Subject Title: Biochemistry & Clinical Pathology **Subject Code:** 0808

Important Instructions to examiners:

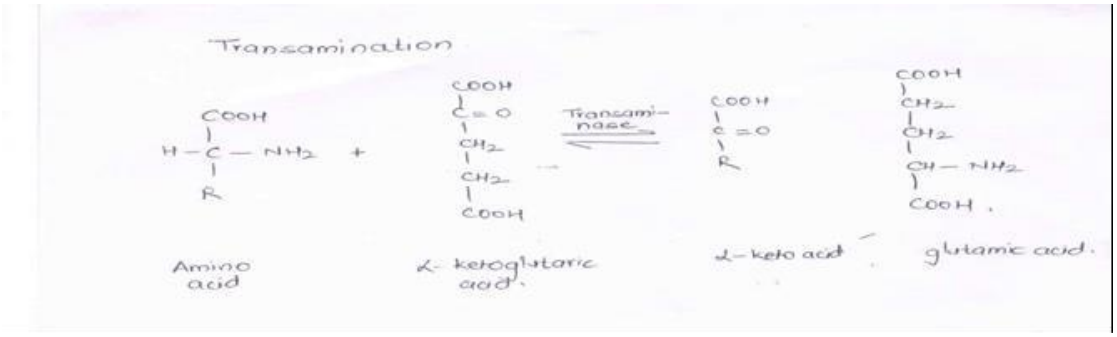
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

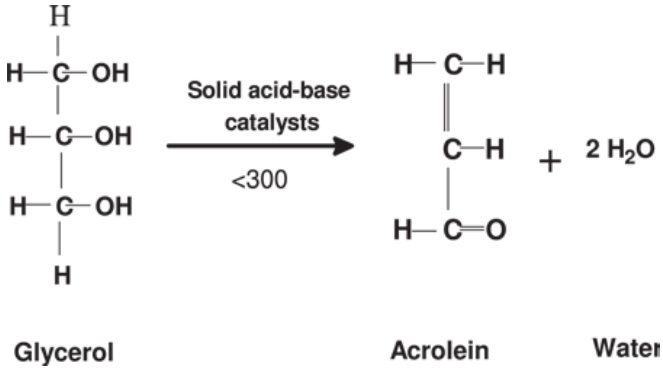
Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Attempt any FIVE of the following**	**5 X 4 = 20M**
1	a)	**Define the terms:** **(i) Marker enzymes** Some enzymes are very useful for the diagnosis of various diseases. In disease condition, level of these enzymes increases in blood or in other body fluids, hence we can identify the disease. They are called as 'Marker enzymes'. **(ii) Isoenzymes** The multiple form of same enzyme are called isoenzymes, e.g. lactate dehydrogenase exist in the blood in five different isoenzyme forms i.e. LDH1, LDH2, LDH3, LDH4, LDH5. **(iii) Metal contactor (Considering it as Metal Cofactor)** Some enzymes requires a non-protein metal group for catalytic activity which is called as Metal cofactors, e.g. Mg++, Mn++, Ca++. **(iv) Zwitterion** At Isoelectric pH , the amino acid carries equal number of positive and negative charges and net charge is zero, such ions are called as Zwitterion.	**1M each**
1	b)	**Name four important organelles of animal cell and write one function of each.** **Cell membrane**: 1. The membrane encloses the cell contents. 2. It maintains cell integrity. 3. It allows transport of certain substances in and out of the cell **Nucleus:** 1.It is involved in the synthesis of RNA.	**Any four** **½ M for name and ½ M for any 1 function**

