Pharma Unit

Biochemistry & Clinical Pathology

Top 25 Most Important Questions with Answers

According to New Syllabus ER 2020-21

2nd Year D. Pharmacy

1. Define biochemistry and write aims, objectives, and importance of Biochemistry?

Ans.

- **Definition:** Biochemistry is the study of chemistry of living organism which deals with structure of tissues, cells, and biomolecules.

- **Aims & Objectives:**

➢ Biochemistry helps to understand the structure and functions of important molecules in living organisms like carbs, proteins, lipids, minerals, and DNA.
➢ Biochemistry is useful for studying how the molecules interact with each other.
➢ Biochemistry helps to understand enzymes, how they work, and the different types.
➢ Biochemistry helps to study how energy is transformed within cells and organisms.
➢ Biochemistry helps to explain the molecular basis of heredity and variations.
➢ It's important for understanding how cells maintain genetic continuity through replication.
➢ We use biochemistry knowledge to control diseases and treat deficiencies.
➢ It helps us to study and understand metabolic abnormalities.

- **Importance:**

➢ Biochemistry deals with study of living system and its working
➢ Biochemistry is involved in the study of nature and working of molecules.
➢ Diagnosis of various metabolic disorders
➢ Biochemistry is involved in study of various deficiency diseases.
➢ Biochemistry helps in synthesizing new molecules.

2. Define carbohydrates and classify them with examples?

Ans.

- **Definition:** Carbohydrates can be defined as organic compounds which are polyhydroxy aldehydes or polyhydroxy ketones. Carbohydrates are also called as saccharides or sugar.

- **Classification:**

A. Glycans: Sweet tasting carbohydrates.

1) Monosaccharides:
   - Biose: E.g. glycoaldehyde,
   - Triose: E.g. glyceraldehyde
   - Pentose: E.g. ribose
   - Hexose: E.g. glucose, fructose
   - Heptose: E.g. pseudoheptulose

2) Oligosaccharides: Example: Sucrose (glucose + fructose), Lactose (glucose + galactose)

B. Aglycans: No sweeting tasting carbohydrates.

1) Homopolysaccharides: Example: Starch, Glycogen, cellulose, hemicellulose
2) Heteropolysaccharides: Example: Hyaluronic acid, Chondroitin sulphate, Heparin

3. Write qualitative test of carbohydrates in detail?

Ans. Qualitative test of carbohydrates

1) Benedict Test: Simple and quick test for detecting reducing sugars.
- Detects: All reducing sugars.
- Reaction: Heating sugar with Benedict's reagent forms brick red precipitate for monosaccharides.

2) Fehling Test: Similar to Benedict's test but uses different reagents.
- Detects: All reducing sugars.
- Reaction: Boiling sugar with Fehling solution produces brick red precipitate for reducing sugars.

3) Barfoed Test: Specifically distinguishes monosaccharides from disaccharides.
- Detects: Monosaccharides.
- Reaction: Heating with Barfoed reagent forms red precipitate for monosaccharides.

4) Seliwanoff Test: Differentiates between aldose and ketose sugars.
- Detects: Ketose sugars.
- Reaction: Boiling with Seliwanoff reagent produces cherry-red color for ketose sugars.

5) Iodine Test: Identifies presence of starch and related polysaccharides.
- Detects: Starch and related carbohydrates.
- Reaction: Starch + Iodine gives blue-violet color; Dextrin gives pink; Glycogen gives brown; Amylose gives deep blue.

6) Molisch Test: General test for detecting presence of any carbohydrate.
- Detects: All carbohydrates.
- Reaction: Carbohydrates + Conc. H_2SO_4 produce blue-violet ring with α-naphthol.

7) Mucic Acid Test: Highly specific for detecting galactose and lactose.

- Detects: Galactose and lactose.
- Reaction: Galactose treated with HNO3 forms mucic acid crystals resembling broken glass.

8) Tollen Mirror Test: Also known as silver mirror test due to formation of shiny silver mirror.

- Detects: Reducing disaccharides.
- Reaction: Heating with Tollen reagent produces silver mirror for aldoses.

4. Define protein and classify them with examples?

Ans.

- **Definition:** Proteins are naturally occurring polymers made-up of amino acids linked together by peptide bonds.
- **Classification:**

A. Simple Proteins: It is very simple protein.
Example: Albumins, Globulins, Glutelins, Prolamins, histones, scleroproteins

B. Conjugated Proteins: It is very complex protein.
Example: Glycoproteins, Lipoproteins, Metalloproteins, Phosphoproteins

C. Derived Proteins

- Primary derived protein: Myosin, fibrin, coagulated albumin.
- Secondary derived protein: Insulin globulin, albumin.

5. Define and classified amino acid with examples?

Ans.

