninhydrin** → amino acids → violet/blue.
- **Xanthoproteic** → aromatic amino acids → yellow/orange.
- **Millon's** → tyrosine → red.
- **Hopkins-Cole** → tryptophan → violet ring.

Q18. Write diseases due to protein malnutrition.

Kwashiorkor:

- Protein deficiency.
- Swollen abdomen/oedema.
- Fatty liver.
- Thin limbs.
- Dry/cracked skin and weak hair.
- Poor immunity and frequent infections.

Marasmus:

- Protein + calorie deficiency.
- Severe weight loss and muscle wasting.
- Dry, wrinkled skin.
- Sunken eyes.

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- Severe weakness and slow growth.

Prevention: balanced diet with milk, eggs, pulses, fish and meat.

Q19. Define and classify lipids with examples.
Lipids are substances insoluble in water but soluble in organic solvents.

- **Simple lipids** → fats, oils.
- **Compound lipids** → phospholipids, glycolipids.
- **Derived lipids** → fatty acids, cholesterol, steroids.

Q20. Explain triglycerides and their properties.

- Triglyceride = **glycerol + 3 fatty acids**.
- Also called triacylglycerol.
- Fats → generally solid.
- Oils → generally liquid.
- Undergo hydrolysis and saponification.
- Unsaturated fats are more prone to oxidation/rancidity.

Q21. Classify fatty acids.

Based on saturation:

- **Saturated** → no double bond → palmitic, stearic acid.
- **MUFA** → one double bond → oleic acid.
- **PUFA** → two or more double bonds → linoleic, arachidonic acid.

Based on chain length:

- Short-chain → 2–6 carbons → butyric acid.
- Medium-chain → 8–12 carbons → capric acid.
- Long-chain → 14 or more carbons → palmitic, stearic acid.

Based on essentiality:

- Essential → linoleic acid, α-linolenic acid.
- Non-essential → palmitic acid, oleic acid.

Q22. Differentiate oils and fats.

Ans.

Oils	Fats
Usually plant origin	Usually animal origin
More unsaturated	More saturated
Lower melting point	Higher melting point

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More prone to oxidation/rancidity	More stable
Can undergo hydrogenation	Already mostly saturated

Examples: sunflower/mustard oil; butter/ghee.

Q23. Write structure and functions of cholesterol.

- Cholesterol is a sterol with a steroid nucleus.
- Component of cell membrane.
- Precursor of steroid hormones.
- Helps form bile acids and vitamin D.
- Excess may contribute to atherosclerosis.

Q24. What are lipoproteins? Classify them and write functions.

- **Chylomicrons** → dietary triglycerides.
- **VLDL** → triglycerides from liver.
- **LDL** → cholesterol to tissues; "bad cholesterol".
- **HDL** → cholesterol back to liver; "good cholesterol".

Q25. Write functions and quality tests of lipids.

Functions:

- Energy source and storage.
- Cell membrane formation.
- Protection and insulation.
- Absorption of vitamins A, D, E, K.
- Steroid hormone formation.

Tests:

- Acid value → free fatty acids/rancidity.
- Saponification value → average molecular weight of fatty acids.
- Iodine value → degree of unsaturation and oxidation tendency.

Q26. Define nucleic acids and explain purines and pyrimidines.
Nucleic acids store and transfer genetic information.

- Types → DNA and RNA.
- **Purines** → Adenine, Guanine → 2 rings.
- **Pyrimidines** → Cytosine, Thymine, Uracil → 1 ring.

Q27. What are nucleosides and nucleotides?

Nucleoside = Base + Sugar

- Adenosine = Adenine + Ribose.
- Deoxycytidine = Cytosine + Deoxyribose.

Nucleotide = Base + Sugar + Phosphate

- Examples → AMP, ADP, ATP, GMP.
- ATP stores/transfers energy.

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Q28. Explain DNA structure according to Watson and Crick.

- Double helix/twisted ladder.
- Two antiparallel strands.
- Backbone → deoxyribose + phosphate.
- A pair with T.
- G pairs with C.
- Base pairs joined by hydrogen bonds.
- DNA stores genetic information.

Q29. Write Chargaff's rule.

- A = T.
- G = C.
- Total purines = total pyrimidines.

Q30. Write functions of RNA.