		2. It is involved in the biogenesis of ribosomes. 3.Co-ordinates the activities of other cell organelle 4. Transfers Hereditary /genetic characters. **Mitochondria:** 1. Helps in Cellular respiration. 2. Generates and stores ATP so called as 'Power house' of a cell. 3. Mitochondria are engaged in oxidative metabolism 4. Are responsible for the transportation of chemical energy into biological energy, in the form of ATP **Endoplasmic reticulum**: 1. Give mechanical support, by forming skeletal network 2. Transports enzymes and other materials throughout the cell. 3. Rough ER is the site for protein synthesis 4. Smooth ER is the site for steroid synthesis. **Golgi apparatus**: 1. Synthesis and secretion of an enzymes. 2. Participates in transformation of membranes 3. Helps in formation of structure such as lysosome, acrosome. 4. Synthesize wall element like pectin, mucilage. **Lysosomes**: 1. Lysosomes are called "suicidal bags" as enzymes contained in them can digest the cell's own material when damaged or dead. 2. These are involved in digestion of cellular substances like proteins, lipids etc.	
1	**c)**	**Write short note on:** **(i) Essential fatty acids** The unsaturated fatty acids which are not synthesized in the body and are required to be supplied through diet for the normal growth of body are called as essential fatty acids. The Essential fatty acids are required for biological processes. Chemically they are polyunsaturated fatty acids. They are required for the membrane structure and function, formation of lipoprotein etc.	**2M Each**

		E.g. Arachidonic acid, linoleic acid, linolenic acid. Etc. **(ii) Nutritional edema** Results from long continued deprivation of proteins & usually occurs in famine areas. This protein deficiency occurs in adult but very rare. Symptoms: • Weight loss, General lethargy, Frequent loose stools, Delay in wound healing, Oedema Treatment: • Food items like soyabean, milk, eggs etc.	
1	**d)**	**Define and classify lipids** The lipids are a large and diverse group of naturally occurring organic compounds that are related by their solubility in nonpolar organic solvents (e.g. ether, chloroform, acetone & benzene) and general insolubility in water. These are esters of fatty acids OR Lipids are heterogeneous group of compound which are chemically esters of fatty acids. Classification: **1.Simple lipids:** Esters of fatty acids with alcohol. • **Fats & oils** : Castor oil • **Waxes** : Bees wax **2.Compound Lipid** **Phospholipids:** • Glycerophospholipids., • Sphingophospholipids, **Glycolipids:**. • Cerebrosides • Gangliosides **Lipoprotiens:** • HDL • LDL **Other complex lipids** • Sulpholipids • Aminolipids	**Def. 1M & 3M Class. with examples**

		3.Derived Lipids: • Eg: Alcohols, Glycerol, Fatty acids etc **4.Miscellaneous Lipids:** • Eg : Carotenoids, Squalene. **(Schematic classification can be considered.)**	
1	**e)**	**Explain the terms and treatment of:** **(i) Hyponatremia** Decrease level of sodium in blood. Symptoms:-Loss of appetite related to growth muscular cramps, headache, nausea, diarrhoea. Treatment: Intravenous (IV) fluids with a high-concentration of sodium, and/or diuretics to raise blood sodium levels. **(ii) Hypothyroidism** Hypothyroidism, also called underactive thyroid or low thyroid, is a disorder of the endocrine system in which the thyroid gland does not produce enough thyroid hormone. Signs & Symptoms: Fatigue, Dry, coarse skin, Feeling cold, Poor memory and concentration, Myxoedema, Constipation, dyspepsia, Hair loss, Weight gain with poor appetite, Slow pulse rate, Shortness of breath, Swelling of the limbs. Treatment: Treatment for hypothyroidism focuses on supplementing the thyroid hormone, Synthetic thyroxine, Iodine and nutrition.	**2M Each: (1M for Expl.+ 1M treatment)**
1	**f)**	**Write short note on:** **(i) Oxidative phosphorylation** Oxidative phosphorylation is a mechanism for ATP synthesis in both plant and animal cells. It involves in electron transport and ATP synthesis. Oxidative phosphorylation occurs in the mitochondria. The mitochondrion has two membranes: an inner membrane and an outer membrane. Oxidative phosphorylation takes place in the inner mitochondrial membrane, in contrast with most of the reactions of the citric acid cycle and fatty acid oxidation, which take place in the matrix. Oxidative phosphorylation is the process in which ATP is formed as a result of the transfer of electrons from	**2M Each**

