Pharma Unit

Biochemistry & Clinical Pathology

Top 10 Most Repeated Questions with Answers

According to New Syllabus ER 2020-21

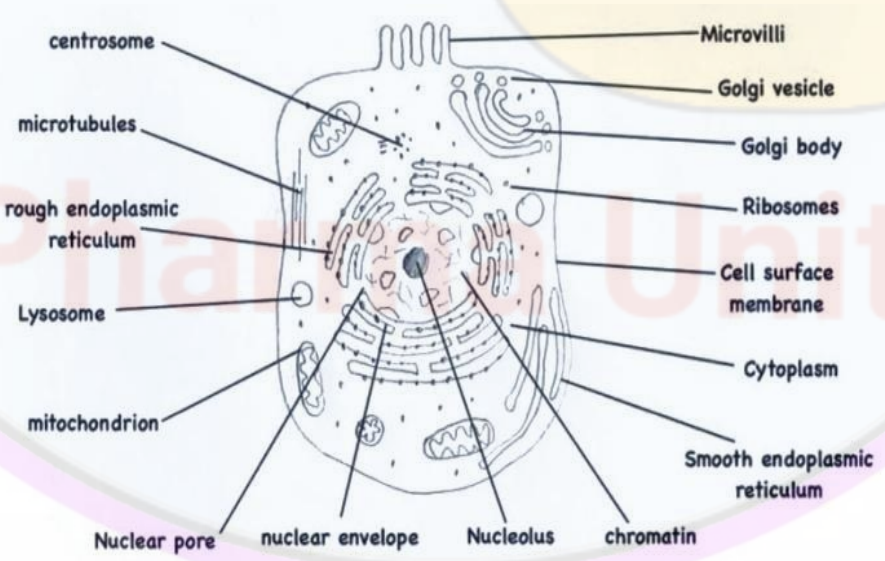
2nd Year D. Pharmacy

1) Define cell and explain components of cell with well labelled diagram?

Ans.

Definition: The cell is the basic structural and functional unit of life. All living things are made up of one or more cells.

Components of cells



Cell Membrane: The cell membrane is the outermost layer of the cell. It separates the inside of the cell from its environment. It is made up of a double layer of lipids and proteins. The lipids form a barrier that prevents certain molecules from entering or leaving the cell, while the proteins help the cell to communicate with its environment.

Cytoplasm: The cytoplasm is a jelly-like substance that fills the cell. It contains lots of tiny structures called organelles. The organelles are like tiny machines that help the cell to do its job.

Nucleus: The nucleus is like the control center of the cell. It contains the cell's genetic material, which controls how the cell grows, develops, and functions. The genetic material is made up of DNA (deoxyribonucleic acid), which contains all the instructions for building and maintaining the cell.

Mitochondria: Mitochondria are organelles that produce energy for the cell. They are the powerhouse of the cell. They break down glucose (a type of sugar) to produce ATP (adenosine triphosphate), which is the main energy source for the cell.

Ribosomes: They are small organelles that make proteins. They read the genetic instructions in the DNA and use them to assemble proteins from amino acids.

Endoplasmic reticulum (ER): Endoplasmic reticulum (ER) is a network of tubes and membranes that help to transport proteins and lipids within the cell. There are two types of ER: rough ER, which has ribosomes attached to its surface and helps to make proteins, and smooth ER, which does not have ribosomes and is involved in lipid synthesis.

Golgi apparatus: Golgi apparatus is an organelle that modifies and packages proteins for export out of the cell. It works closely with the ER to ensure that the proteins are properly folded and processed before they are sent out of the cell.

Lysosomes: Lysosomes are organelles that contain digestive enzymes. They help to break down and recycle cellular waste, such as damaged organelles or old proteins.

2) Explain Watson and crick model of DNA and differentiate between DNA and RNA?

Ans.

Watson and Crick Model of DNA

The Watson and Crick model of DNA describes the structural arrangement of the DNA molecule as a double helix, proposed in 1953 by James Watson and Francis Crick. This model is based on data from X-ray diffraction studies conducted by Rosalind Franklin and Maurice Wilkins.

Features of the Watson and Crick Model

a) Double Helix Structure: DNA consists of two polynucleotide strands coiled around a common axis in a right-handed spiral.
b) Sugar-Phosphate Backbone: Each strand is made of a sugar-phosphate backbone, with the sugars and phosphates connected via phosphodiester bonds.
c) Base Pairing: Nitrogenous bases project inward and pair specifically:
d) Adenine (A) pairs with Thymine (T) through 2 hydrogen bonds.
e) Cytosine (C) pairs with Guanine (G) through 3 hydrogen bonds.
f) Antiparallel Orientation: The two strands run in opposite directions, one in the 5' to 3' direction and the other in the 3' to 5' direction.
g) Complementary Strands: The sequence of bases in one strand determines the sequence in the complementary strand.
h) Major and Minor Grooves: The helical structure creates grooves that provide binding sites for proteins and enzymes.
i) Helical Turn: Each turn of the helix spans 10 base pairs, and the distance between adjacent bases is 3.4 Å (angstroms), making each turn approximately 34 Å in length.