- **mRNA** → carries a genetic message.
- **tRNA** → carries amino acids.
- **rRNA** → forms ribosomes.
- Together → protein synthesis.

Q31. Justify the 3'–5' phosphodiester backbone of nucleic acids.

- Phosphate forms a bridge between the **3' carbon of one sugar and 5' carbon of the next sugar**.
- Forms a strong and stable backbone.
- Gives DNA/RNA directionality.
- Important for replication, transcription and enzyme recognition.

Q32. Define enzymes and write their properties.
Enzymes are biological catalysts that increase the rate of biochemical reactions.

- Mostly proteins.
- Highly specific.
- Required in small amounts.
- Not consumed during reaction.
- Activity affected by pH, temperature and substrate concentration.

Q33. Classify enzymes according to IUB system with examples.

1. **Oxidoreductases** → oxidation-reduction → dehydrogenase, oxidase.
2. **Transferases** → transfer groups → kinase, transaminase.
3. **Hydrolases** → hydrolysis → amylase, protease.
4. **Lyases** → break/add groups without hydrolysis/oxidation → decarboxylase, aldolase.
5. **Isomerases** → rearrangement → isomerase, mutase.
6. **Ligases** → join molecules using ATP → DNA ligase, synthetase.

Q34. Explain mechanism of enzyme action.

Enzyme + Substrate
↓
Enzyme–Substrate complex
↓
Product + Enzyme

- Substrate binds to active sites.
- Activation energy is lowered.
- Product is formed and released.

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- Enzymes can be reused.
- Models → **Lock-and-key** and **induced-fit**.

Q35. Write factors affecting enzyme activity.

- **Temperature** → optimum around 37°C in humans; excess heat denatures enzymes.
- **pH** → each enzyme has optimum pH.
- **Substrate concentration** → increases rate until saturation.
- **Enzyme concentration** → increases rate if substrate is available.
- **Inhibitors** → decrease/stop activity.

Q36. What are enzyme inhibitors? Classify them.

- **Competitive** → competes at an active site.
- **Non-competitive** → binds at another site.
- **Irreversible** → permanently blocks enzymes.
- **Allosteric** → binds regulatory sites.

Q37. Write a short note on competitive inhibition.

- Inhibitor competes with substrate for active site.
- Increasing substrate can overcome inhibition.
- **Vmax remains unchanged; Km increases.**
- Example: sulfonamides competitively inhibit bacterial **dihydropteroate synthase**.

Q38. Write therapeutic importance of enzymes.

- Digestive problems → pepsin, trypsin, pancreatin, lactase.
- Blood clots → streptokinase, urokinase.
- Swelling/inflammation → bromelain, serratiopeptidase.
- Enzyme replacement → glucocerebrosidase in Gaucher disease.

Q39. Define and classify vitamins.
Vitamins are organic nutrients required in small amounts for normal body functions.

Fat-soluble: A, D, E, K
Water-soluble: B-complex and C.

Q40. Write important details of fat-soluble vitamins.

Vitamin A – Retinoids

- Sources → liver, milk, carrot.
- Function → vision, skin, immunity, growth.
- Active forms → retinal/retinoic acid.
- Requirement → about 600 µg RE/day.
- Deficiency → night blindness, xerophthalmia, keratinisation.

Vitamin D – Steroid-like vitamin

- Sources → sunlight, fish, egg.
- Function → calcium absorption, bones and teeth.
- Active form → calcitriol.
- Requirement → about 15 µg/day.
- Deficiency → rickets, osteomalacia.

Vitamin E – Tocopherols

- Sources → vegetable oils, nuts.

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- Function → antioxidant.
- No major coenzyme form.
- Requirement → about 8–10 mg/day.
- Deficiency → neuromuscular problems in severe deficiency.

Vitamin K – Quinone

- Sources → green vegetables.
- Function → blood clotting.
- Active form → reduced vitamin K.
- Requirement → about 55–65 µg/day.
- Deficiency → bleeding.

Memory: A = Eye; D = Bone; E = Antioxidant; K = Clotting.

Q41. Write important details of water-soluble vitamins.