		NADH or FADH 2 to O 2 by a series of electron carriers. This process is the major source of ATP in aerobic organisms **(ii) Transamination** In transamination, the NH2 group on one molecule is exchanged with the C =O group on the other molecule. The amino acid becomes a keto acid, and the keto acid becomes an amino acid  In this example alpha keto glutaric acid becomes glutamic acid, amino acid becomes keto acid. This reaction is reversible. **Importance**: It is important for redistribution of amino group and production of non-essential amino acid as per the required of the cell. It diverts excess amino acids towards energy generation	
1	**g)**	**Explain the terms:** **(i) Purpura** It's a condition of platelet / thrombocyte count less than normal.(Thrombocytopenia) There are red or purple discolorations on the skin. They are caused by bleeding underneath the skin & mucous membrane. Appearance of spots can be secondary to vasculitis or dietary deficiency of Vitamin C .Bleeding time is prolonged. **(ii) Polycythemia** Concentration of RBCs increase abnormally with corresponding increase in haemoglobin level • Relative Polycythemia: Decreased plasma volume due to vomiting, diarrhoea, dehydration • Absolute Polycythemia: Increased secretion of erythropoietin	**2M Each**

2		**Attempt any THREE of the following:**	**3×4=12M**
2	**a)**	**Define the terms:** (i) **Biochemistry-** The study dealing with the chemistry of living organism in its different phases of activity is called as biochemistry. (ii) **Pathology-** It's a significant field in medical diagnosis and medical research, concerned mainly with the causal study of disease, whether caused by pathogens or non-infectious physiological disorder. **(iii)Catabolism-** It's a degradative process concerned with the breakdown of complex molecules to simpler ones along with release of energy. **(iv)Anabolism-**It includes the biosynthetic reactions of formation of complex molecules from simple ones and requiring energy.	**Each for 1 M**
2	**b)**	**Write a note on:** **(i) Acrolein formation** When fats are treated with dehydrating agents like conc. H2SO4, KHSO4 etc. they are converted into a product having characteristic obnoxious odour. This is due to the presence of glycerol in fat or oil. Glycerol obtained after acidic hydrolysis is then dehydrated to give acrolein, having characteristic obnoxious odour. This test can be used to distinguish between fats and waxes. (As wax does not contain glycerol).  **(ii) Denaturation of proteins** The phenomenon of disorganization of native protein structure is known as denaturation.	**2M each**

		• It results in loss of secondary, tertiary & quaternary structure of proteins. • This involves change in physical, chemical & biological properties of protein molecules. Agents of denaturation: • Physical: Heat, violent shaking, X-rays, UV radiation. • Chemical: acids, alkalis, organic solvents, heavy metal salts etc. Characteristics of denaturation: • Helical structure is lost • Primary structure with peptide linkages remains intact.(Peptide bonds are not hydrolysed) • Biological activity of protein is lost • Denatured protein is insoluble	
2	**c)**	**What is vitamin C? Explain its biochemical role. Mention deficiency condition and its symptoms.** **Vitamin C** is water soluble vitamin, also known as L-ascorbic acid. **Biochemical role:** Vitamin C plays important role in: □ Collagen formation □ Bone formation □ Iron & haemoglobin metabolism □ Tryptophan, Tyrosine, & Folic acid metabolism □ Synthesis of immunoglobulins (antibodies) □ Synthesis of peptide hormone & corticosteroid hormones □ Reduces risk of cataract formation □ As an antioxidant reduces risk of cancer, coronary heart disease. **Deficiency conditions:** Deficiency of vitamin causes **Scurvy** **Symptoms**: Weakness, pain in bones and joints , loosening of teeth, poor healing of wound, internal hemorrhage, swelling of long bone, Easy factorability of bones.	**0.5 M + 2 M role (any 4 pts.)+ 0.5 M +1M**