- **Definition:** Amino acids are the monomers of proteins having an amino and carboxyl group attached to the same carbon atom.
- **Classification:**

A. By Chemical Properties
Neutral amino acids: Glycine, Alanine, Valine, Leucine, Serine
Basic amino acids: Lysine, Arginine, Histidine
Acidic amino acids: Aspartic acid, Glutamic acid

B. By Chemical Structure:
Aliphatic amino acids: Glycine, Alanine
Aromatic amino acids: Phenylalanine, Tyrosine, Tryptophan
Sulphur amino acids: Cysteine, Methionine

C. By Dietary Value:
Essential amino acids: Leucine, Isoleucine, Arginine
Nonessential amino acids: Alanine, Glycine, Tyrosine

6. Discuss qualitative test of protein and amino acid?

Ans.

Qualitative test of protein and amino acid

A. Xanthoproteic Test:

- Principle: Aromatic amino acids react with concentrated HNO3 to form nitro compounds, producing a deep yellow or orange color upon addition of alkali.
- Significance: Detects proteins containing aromatic amino acids like phenylalanine and tyrosine.

B. Sakaguchi Test (Test for Arginine):

- Principle: Arginine reacts with Sakaguchi reagent (sodium hypochlorite and α-naphthol) to produce a red or deep red color.
- Significance: Identifies proteins containing arginine.

C. Millon's Reagent Test (Test for Tyrosine):

- Principle: Tyrosine reacts with Millon's reagent (acidified mercury sulphate with sodium nitrite) to produce a red color or precipitate.
- Significance: Detects proteins containing tyrosine; negative for gelatine.

D. Ninhydrin Reaction/Test:

- Principle: Free amino groups react with ninhydrin to produce a blue color upon heating.
- Significance: Indicates the presence of proteins, peptides, and amino acids; useful in detecting proteases and peptones.

E. Nitroprusside Test (Test of Cystine):

- Principle: Cystine reacts with sodium nitroprusside in dilute NaOH to produce a red color.
- Significance: Identifies proteins containing cystine.

F. Biuret Test:

- Principle: Proteins containing more than one peptide linkage react with CuSO4 in alkaline medium to produce a violet or deep violet color.
- Significance: Detects proteins, proteoses, peptones, and polypeptides based on peptide linkages.

G. Hopkins-Cole Reaction/Test:

- Principle: Tryptophan-containing proteins react with Hopkins-Cole reagent (glyoxylic acid) and H2SO4 to form a violet or purple ring at the liquid junction.
- Significance: Indicates the presence of tryptophan in proteins.

H. Heat Coagulation Test:

- Principle: Heating a protein solution followed by addition of acetic acid results in opalescence, indicating protein presence, particularly albumin.

7. Discuss diseases related to protein malfunction?

Ans.

A. **Kwashiorkor Disease:** It is Characterized by qualitative and quantitative protein deficiency.

- Causes: Large family size, Poor maternal health, Premature termination of breastfeeding. Poor environmental conditions, Delayed supplementary feeding, Use of diluted cow's milk.
- Symptoms: Retarded growth, Oedema, Skin and hair pigmentation changes, Texture changes in skin. Liver enlargement, Hypalbuminaemia, GIT disturbances, Psychic changes, Hypoglycaemia, Increased undigested food in stools.
- Treatment: Protein-rich diet including milk, eggs, soybeans, liver, meat, and seafood, Blood transfusion in severe cases, Emphasize preventive measures.

B. **Marasmus Disease:** This disease is common in infants under 1 year.

- Causes: Protein and carbohydrate deficiency, Early cessation of breastfeeding.
- Symptoms: Retarded growth, Loss of body fat, Weakness, Skin texture changes, Skin and hair pigmentation alterations, GIT disturbances, Oedema.
- Treatment: Calorie-rich diet, Protein-rich diet, Attention to other nutritional factors.

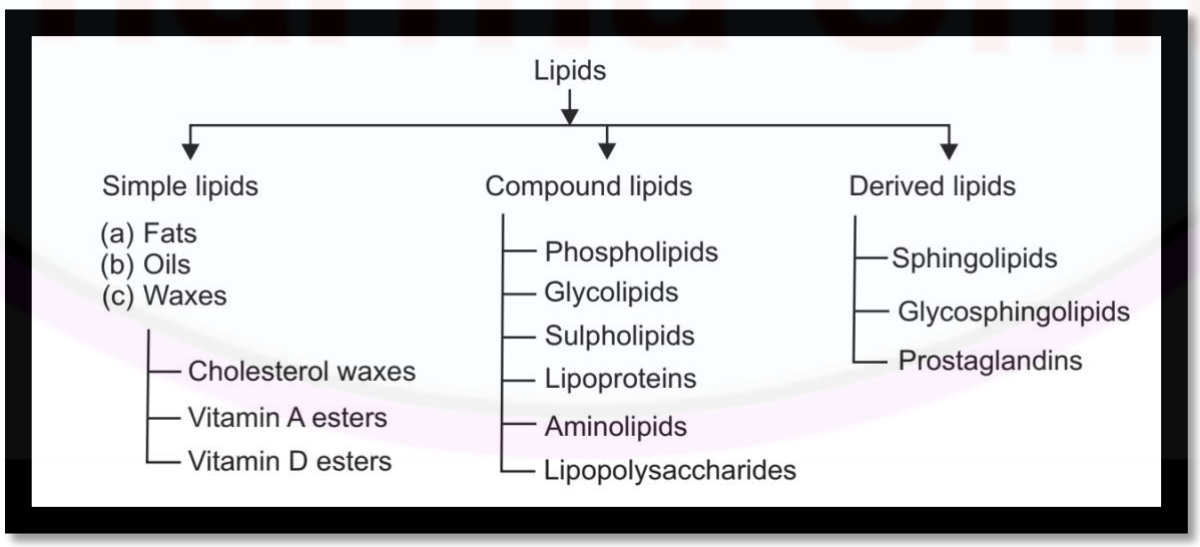
C. Nutritional Oedema:

- Causes: Prolonged and significant protein deficiency in adults.
- Symptoms: Weight loss reduced subcutaneous fat, Anaemia, Increased susceptibility to infection, Lethargy, Watery stools, Inability to sustain work, delayed wound healing, Inability to perform prolonged hard work. Oedema.
- Treatments: Diet rich in milk, milk products, eggs, and soybeans. Emphasize preventive actions by regulating daily protein intake.

8. Define lipids and write classification of lipids with examples?

Ans.

- **Definition:** Lipids are heterogenous group of organic compounds related to fatty acids which are insoluble in water and soluble in organic solvents like ether, chloroform, and benzene.
- **Classification:**



9. Write qualitative test of lipids?

Ans.

Qualitative test of lipids

a) **Sudan III Test:** Mix the sample with Sudan III stain and shake gently. Lipids will form a distinct red layer on top if present.
b) **Paper Chromatography:** Apply the lipid sample onto chromatography paper. Allow the paper to run in a suitable solvent. Lipids will appear as distinct spots on the paper.
c) **Emulsion Test:** Mix the sample with water and shake vigorously. Lipids will form an emulsion, visible as a milky or cloudy appearance.
d) **Grease Spot Test:** Apply a small amount of sample onto filter paper. Allow the paper to dry. Lipids will leave a translucent spot on the paper.
e) **Solubility Test:** Test lipid solubility in various solvents like ether, chloroform, or acetone. Lipids are typically soluble in organic solvents and insoluble in water.
f) **Iodine Test:** Mix the sample with iodine solution. Lipids will form a brown color if unsaturated, and a blue-black color if saturated.
g) **Acrolein Test:** Heat the sample with glycerol and sulfuric acid. Lipids will produce an acrid, pungent odour characteristic of acrolein.
h) **Halphen Test:** Mix the sample with bromine water and chloroform. Lipids will form a white precipitate if present.
i) **Ninhydrin Test:** Treat the sample with ninhydrin solution and heat. Lipids will produce a purple coloration if present.

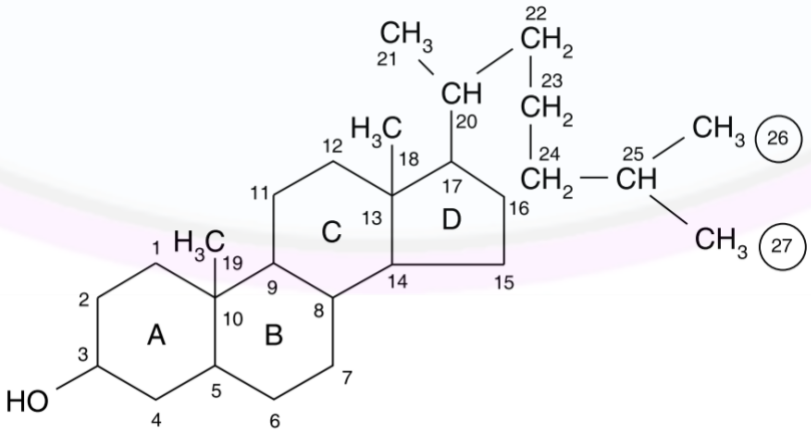
10. Write a note on cholesterol?

Ans.

A. Introduction:

- Most important Primary monohydric or steroid alcohol.
- Integral part of bio membranes.
- Mainly synthesized in the liver, affected by dietary fat intake.
- Abundant in animal tissues, found in membranes with phospholipids.
- Precursor for bile salts, sex hormones, corticosteroids, and vitamin D.

B. Structure of cholesterol:



C. Functions/Importance of Cholesterol:

- Structural component of bio membranes.
- Precursor for bile salt biosynthesis.
- Essential for corticosteroid hormone production, aiding in stress relief.
- Necessary for sex hormone and prostaglandin biosynthesis.
- Chief constituent of gallstones.

D. Abnormal Metabolism Related with Cholesterol: Hypercholesterolemia, Arteriosclerosis.

E. Colour Tests for Cholesterol:

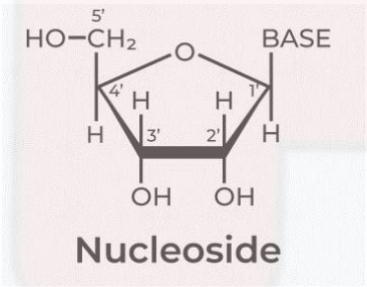
- Liebermann-Burchard reaction: Chloroform solution of sterol + acetic anhydride + sulphuric acid = green color. Basis for colorimetric estimation of blood cholesterol.
- Salkowski test: Chloroform solution of sterol + concentrated sulphuric acid = red to purple color.