- **B1 – Thiamine**
  - Coenzyme → TPP.
  - Function → carbohydrate metabolism.
  - Deficiency → beriberi.
- **B2 – Riboflavin**
  - Coenzyme → FAD, FMN.
  - Function → energy metabolism.
  - Deficiency → cheilosis.
- **B3 – Niacin**
  - Coenzyme → NAD, NADP.
  - Function → oxidation-reduction/energy metabolism.
  - Deficiency → pellagra.
- **B5 – Pantothenic acid**
  - Coenzyme → Coenzyme A.
  - Function → fatty-acid metabolism.
  - Deficiency → rare; fatigue/dermatitis.
- **B6 – Pyridoxine**
  - Coenzyme → PLP.
  - Function → amino-acid metabolism.
  - Deficiency → anaemia/neurological symptoms.
- **B7 – Biotin**
  - Coenzyme → biotin-dependent carboxylases.
  - Function → carboxylation reactions.
  - Deficiency → dermatitis/hair loss.
- **B9 – Folate**
  - Coenzyme → THF.
  - Function → DNA synthesis.
  - Deficiency → megaloblastic anemia.
- **B12 – Cobalamin**
  - Coenzyme → methylcobalamin, adenosylcobalamin.
  - Function → RBC formation and nerve function.
  - Deficiency → megaloblastic anaemia + neurological problems.
- **C – Ascorbic acid**
  - Function → collagen formation and antioxidant action.
  - Deficiency → scurvy.

Approximate daily requirements to remember:
B1 ≈ 1–1.2 mg; B2 ≈ 1.6–2 mg; B3 ≈ 14–16 mg; B6 ≈ 1.3–2 mg; B9 ≈ 200–300 µg; B12 ≈ 2–2.5 µg; C ≈ 65–75 mg.

Q42. Enumerate major pathways of carbohydrate metabolism.

1. Glycolysis.

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2. TCA/Krebs cycle.
3. Glycogenesis.
4. Glycogenolysis.
5. Gluconeogenesis.
6. Pentose Phosphate Pathway (PPP).

PPP produces **NADPH and ribose-5-phosphate**.

Q43. Explain glycolysis with flow chart and energetics.

Glucose
↓ Hexokinase
Glucose-6-phosphate
↓ Isomerase
Fructose-6-phosphate
↓ Phosphofructokinase
Fructose-1,6-bisphosphate
↓ Aldolase
Glyceraldehyde-3-phosphate + DHAP
↓
1,3-Bisphosphoglycerate
↓
3-Phosphoglycerate
↓
2-Phosphoglycerate
↓ Enolase
PEP
↓ Pyruvate kinase
Pyruvate

Without oxygen → Pyruvate → **Lactate**.

Energetics:

- ATP used = 2.
- ATP directly formed = 4.
- **Net ATP = 2.**
- NADH formed = 2.

Q44. Explain glycogenesis and glycogenolysis.

- **Glycogenesis:** Glucose → glycogen; storage.
- **Glycogenolysis:** Glycogen → glucose; release.
- Mainly occur in the liver and muscles.
- Help maintain blood glucose and energy supply.

Q45. Explain regulation of blood glucose.

- **Insulin ↓ blood glucose** → increases glucose uptake and glycogenesis.
- **Glucagon ↑ blood glucose** → increases glycogenolysis and gluconeogenesis.
- Adrenaline and cortisol also increase blood glucose.

Q46. Explain TCA/Krebs cycle and energetics.

Ans.

Acetyl-CoA + Oxaloacetate
↓
Citrate → Isocitrate

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↓
α-Ketoglutarate
↓
Succinyl-CoA
↓
Succinate
↓
Fumarate
↓
Malate
↓
Oxaloacetate

Oxidative steps:

- Isocitrate → α-ketoglutarate → NADH + CO_2.
- α-ketoglutarate → Succinyl-CoA → NADH + CO_2.
- Succinate → Fumarate → $FADH_2$.
- Malate → Oxaloacetate → NADH.

Classical exam convention in your source:

- 3 NADH → 9 ATP.
- 1 $FADH_2$ → 2 ATP.
- 1 GTP → 1 ATP.
- **Total = 12 ATP/acetyl-CoA.**

Q47. Explain gluconeogenesis.

Lactate / amino acids / glycerol
↓
Pyruvate
↓ Pyruvate carboxylase
Oxaloacetate
↓ PEP carboxykinase
PEP
↓
Fructose-1,6-bisphosphate
↓ Fructose-1,6-bisphosphatase
Fructose-6-phosphate
↓
Glucose-6-phosphate
↓ Glucose-6-phosphatase
Glucose

- Formation of glucose from non-carbohydrate sources.
- Mainly liver and kidney during fasting.