		Scurvy leads to the formation of spots on the skin, spongy gums, and bleeding from all mucous membranes. The spots are most abundant on the thighs and legs, and a person with the ailment looks pale, feels depressed, and is partially immobilized .	
2	**d)**	**Explain the identification test for:** **(i) Carbohydrates** **Molisch Test-** Principle-Step I : Formation of furfural compound STEP II: Furfural compound reacts with alpha napthol present in molisch reagent to give violet ring at junction of two liquids and Conc. H2SO4 acts as a dehydrating agent. Molisch test: - Sugar solution + Molisch reagent + Conc H2SO4 from the side of test tube – gives Violet ring at the junction of two liquids. **(ii) Proteins** **Biuret test:** Principle –this test is positive for all compounds containing more than one peptide linkage. The peptide linkage of protein reacts with copper ions to form a complex of violet colour. Procedure : Biuret Test: General test for proteins: 3 ml of protein solution + 3 ml of 5% Sodium hydroxide + 3 to 4 drops of 1% Copper sulphate. Purple or pinkish purple colour is developed. Proteins are present.(i.e. presence of peptide bond)	**Each for 2M**
2	**e)**	**Define unit of enzyme activity. Mention four important factors that affect enzyme activity. Explain effect of temperature.** **Unit of Enzyme activity** : The unit of enzyme's catalytic activity or 1 U (µmol/min) is defined as the amount of the enzyme that catalyses the conversion of one micromole of substrate per minute under the specified conditions of the assay method **Factors affecting enzyme activity** • Hydrogen ion concentration • Concentration of enzymes	**Def.1 M+ List of any 4 factors 1M + Effect of Temp 1M and dig. 1M**

- Concentration of substrate
- Temperature
- Time
- Products of reaction
- Effect of light & other physical factors
- Allosteric factors
- Effect of hormones & other biochemical agents

Effect of temperature:

• Optimum temperature is usually reached at around 37°C—45°C for animal enzymes.

• Velocity of reaction is increased from 1.1 to 3 times for every 10° C rise in temperature.

• Above the optimum temperature, rate decreases.

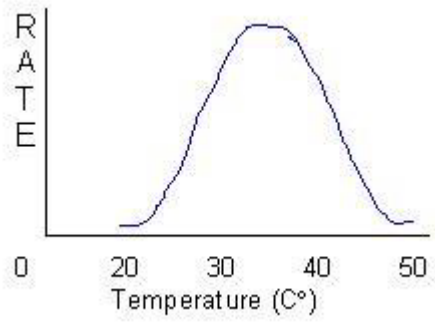
• The enzyme gets denatured at a rate faster than the increase in reaction.

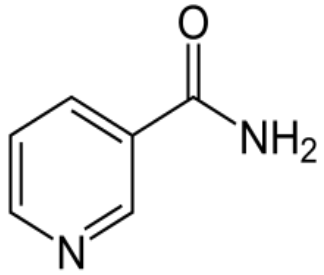
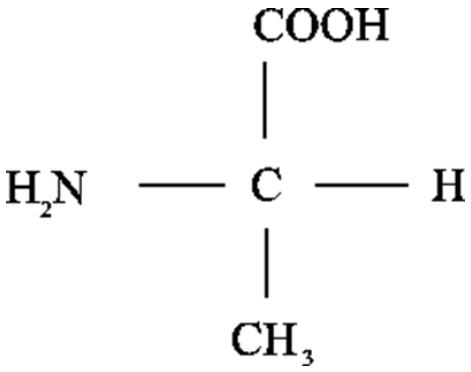
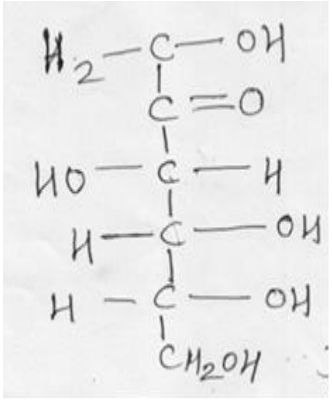
• Most of the enzymes get denatured above 50°C.