11. Define nucleic acid and write component of nucleoside and nucleotides with examples?

Ans.

Definition: Nucleic acids are very complex, colourless, amorphous compounds made-up of carbon, hydrogen, oxygen, nitrogenous bases, i.e. purine or pyrimidine, sugar and phosphorous. Example - DNA & RNA.

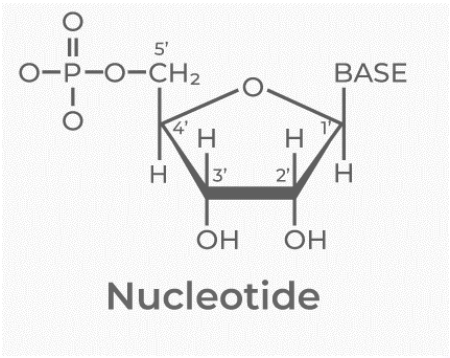
- **Components of Nucleosides:**



Nucleoside

- Composed of purine or pyrimidine base. Contains D-ribose or D-deoxyribose. Linked by a β-glycosidic linkage.
- Purine or pyrimidine base linked to D-ribose or D-2-deoxyribose via a β-N-glycoside linkage.
- In purine nucleosides, linkage occurs at position 9; in pyrimidine nucleosides, at position 3.
- Sugars exist as furanose rings with a β-glycosidic linkage to the base.
- Adenine linked to ribose is adenosine; guanine is guanosine.
- Pyrimidine nucleosides include cytidine and uridine.
- Analogous nucleosides with deoxyribose are called deoxyribosides, e.g., deoxyadenosine, deoxycytidine.

- **Components of Nucleotides:**



  - Nitrogenous base, Pentose sugar, Phosphate.
  - Nucleotides consist of a base, sugar, and phosphate.
  - Nucleotides are generally named based on the presence of purine or pyrimidine base and the phosphate of corresponding nucleosides.

12. Define enzymes and write factors affecting enzyme activity?

Ans.

Definition: Enzymes are proteins that act as biological catalysts by accelerating chemical reactions. This are soluble, colloidal, organic catalysts, protein in chemical nature, produced by living cells.

Factors affecting enzyme activity:

a) Effect of Nature and Concentration of Substrate: Increased substrate concentration, with constant enzyme concentration, increases reaction rate. Initially, reaction rate is directly proportional to substrate concentration due to active site occupancy. Further increase in substrate concentration increases catalysis until enzyme saturation.
b) Effect of Nature and Concentration of Enzymes: Enzyme activity directly proportional to enzyme concentration. Increased velocity requires highest substrate concentration, specific substrate, optimum pH, and temperature.
c) Effect of Time: Enzyme activity may change over time due to factors like substrate depletion or enzyme degradation.
d) Effect of Temperature: Enzyme activity increases with temperature up to an optimal point, then decreases due to denaturation at higher temperatures or reduced activity at lower temperatures.
e) Effect of pH: Enzymes have an optimal pH for maximum activity. Deviations from this pH can affect enzyme structure and activity, with extreme pH values leading to denaturation.
f) Effect of UV Rays: UV rays denature enzymes, affecting velocity. Damage more pronounced at 2650Å wavelength. Purity of enzyme affects degree of damage; impurities can absorb UV rays.
g) Effect of Inhibitors: Inhibitors decrease enzyme action and reaction rate.
h) Effect of Activators: Activators increase enzyme activity and reaction rate. Examples: monovalent cations (K+, Na+), cysteine HCl for papain.

13. Write therapeutic uses and pharmaceutical importance?

Ans.

Therapeutic Importance of Enzymes:

- L-asparaginase is used in cancer treatment.
- Galactosidase is used in the treatment of lactose intolerance in children.

- Fibrinolysin and deoxyribonuclease Aid in removing fibrinous material from wounds.
- Trypsin and streptokinase used in thrombosis treatment.
- Pepsin, lipase, amylase, peptidases Used in chronic pancreatitis and gastrointestinal disorders.

Pharmaceutical Importance of Enzymes (in Manufacturing of Bulk Drugs):

- Penicillin acylase Produces 6-aminopenicillanic acid from penicillin-G.
- Papain Used as a digestant for protein hydrolysate production.
- Hyaluronidase Employed in orthopaedic practice.
- Urokinase Utilized in cardiac diseases.
- Amino acylase Produces L-amino acids.
- Glucose isomerase Produces high fructose syrup.
- Amylase Produces dextrin.

14. Define vitamin and classify Vitamins with examples?

Ans.

Definition: Vitamins are the organic compounds which are found in natural food stuffs and are essential for normal growth and metabolic functions of the body.

Classification:

a) Fat-soluble vitamins: Vitamin A, vitamin D, vitamin E, vitamin K.

b) Water-soluble vitamins:

- Vitamin B complex group: Thiamine, Biotin, Riboflavin, Folic acid, Niacin, Pyridoxine, Cyanocobalamin, Pantothenic acid
- Ascorbic acid (vitamin C).

15. Write deficiency disease of fat and water soluble vitamins?

Ans.