Difference Between DNA & RNA

Feature	DNA (Deoxyribonucleic Acid)	RNA (Ribonucleic Acid)
Structure	Double-stranded helix	Single-stranded
Sugar	Deoxyribose (lacks one oxygen atom at the 2' position)	Ribose (contains an OH group at the 2' position)
Nitrogenous Bases	Adenine (A), Thymine (T), Cytosine (C), Guanine (G)	Adenine (A), Uracil (U), Cytosine (C), Guanine (G)
Base Pairing	A-T (2 hydrogen bonds), C-G (3 hydrogen bonds)	A pairs with U, C pairs with G (when base pairing occurs in RNA structures like tRNA)
Function	Long-term storage of genetic information	Various roles: mRNA (messenger), tRNA (transfer), rRNA (ribosomal)
Location	Nucleus (in eukaryotes)	Cytoplasm (mostly), nucleus (for synthesis)
Stability	Stable due to deoxyribose and double-stranded structure	Less stable, prone to degradation
Types	One type	Three main types: mRNA, tRNA, rRNA

3) 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.

4) Define and classify protein? Explain Qualitative test for proteins?

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, Glutelin's, 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.

Qualitative test of protein

1. **Xanthoproteic Test:**
   Principle: Aromatic amino acids react with concentrated HNO_3 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.
1. **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.
2. **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.
3. **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.

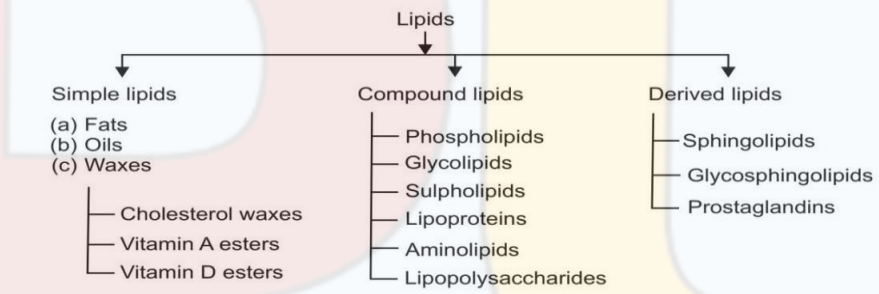
4. **Nitroprusside Test (Test of Cystine):**
   Principle: Cystine reacts with sodium nitroprusside in dilute NaOH to produce a red color.
   Significance: Identifies proteins containing cystine.
5. **Biuret Test:**
   Principle: Proteins containing more than one peptide linkage react with $CuSO_4$ in alkaline medium to produce a violet or deep violet color.
   Significance: Detects proteins, proteoses, peptones, and polypeptides based on peptide linkages.
6. **Hopkins-Cole Reaction/Test:**
   Principle: Tryptophan-containing proteins react with Hopkins-Cole reagent (glyoxylic acid) and H_2SO_4 to form a violet or purple ring at the liquid junction.
   Significance: Indicates the presence of tryptophan in proteins.
7. **Heat Coagulation Test:**
   Principle: Heating a protein solution followed by addition of acetic acid results in opalescence, indicating protein presence, particularly albumin.

5) Define lipids and write classification of lipids with examples? Write qualitative test of lipids?

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:



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 odor 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.

6) Define carbohydrates and classify them with examples? Write qualitative test of carbohydrates in detail?

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

B. Oligosaccharides: Example: Sucrose (glucose + fructose), Lactose (glucose + galactose)
   a) Aglycans: No sweeting tasting carbohydrates.
      - Homopolysaccharides: Example: Starch, Glycogen, cellulose, hemicellulose
      - Heteropolysaccharides: Example: Hyaluronic acid, Chondroitin sulphate, Heparin