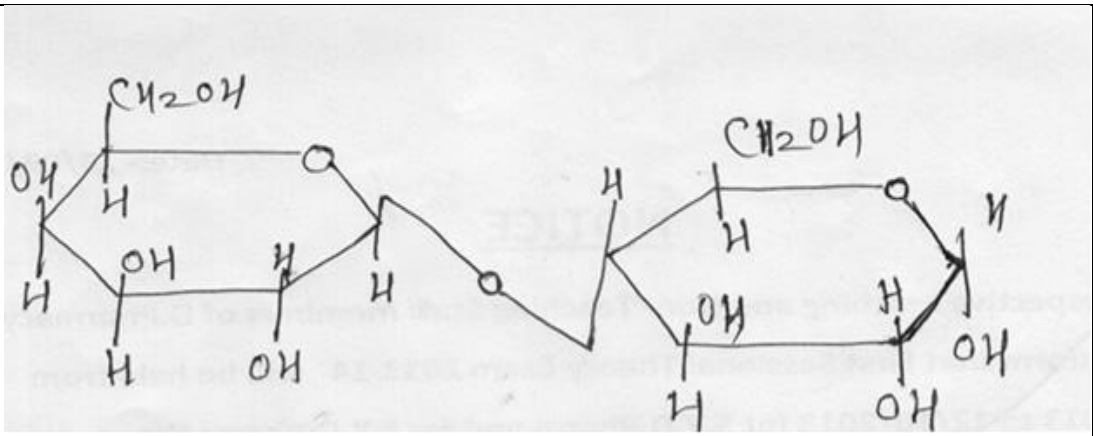
• The time of exposure is also important factor. An enzyme may withstand higher temperatures for short periods of time.

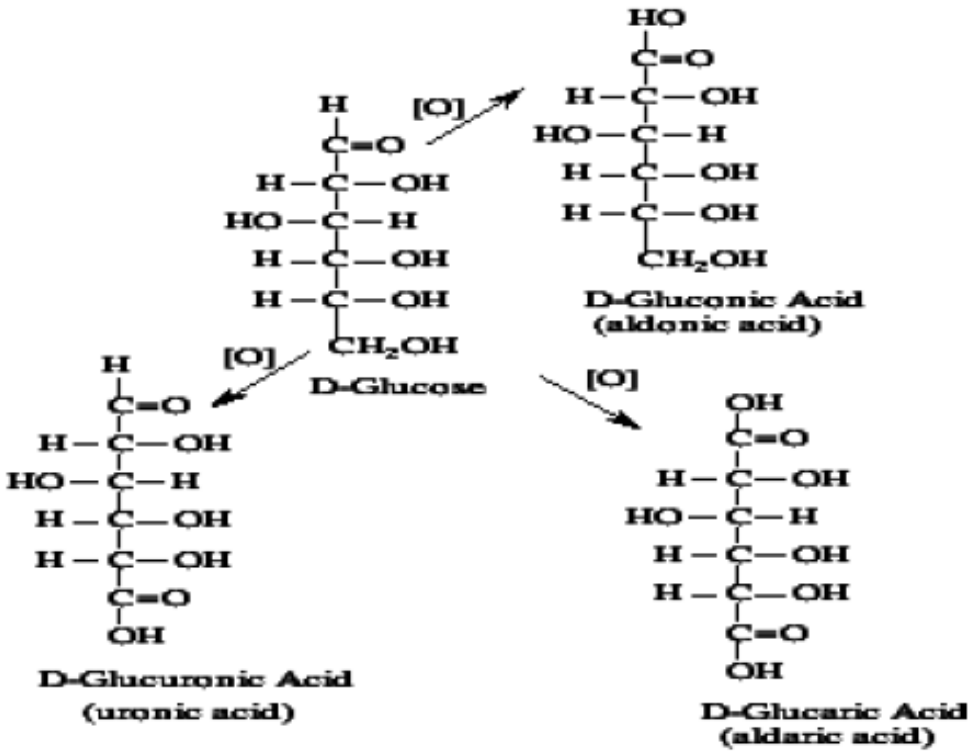
• Optimum temperature has meaning only if the time of reaction is also stipulated. Enzyme activity is maximum at optimum temperature.