Fat Soluble vitamins deficiency disease:

A. Vitamin A (Retinol):

- Night Blindness: Early symptom, difficulty seeing in low light conditions.
- Xerophthalmia: Progression from night blindness to dryness and damage of the cornea, leading to blindness if untreated.
- Impaired Immunity: Vitamin A deficiency compromises immune function, increasing susceptibility to infections.

B. Vitamin D (Calciferol):

- Rickets: Occur in children Softening and weakening of bones due to inadequate mineralization, leading to bowed legs and other skeletal deformities.
- Osteomalacia: Occur in adult Similar to rickets, but occurring in adults, characterized by weak, soft bones prone to fractures.

C. Vitamin E (Tocopherol):

- Muscle Weakness: Due to oxidative damage to muscle cells.
- Neurological Symptoms: Such as impaired reflexes and coordination, due to nerve damage.
- Anaemia: Vitamin E deficiency can contribute to haemolytic anaemia.

D. Vitamin K (Phylloquinone, Menaquinone):

- Haemorrhage: Impaired blood clotting leading to excessive bleeding, bruising, and haemorrhage
- Osteoporosis: Vitamin K is involved in bone metabolism. deficiency may contribute to bone density loss.

Water soluble vitamins deficiency disease:

A. Vitamin B1 (Thiamine):

Beriberi: Peripheral neuropathy, muscle weakness, cardiovascular symptoms such as rapid heartbeat and swelling.

B. Vitamin B2 (Riboflavin):

Ariboflavinosis: Cracks and sores around the corners of the mouth, inflammation of the tongue and throat, skin disorders

C. Vitamin B3 (Niacin):

Pellagra: Characterized by the "3 Ds" - dermatitis, diarrhoea, and dementia. Other symptoms include inflamed mucous membranes, hallucinations, and eventual death if untreated.

D. Vitamin B5 (Pantothenic Acid):

Deficiency is rare, but can lead to symptoms such as fatigue, irritability, and numbness or tingling in extremities.

E. Vitamin B6 (Pyridoxine):

Peripheral Neuropathy: Numbness, tingling, and weakness in hands and feet.
Anaemia: Due to impaired haemoglobin synthesis.
Dermatitis: Inflammation of the skin.

F. Vitamin B7 (Biotin):

Rare, but symptoms can include hair loss, scaly skin, and neurological symptoms.

G. Vitamin B9 (Folate):

Megaloblastic Anaemia: Characterized by large, immature red blood cells, leading to fatigue and weakness.
Neural Tube Defects: During pregnancy, folate deficiency can lead to birth defects such as spina bifida in the developing foetus.

H. Vitamin B12 (Cobalamin):

Pernicious Anaemia: Megaloblastic anaemia due to inability to absorb B12, caused by autoimmune destruction of intrinsic factor-producing cells in the stomach.

Neurological Symptoms: Such as numbness, tingling, and difficulty walking due to nerve damage.

These are the key deficiency diseases associated with both fat-soluble and water-soluble vitamins.

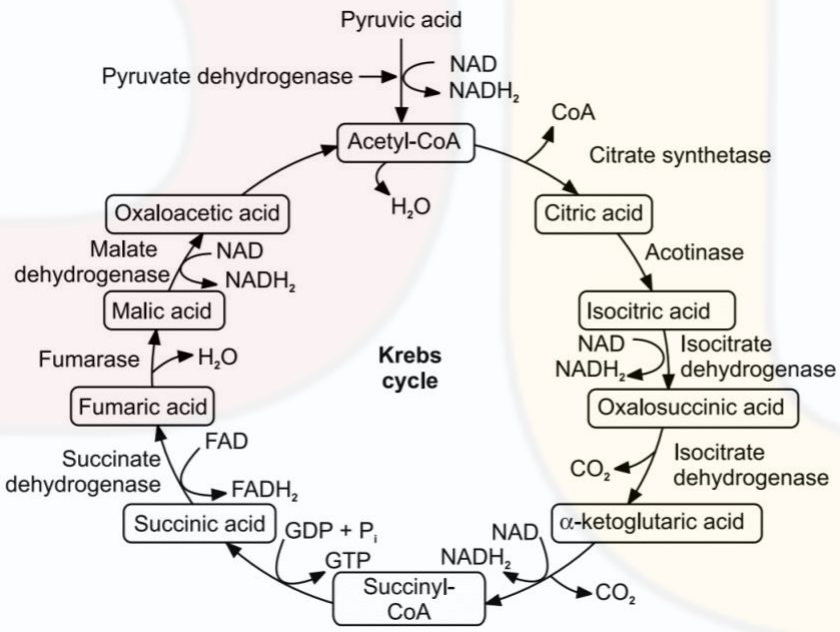
I. Vitamin C (Ascorbic Acid):

Scurvy: Scurvy is a condition caused by severe and prolonged Vitamin C deficiency. Symptoms include Weakness and fatigue Anaemia Gum disease (gingivitis) and loosening, or loss of teeth Easy bruising Swollen, painful joints Delayed wound healing Dry, scaly skin Depression and mood changes Impaired immune function, leading to frequent infections.