Q48. Explain lipolysis.

- Lipolysis = breakdown of triglycerides.
- Triglycerides → glycerol + fatty acids.
- Mainly adipose tissue.
- Increased during fasting and exercise.
- Fatty acids are used for energy.

Q49. Explain β-oxidation of fatty acids.

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Triglyceride
↓ Lipase
Glycerol + Free fatty acids
↓
Fatty acyl-CoA
↓ β-oxidation
Acetyl-CoA
↓ TCA cycle
ATP

- Occurs mainly in mitochondria.
- Each cycle removes 2 carbon atoms as acetyl-CoA.
- Important during fasting/exercise.

Q50. Explain β-oxidation of palmitic acid.

- Palmitic acid → **C16 fatty acid**.
- Activation → palmitoyl-CoA.
- Transport → carnitine shuttle.
- β-oxidation → 8 acetyl-CoA.
- Produces NADH and $FADH_2$.
- Source note gives approximately **106 ATP** using modern ATP accounting.

Q51. Explain carnitine shuttle.

1. Fatty acid → fatty acyl-CoA.
2. **CPT-I** → acyl-carnitine.
3. Acyl-carnitine enters mitochondria.
4. **CPT-II** → fatty acyl-CoA.
5. Fatty acyl-CoA undergoes β-oxidation.
6. Carnitine is recycled.

Q52. Explain ketogenesis and ketolysis.

Ketogenesis:

Fatty acids
↓ β-oxidation
Acetyl-CoA
↓
Acetoacetyl-CoA
↓
HMG-CoA
↓
Acetoacetate
↙ ↘
β-Hydroxybutyrate Acetone

- Occurs mainly in the liver.
- Increased during prolonged fasting, low carbohydrate intake and uncontrolled diabetes.
- Ketone bodies provide alternative energy.

Ketolysis:

- Ketone bodies → acetyl-CoA.
- Acetyl-CoA → TCA cycle → ATP.
- Occurs in extrahepatic tissues.

Q53. Write disorders of carbohydrate metabolism.

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- **Hyperglycaemia** → high blood glucose.
- **Hypoglycaemia** → low blood glucose.
- **Glycosuria** → glucose in urine.
- **Diabetes mellitus** → insulin deficiency/ineffectiveness → hyperglycaemia, thirst, frequent urination, fatigue.

Q54. Write disorders of lipid metabolism.

- **Ketoacidosis** → excess ketone bodies; commonly uncontrolled diabetes.
- **Fatty liver** → excess fat in liver cells.
- **Hypercholesterolaemia** → excess cholesterol in blood.

Q55. Write the general reactions of amino acid metabolism.

1. **Transamination** → transfer of amino group.
2. **Deamination** → removal of amino group.
3. **Decarboxylation** → removal of CO_2.

Q56. Explain transamination.

- Transfer of amino group from amino acid to keto acid.
- Enzymes → **ALT and AST**.
- Requires **PLP from vitamin B6**.
- Important in amino-acid metabolism.

Q57. Explain deamination and decarboxylation.

Deamination:

- Removal of amino group.
- Produces ammonia + keto acid.
- Mainly liver.
- Ammonia → urea.

Decarboxylation:

- Removal of CO_2.
- Produces biologically active amines.
- Histidine → histamine.
- Glutamate → GABA.

Q58. Explain urea cycle.

$NH_3 + CO_2$
↓ Carbamoyl phosphate

- Ornithine
  ↓
  Citrulline
- Aspartate
  ↓
  Argininosuccinate
  ↓
  Arginine + Fumarate
  ↓
  Urea + Ornithine
- Occurs in the liver.
- Converts toxic ammonia into urea.
- Urea is excreted through urine.

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Q59. Write disorders of ammonia metabolism.

- Ammonia is produced during amino-acid metabolism.
- Highly toxic, especially to the brain.
- Liver converts ammonia → urea.
- Excess → **hyperammonemia**.
- Effects → confusion, vomiting, seizures and brain damage.

Q60. Write short notes on PKU and Alkaptonuria.

PKU:

- Inherited phenylalanine metabolism disorder.
- Phenylalanine hydroxylase deficiency.
- Phenylalanine accumulates.
- Untreated → brain-development problems.
- Management → low-phenylalanine diet.