Digram :

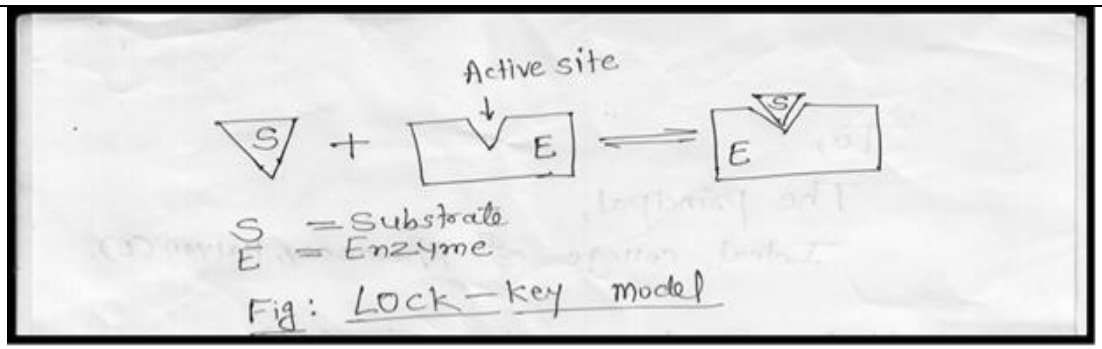


3		**Attempt any Three of the followings**	**3×4 =12M**
3	**a)**	Write structure of: i) Nicotinamide  ii) Alanine  iii) D-Fructose  iv) Lactose	**1 M each**

			
3	**b)**	**Define Proteins. Explain the role of proteins in human body.** **Proteins** are most abundant organic biomolecules, consisting of one or more long chains of amino acid residues. **Role of proteins in human body** 1] Some proteins act as hormones and hence regulate various metabolic process e.g. insulin is responsible for maintaining blood sugar level. 2] Some proteins act as catalyst for biological reaction. 3] Some proteins act as biological structural materials viz collagen in connective tissue, keratin in hair. 4] Haemoglobin acts as a oxygen carrier in mammals. 5] Some blood proteins help to form antibodies which provide resistance to disease so called as antibodies or defence proteins. 6] Nucleoproteins act as carrier of genetic characters. 7] Proteins which are required to carry out mechanical work are called muscle proteins.	**Defn.1M, Expln 3M any 6 points**

3	**c)**	**Explain oxidation of glucose with different oxidising agents with reactions.** Glucose gives acid on oxidation. Different oxidising agents give different products. • with bromine gives Gluconic acid . • With platinum it gives Glucouronic acid. • With nitric acid it gives Glucosaccharic acid  	**4 M**
3	**d)**	**Explain biochemical role of potassium & chlorine in our body.** **Potassium:** Plays important role in Regulating osmotic pressure of cell Acid base balance & water balance Gaseous transport Transmission of nerve impulse Protein biosynthesis by ribosomes Helps in enzymatic transfer of phosphate from ATP to pyruvic acid	**2 M each** **Any 4 points each**

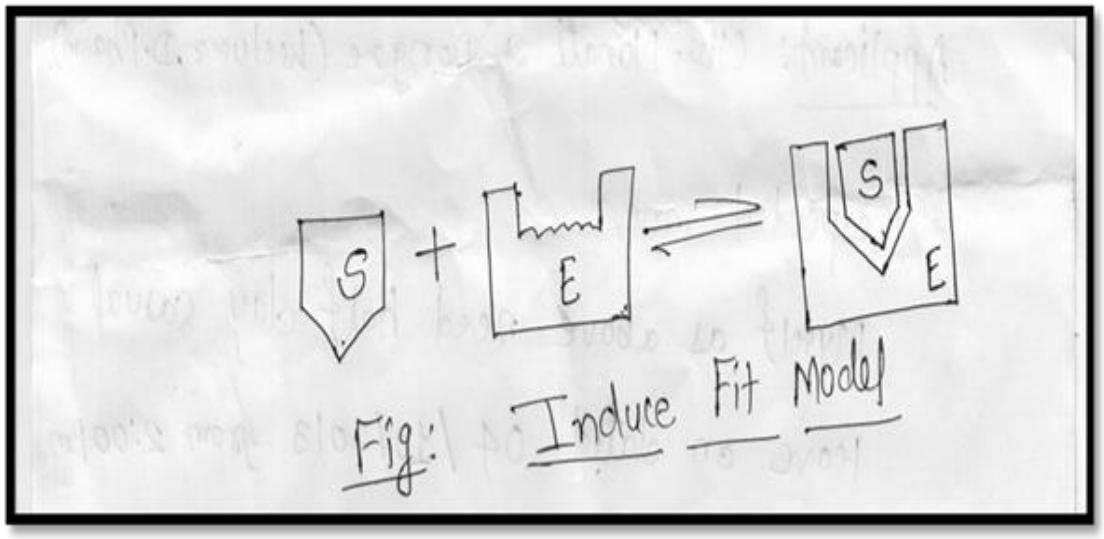
		Chlorine: Plays important role in : Osmotic pressure regulation Acid base balance & fluid balance The enzyme salivary amylase is activated by chloride Important factor in production of HCl in gastric juice	
3	**e)**	What are oils? Explain the role of antioxidant in preservation of oil. **Oils** are Simple lipids; they are esters of fatty acids with glycerol & liquid at room temperature. **Antioxidants** are the substances which can prevent the occurrence of oxidative rancidity. Rancidity occurs when oils are exposed to air, moisture, light, bacteria. It results in deterioration of oils & thereby formation of unpleasant products. Such rancid oils are unsuitable for human consumption. Trace amounts of antioxidants like tocopherol, alpha-napthol, hydroquinone, Gallic acid etc. are added in commercial preparations of oils or in food products to prevent rancidity.	**Defn 1 M** **Expn 3M**
4		**Attempt any Three of the followings**	**3×4 =12M**
4	**a)**	**Define the term 'Enzyme'. Explain binding of substrate with an enzyme at the active site.** Highly specific proteinous substances that are synthesized in a living cell & catalyze or speed up the thermodynamically possible reactions necessary for their existence. Binding of substrate is explained by 2 models: Lock & key model Induce fit model	**1M Defn** **Expln. With diagram 1.5 M each**