16. Explain TCA cycle/Krebs cycle/citric acid cycle?

Ans.

Definition: The cycle of reactions involved in the oxidation of acetyl-CoA into CO2 and H2O are collectively called Krebs cycle, as it is discovered by Sir Hans Krebs. In this cycle, different tricarboxylic acids are formed, hence called as tricarboxylic acid cycle (TCA cycle).



Reaction:

1) Formation of acetyl-CoA
2) Formation of isocitric acid
3) Formation of oxalosuccinic acid
4) Formation of α-ketoglutaric acid
5) Formation of succinyl-CoA
6) Formation of succinic acid
7) Formation of fumaric acid
8) Formation of malic acid
9) Formation of oxaloacetic acid

- Formation of Acetyl-CoA: Pyruvic acid, which is produced during glycolysis, enters the mitochondria where it undergoes decarboxylation to form acetyl-CoA. This reaction also generates NADH2 (reduced form of NAD+).

- Formation of Isocitric Acid: Acetyl-CoA combines with oxaloacetic acid to form citric acid (citrate). Citrate is then converted to isocitric acid through a series of enzymatic reactions catalysed by aconitase.
- Formation of Oxalosuccinic Acid: Isocitric acid is converted into oxalosuccinic acid by the enzyme isocitrate dehydrogenase.
- Formation of α-Ketoglutaric Acid: Oxalosuccinic acid undergoes oxidative decarboxylation to form α-ketoglutaric acid.
- Formation of Succinyl-CoA: α-ketoglutaric acid is converted into succinyl-CoA through a series of reactions involving coenzyme A (CoA) and the release of carbon dioxide.
- Formation of Succinic Acid: Succinyl-CoA is converted into succinic acid by succinyl-CoA synthetase, releasing CoA and producing GTP (which can later generate ATP).
- Formation of Fumaric Acid: Succinic acid is oxidized to fumaric acid by succinate dehydrogenase, generating FADH2 (reduced form of FAD).
- Formation of Malic Acid: Fumaric acid is hydrated to form malic acid with the help of the enzyme fumarase.
- Formation of Oxaloacetic Acid: Malic acid is oxidized to oxaloacetic acid by malate dehydrogenase, generating NADH2. Oxaloacetic acid can then combine with another acetyl-CoA to restart the cycle.

One molecule of glucose gives two molecules of pyruvic acid, therefore, total number of ATP formed in citric acid cycle = 15 × 2 = 30 ATP

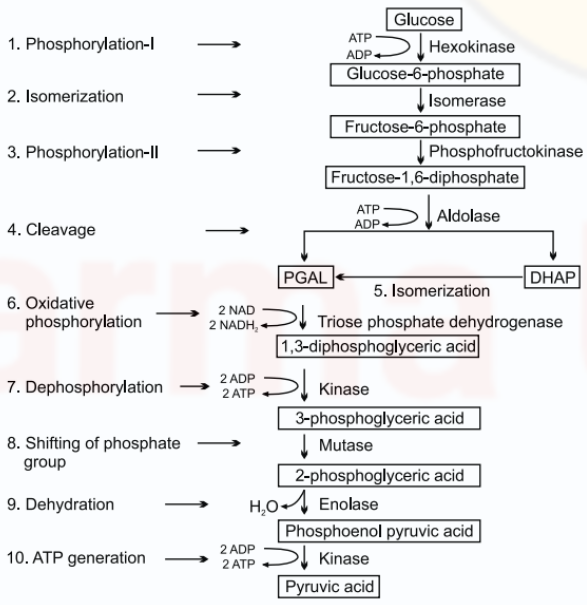
Total number of ATP formed in aerobic oxidation.

- From TCA cycle—30
- From glycolysis—08

Total = 38 ATP

17. Explain glycolysis or EMP Pathway?

Ans.



Glycolysis Reactions:

a) Phosphorylation-I: Glucose converts to glucose-6-phosphate with hexokinase, using one ATP.

b) Isomerization: Glucose-6-phosphate turns to fructose-6-phosphate via isomerase.

c) Phosphorylation-II: Fructose-6-phosphate phosphorylates to fructose-1,6-diphosphate with phosphofructokinase, using ATP.
d) Cleavage: Fructose-1,6-diphosphate splits into phosphoglyceraldehyde (PGAL) and dihydroxy acetone phosphate (DHAP) with aldolase.
e) Isomerization: DHAP converts to PGAL.
f) Oxidative phosphorylation: PGAL transforms to 1,3-diphosphoglyceric acid with triose phosphate dehydrogenase, generating 2 NADH2.
g) Dephosphorylation: 1,3-diphosphoglyceric acid becomes 3-phosphoglyceric acid, yielding 2 ATP and using 2 ADP.
h) Shifting of phosphate group: Phosphate shifts to carbon 2 in 3-phosphoglyceric acid with mutase.
i) Dehydration: 2-phosphoglyceric acid dehydrates to phosphoenol pyruvic acid via enolase.
j) Formation of pyruvic acid: Phosphoenol pyruvic acid converts to pyruvic acid with kinase, generating 2 ATP.