Alkaptonuria:

- Inherited tyrosine metabolism disorder.
- Homogentisate oxidase deficiency.
- Homogentisic acid accumulates.
- Urine becomes dark when standing.
- May cause pigmentation and joint problems.

Q61. Explain jaundice and its types.
Jaundice = yellow colour of skin/eyes due to increased bilirubin.

- **Pre-hepatic** → excessive RBC destruction.
- **Hepatic** → liver damage.
- **Post-hepatic** → bile-flow obstruction.

Q62. Explain Electron Transport Chain and oxidative phosphorylation.

Ans.

- ETC occurs in the inner **mitochondrial membrane**.
- NADH and $FADH_2$ donate electrons.
- Electrons pass through carriers.
- Energy forms a proton gradient.
- ATP synthase uses the gradient to form ATP.

Q63. Classify minerals and write functions and deficiency diseases.

Major minerals: Ca, P, Na, K, Mg.
Trace minerals: Fe, Zn, I, Cu, Se etc.

- **Calcium** → bones/teeth → weak bones/rickets.
- **Phosphorus** → bones, ATP → weakness/poor bone mineralisation.
- **Iron** → haemoglobin → anaemia.
- **Sodium** → fluid balance, nerves, muscles → electrolyte disturbance.
- **Potassium** → nerve/muscle function → weakness.
- **Magnesium** → enzymes/muscles → deficiency causes neuromuscular problems.
- **Iodine** → thyroid hormones → goitre.
- **Zinc** → immunity/wound healing → poor healing.
- **Selenium** → antioxidant protection.
- **Copper/Manganese/Chromium** → enzyme/metabolic functions.
- **Fluoride** → teeth; helps prevent dental caries.

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Important dietary requirements:

- Calcium → ~1000 mg/day.
- Phosphorus → ~700 mg/day.
- Iron → ~17–21 mg/day depending on age/sex.
- Sodium → ~2 g/day.
- Chloride → ~2–3 g/day.

Q64. Write sources, functions and deficiency of calcium and iron.

Calcium:

- Sources → milk, cheese, yoghurt, green leafy vegetables, ragi, almonds.
- Functions → bones, teeth, muscle contraction, blood clotting, nerve signalling.
- Deficiency → weak bones, muscle cramps, rickets.

Iron:

- Sources → green leafy vegetables, jaggery, liver, red meat, nuts, whole grains.
- Functions → haemoglobin, oxygen transport, energy production.
- Deficiency → anaemia, fatigue, pallor, weakness, poor concentration.

Q65. Explain distribution and functions of water.

Distribution:

- **ICF** → inside cells.
- **ECF** → outside cells.

Functions:

- Solvent for biochemical reactions.
- Transport of nutrients and wastes.
- Temperature regulation.
- Maintains blood volume and fluid balance.

Q66. Explain water turnover and balance.

Approximate intake/day:

- Drinking water → 1200–1500 mL.
- Food → 700–1000 mL.
- Metabolic water → 200–300 mL.

Approximate loss/day:

- Urine → 1200–1500 mL.
- Sweat → 500–700 mL.
- Respiration → 300–500 mL.
- Faeces → 100–200 mL.

Total intake ≈ total loss → water balance.

Q67. Explain electrolyte composition, dietary intake and balance.

Important electrolytes:

- Na^+ → major extracellular cation.
- K^+ → major intracellular cation.

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- Ca^{2+} → bones, muscles, nerves.
- Mg^{2+} → enzymes and muscles.
- Cl^{-} → fluid and acid-base balance.
- HCO_3^{-} → acid-base balance.
- Phosphate → bones, ATP and buffering.

Dietary sources:

- Na/Cl → common salt.
- K → fruits, banana, potato, pulses.
- Ca → milk, curd, green vegetables.
- Mg → nuts, seeds, whole grains.

Balance: mainly maintained by kidneys, hormones and fluid intake.

Q68. What is dehydration? Mention causes and effects.
Dehydration = excessive loss of body water.

Causes: diarrhoea, vomiting, sweating, fever and low water intake.

Effects:

- Thirst/dry mouth.
- Weakness/dizziness.
- Reduced urine.
- Severe → low BP, shock and kidney damage.

Q69. What is ORS/ORT? Write composition and uses.
ORS is a glucose-electrolyte solution used to prevent/treat dehydration.