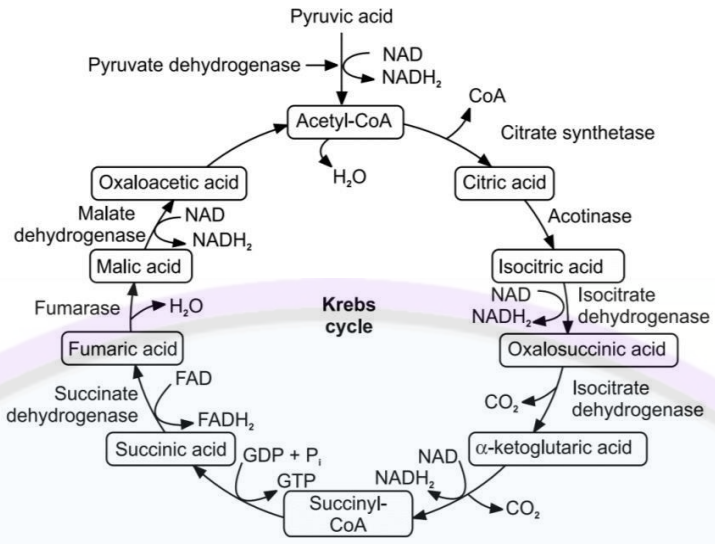
Qualitative test of carbohydrates

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 HNO_3 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.

7) Explain Krebs cycle in detail?

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

A. 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+).
B. 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 catalyzed by aconitase.
C. Formation of Oxalosuccinic Acid: Isocitric acid is converted into oxalosuccinic acid by the enzyme isocitrate dehydrogenase.
D. Formation of α-Ketoglutaric Acid: Oxalosuccinic acid undergoes oxidative decarboxylation to form α- ketoglutaric acid.
E. 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.
F. 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).
G. Formation of Fumaric Acid: Succinic acid is oxidized to fumaric acid by succinate dehydrogenase, generating FADH2 (reduced form of FAD).
H. Formation of Malic Acid: Fumaric acid is hydrated to form malic acid with the help of the enzyme fumarase.
I. 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.

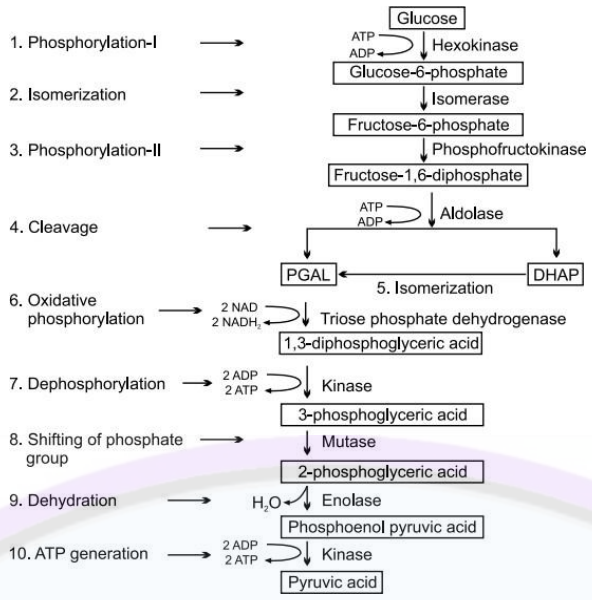
Total number of ATP formed

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

8) Explain glycolysis in details?

Ans.

Glycolysis Reactions:



1. Phosphorylation-I: Glucose converts to glucose-6-phosphate with hexokinase, using one ATP.
2. Isomerization: Glucose-6-phosphate turns to fructose-6-phosphate via isomerase.
3. Phosphorylation-II: Fructose-6-phosphate phosphorylates to fructose-1,6-diphosphate with phosphofructokinase, using ATP.
4. Cleavage: Fructose-1,6-diphosphate splits into phosphoglyceraldehyde (PGAL) and dihydroxy acetone phosphate (DHAP) with aldolase.
5. Isomerization: DHAP converts to PGAL.
6. Oxidative phosphorylation: PGAL transforms to 1,3-diphosphoglyceric acid with triose phosphate dehydrogenase, generating 2 NADH2.
7. Dephosphorylation: 1,3-diphosphoglyceric acid becomes 3-phosphoglyceric acid, yielding 2 ATP and using 2 ADP.
8. Shifting of phosphate group: Phosphate shifts to carbon 2 in 3-phosphoglyceric acid with mutase.
9. Dehydration: 2-phosphoglyceric acid dehydrates to phosphoenol pyruvic acid via enolase.
10. 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).

9) Write a note on oral rehydration therapy?

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 flavoring agents. Dry powdered preparations mixed with water and taken orally. Provided free of cost by the Government of India, usually available at Primary Health Centers (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:

a) Sodium chloride: 3.5 gm
b) Potassium chloride: 1.5 gm
c) Sodium citrate: 2.9 gm
d) Glucose: 20 gm

10) 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 hematuria, while hemoglobin-only pigment is hemoglobinuria. 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.

All The Best For Your Exam

Very Imp Note:

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