ATP formed:

Oxidative phosphorylation: 6 ATP.

Dephosphorylation: 2 ATP.

Phosphoenol pyruvic acid to pyruvic acid: 2 ATP.

Total: 10 ATP.

ATP consumed:

Phosphorylation-I: 1 ATP.

Phosphorylation-II: 1 ATP.

Total: 2 ATP.

Therefore, in glycolysis, 8 ATPs are synthesized (10 - 2 = 8 ATPs).

18. Explain Beta oxidation of fatty acids?

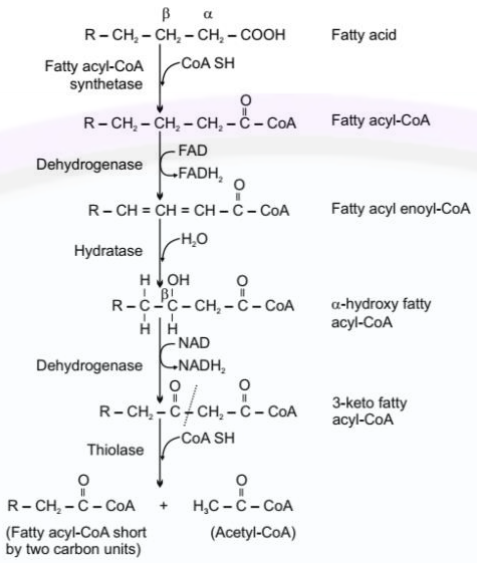
Ans.

Definition: Beta-oxidation is a sequential removal of two carbon units as acetyl-CoA from carboxyl terminal of fatty acids by oxidation.

Steps in Beta oxidation of fatty acids:

- Activation of fatty acid: Fatty acid converts to active fatty acyl-CoA with fatty acyl-CoA synthetase.
- Formation of unsaturated acyl-CoA: FAD accepts hydrogens from fatty acyl-CoA, forming unsaturated acyl-CoA.
- Formation of β-hydroxyl acyl-CoA: One water molecule adds to produce β-hydroxy fatty acyl-CoA.
- Formation of 3-keto fatty acyl-CoA: NAD accepts hydrogens from β-hydroxy acyl-CoA, forming 3-keto fatty acyl-CoA.
- Thiolytic cleavage of 3-keto fatty acyl-CoA: 3-keto fatty acyl-CoA undergoes thiolytic cleavage, forming acetyl-CoA and a shorter active fatty acid.

- This process repeats until the entire fatty acid molecule is broken down into acetyl-CoA units.



19. Define minerals classify it and write function of minerals?

Ans.

Definition: Minerals are the elements which are necessary for a variety of physiological functions and a number of biochemical processes.

Classification:

- Macrominerals Required in large quantities for daily bodily functions. Examples include Ca, P, Na, K, Mg, Fe, Zn, etc.
- Microelements: Required in trace quantities for daily bodily functions. Examples include Co, Cu, I, Se, Mn, etc.

Function of minerals:

- Minerals provide Maintenance of osmotic pressure of blood.
- Minerals helps in transportation of oxygen.
- Minerals helps in growth and maintenance of tissues and bones.
- Mineral helps in working of nervous system.
- Minerals provide muscle contraction.
- Minerals maintain electrolyte balance in the body.
- Minerals provide acid base balance in the body.
- Minerals helps in Blood coagulation.
- Minerals also perform Cardiac activity.
- Maturation of sperms
- Thyroid hormone synthesis

20. Describe distribution and function electrolytes in the body?

Ans.

Distribution of electrolytes in the body:

- Electrolytes are evenly distributed in body fluids to maintain osmotic equilibrium and water balance.
- Total concentration of cations and anions in each body compartment (extracellular fluid or intracellular fluid) equals electrical neutrality.
- Electrolytes are positively and negatively charged ions present in solution in all body fluids.
- Electrolyte concentration is expressed as milliequivalents per liter (mEq/L).
- Na and K are the principal extracellular cations.
- The difference in concentration of these cations is vital for cell survival, maintained by the Na-K pump.
- Body water balance is closely linked to the balance of dissolved electrolytes, with Na and K being most important.

Electrolyte content of ECF and ICF		
Ions	*Extracellular fluid (mEq/L)*	*Intracellular fluid (mEq/L)*
Cations		
Na^+	142	10
K^+	5	150
Ca^{2+}	5	2
Mg^{2+}	3	40
Total	155	202
Anions		
Cl^-	103	2
HCO_3^-	27	10
HPO_4^-	2	140
SO^{2-}	1	5
Organic acids	6	5
Protein	16	40
Total	155	202

Function electrolytes in the body:

- Regulate water balance and osmotic pressure in cells.
- Essential for transmitting nerve signals.
- Control muscle contraction and relaxation.
- Regulate pH levels in bodily fluids.
- Ensure proper hydration and prevent dehydration.
- Support enzyme function and cell signaling.
- Influence blood volume and pressure.
- Facilitate movement of nutrients across cell membranes.
- Essential for proper kidney operation.
- Maintain heart function and rhythm.

21. Explain dehydration?

Ans.