Per 1 litre:

- Sodium chloride → 2.6 g.
- Glucose → 13.5 g.
- Potassium chloride → 1.5 g.
- Trisodium citrate → 2.9 g.
- Water → 1 L.

Uses: diarrhoea, vomiting, cholera, heat-related dehydration and electrolyte loss.

Q70. Write a short note on biotechnology, genetic engineering and recombinant DNA technology.

Biotechnology: use of living organisms/cells or biological processes to produce useful products.

Genetic engineering: deliberate modification of genetic material.

Recombinant DNA steps:

1. Identify desired genes.
2. Cut DNA using restriction enzymes.
3. Insert gene into vector/plasmid.
4. Join using DNA ligase.
5. Introduce recombinant DNA into the host cell.
6. Host produces the desired product.

Applications:

- Human insulin.
- Vaccines.

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- Therapeutic proteins.
- Gene therapy.
- Diagnostic products.
- Genetically modified organisms.
- Agriculture and environmental protection.

Q71. Write important functions of kidneys.

- Excretion of waste products.
- Water and electrolyte balance.
- Acid-base balance.
- Blood pressure regulation.
- Erythropoietin production.
- Vitamin D activation.

Q72. Describe kidney function tests and significance.

- **Urine examination** → protein, glucose, blood and abnormal constituents.
- **BUN** → assesses urea-related waste; increased with reduced renal clearance.
- **Serum creatinine** → increased level generally indicates reduced kidney filtration.
- **GFR** → estimates filtration ability; low GFR → reduced kidney function.
- **Creatinine clearance** → estimates renal clearance.

Q73. Write important functions of the liver.

- Metabolism of carbohydrates, proteins and fats.
- Detoxification of drugs and toxins.
- Bile production.
- Storage of glycogen, vitamins and minerals.
- Plasma protein and clotting-factor synthesis.
- Ammonia → urea.

Q74. Write important Liver Function Tests (LFTs) and their significance.

- **Bilirubin** → jaundice/liver and biliary disorders.
- **ALT/SGPT** → hepatocellular injury.
- **AST/SGOT** → liver and other tissue injury.
- **ALP** → cholestasis/biliary obstruction.
- **Albumin/total protein** → liver protein-synthetic function.
- **PT/INR** → clotting-factor synthesis.
- **GGT** → hepatobiliary/cholestatic disorders.

Q75. What is a lipid profile? Mention tests and significance.

Tests:

- Total cholesterol.
- Triglycerides.
- LDL.
- HDL.

Significance:

- High LDL → increased cardiovascular risk.
- Triglycerides → lipid/metabolic risk.
- HDL → helps remove excess cholesterol.
- Used to detect and monitor dyslipidaemia.

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Q76. What are lymphocytes? Write their functions.
Lymphocytes are WBCs important for immunity.

- **B-cells** → antibodies.
- **T-cells** → cellular immunity.
- **NK cells** → destroy infected/abnormal cells.
- Abnormal count may occur in infections and other diseases.

Q77. Write the roles of neutrophils, eosinophils and basophils.

- **Neutrophils** → first-line defence; phagocytosis; bacteria/fungi.
- **Eosinophils** → parasites and allergies.
- **Basophils** → histamine release; allergy and inflammation.

Q78. What are platelets? Write their functions.

- Small blood-cell fragments.
- Help blood clotting.
- Stick to damaged vessels.
- Form platelet plug.
- Low platelets → increased bleeding.

Q79. What are abnormal erythrocytes? Give examples and significance.

- **Microcytes** → small RBCs → iron-deficiency anaemia.
- **Macrocytes** → large RBCs → megaloblastic anaemia.
- **Sickle cells** → crescent-shaped → sickle-cell disease.
- **Target cells** → seen in some liver/haemoglobin disorders.

Q80. What are the normal constituents of urine?

- Water → major component.
- Urea.
- Uric acid.
- Creatinine.
- Electrolytes.
- Urinary pigments.

Q81. Write abnormal constituents of urine and their significance.

- **Glucose** → diabetes mellitus.
- **Protein** → proteinuria/kidney disease.
- **Ketone bodies** → diabetes, starvation, severe vomiting.
- **Blood/RBCs** → UTI, kidney stones, injury.
- **Pus cells** → UTI.
- **Bile pigments** → jaundice/hepatitis.

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