In this case the shape of active site of an enzyme and that of substrate is complementary to each other.

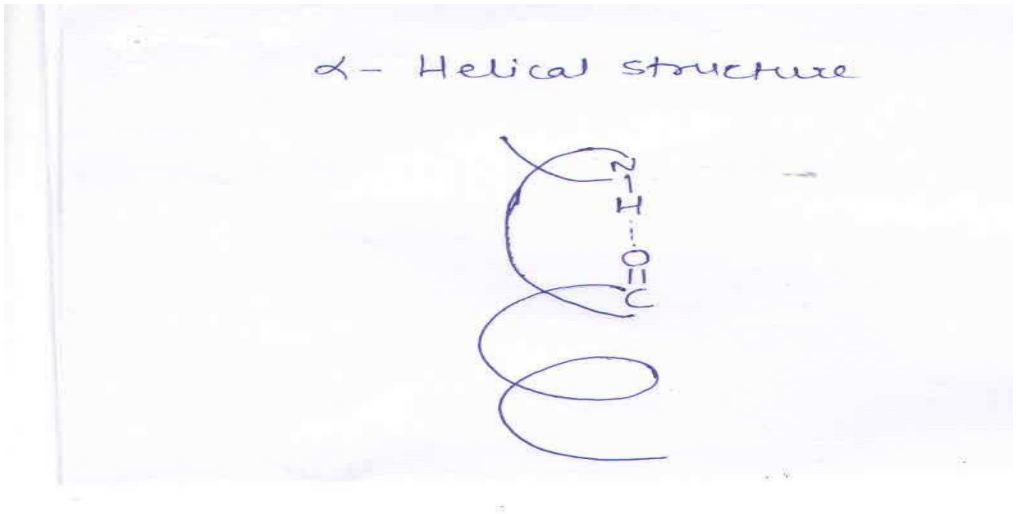
The substrate molecule fits into the active site of enzyme just as key fits into a lock. Hence called Lock & Key model.