Definition: Dehydration is defined as more loss of water from the human body, than the normal output with respect to the input of water.

Causes:

- Severe diarrhoea and vomiting from viral or bacterial infections.
- Excessive loss of water through expired air.
- Desert travel.
- Refusal to drink water.

- Electrolyte imbalances during elimination.
- Excessive urination in diabetic patients.
- Decreased water intake in case of unconscious patient.
- Unavailability of water.
- Loss of water from serious burns.

Symptoms: Dry, hot skin and tongue. Reduced tears and saliva production. Weight loss due to reduced tissue water. Acid-base balance disturbances. Increased body temperature. Dry, wrinkled skin. Increased nonprotein plasma content. Decreased urine output. Increased pulse rate and reduced cardiac output. Elevated packed cell volume.

Treatment: Oral rehydration with plenty of water. Intravenous administration of fluids. Dextrose saline for energy. Maintaining a cool environment for the patient.

22. Explain oral rehydration therapy (ORT)?

Ans.

Definition: These are orally administered electrolyte solutions used to supply water and electrolytes needed to the patient.

ORT/ORS: Various formulations available, typically containing glucose, sodium chloride, potassium chloride, and sodium bicarbonate, sometimes with flavouring agents. Dry powdered preparations mixed with water and taken orally. Provided free of cost by the Government of India, usually available at Primary Health Centres (PHCs). Common brands include Electrol powder and pediatric powder. Effective first-aid remedy for conditions such as dysentery, diarrhea, prolonged fever, vomiting, etc.

Composition:

Composition per liter of ORS solution:

- Sodium chloride: 3.5 gm
- Potassium chloride: 1.5 gm
- Sodium citrate: 2.9 gm
- Glucose: 20 gm

23. Define biotechnology? Write objective and application of biotechnology?

Ans.

Definition: Biotechnology is the application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services to the human welfare.

Objectives of biotechnology:

- Understand inheritance and gene expression.
- Improve treatment for genetic disorders and diseases.
- Enhance agricultural productivity and produce valuable biological molecules economically.
- Develop diagnostic test kits for identifying diseases.

- Utilize biotechnological techniques for pollution control and biofuel production to maintain ecosystem health.

Application of biotechnology:

- Develop virus-resistant crops and livestock.
- Create diagnostic kits for genetic and acquired diseases.
- Use gene therapies to treat diseases.
- Produce recombinant vaccines for disease prevention.
- Aid environmental conservation efforts.
- Employ biotechnological techniques in various scientific disciplines.
- Improve food quality, quantity, and processing.
- Rely on genetic and chemical engineering in modern biotechnology.
- Utilize biotechnology for tissue culture, pharmacogenomics, and gene therapy.
- Develop microbial biotechnology for biofertilizers, biopesticides, and microbial genomics.
- Apply biotechnology in horticulture, enzyme, and textile industries.
- Enhance animal breeding through biotechnology.
- Utilize biotechnology techniques in detergent manufacturing.
- Significantly contribute to the healthcare system.
- Support enzyme and leather industries.

24. Describe abnormal constituents of urine and their significance disease?

Ans. Abnormal constituents of urine are Protein, sugar, ketone, bile, blood, pus.

a) Protein: Presence of proteins in urine is proteinuria. Conditions include nephritis, nephrotic syndrome, infections, and mercury poisoning. Also observed after exercise, high protein meals, and during pregnancy.
b) Sugars: Sugar in urine is glycosuria. Seen in diabetes mellitus and renal glycosuria.
c) Ketone Bodies: Ketone bodies in urine, ketonuria, occur due to carbohydrate starvation, pregnancy, or during anaesthesia.
d) Bile Pigments and Salts: Bile salts and pigments in urine cause a greenish-yellow color. Associated with defective liver function or bile duct obstruction. Seen in various types of jaundice.
e) Blood: Blood in urine is haematuria, while haemoglobin-only pigment is haemoglobinuria. Conditions include kidney lesions, enteric fever, malaria, and snake venom poisoning.
f) Pus: Presence of pus in urine is pyuria, caused by inflammation of the urinary bladder, urethra, or kidney pelvis.

25. What are lymphocytes? Explain the function of lymphocytes?

Ans.

Definition: Granular leukocytes, a type of white blood cells (WBCs).

Normal Count: Constitutes 25 to 30% of total WBC count.

Production: Produced in lymph nodes and lymphatic tissue found in spleen, liver, and bone marrow.

Types: Small lymphocytes (T-cells), Large lymphocytes (B-cells)

Characteristics:

- Large lymphocytes have abundant, pale-blue, non-granular cytoplasm.
- Large nucleus, typically spherical and stains blue.
- Size ranges from 7–10 µm for small lymphocytes to up to 20 µm for large lymphocytes.

Function:

- Responsible for antibody formation.
- Produce β- and γ-serum globulins.
- Play a crucial role in the body's defence mechanisms.
- Aid in the repair of inflamed tissues.
- Small lymphocytes have a long lifespan and are essential for immunity.

Very Imp Note:

- **Please Read All the chapters very carefully before Biochemistry Exam.**
- **These questions are only for the reference purpose.**