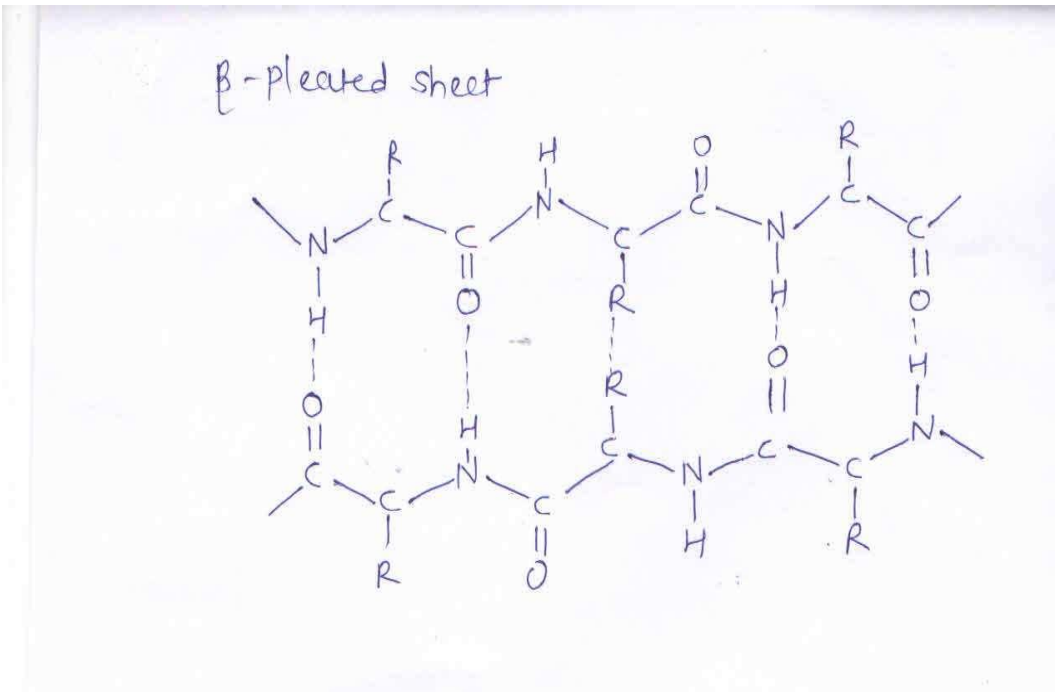
The shape of active site is rigid and complementary to the shape of substrate complex



In this case the shape of active site of an enzyme is flexible so as to accommodate wide variety of substrate molecules.

The shape of active site of enzyme is made complementary to the substrate molecule.

4	**b)**	**Explain secondary structure of proteins.** The conformation of polypeptide chain by twisting or folding is referred to as Secondary structure of protein: The folding of the chain is mainly due to the presence of hydrogen bond between amino groups and carboxyl groups of the peptide bond. Two types of secondary structure are likely: (i) α- helix (ii) β-pleated sheet i) α- helix (α- helical) The α helical is the most common spiral structure of protein. It has a rigid arrangement of polypeptide chain. The α - helical structure depends on the intramolecular hydrogen bonding between NH and **C=0**group of peptide bond, in the α - helix the polypeptide is folded in such a way that the C=O of each amino acid residue is hydrogen bonded to the NH of 4th amino acid residue along the chain.  (ii) β-pleated sheet: It is another form of secondary structure, this result from hydrogen bonding between two peptide chains. It may occur in two types a) Parallel pleated sheet: In this type of structure the polypeptide chain is side by side and in the same direction so that N-terminal residues are on the same end. This pleated sheet confirmation is stabilized by hydrogen bonding, here bonds are formed between NH group of a peptide in one chain and C=O group of a neighboring chain.	

		b) anti- parallel pleated sheet- In this type of structure the polypeptide chain lie in opposite direction so that N-terminal end of one and C- terminal of the other, face each other. In this structure the polypeptide chains are held together by hydrogen bonds, so as to give a sheet like structure and hence are called as β – pleated sheet confirmation. 	
4	**c)**	**What is pathological urine?Mention abnormal costituents of urine & their significance**. **Pathological urine-** Urine that contains substances essential to the body or tissues (like sugar, bile salts, albumin etc.), in addition to normal organic & inorganic substances, is called as pathological or abnormal urine. Such urine indicates some disease or disorder.	**Defn1M** **Constituents 3M**

Abnormal constituents	**Associated ailment**
Sugar (glucose)	Glycosuria- Diabetes mellitus
Ketone bodies	Ketonuria-Diabetes mellitus, Pregnancy, Carbohydrate starvation

		Albumin	Proteinuria / Albuminuria, Pregnancy, severe exercise, high protein meal, Nephritis	
		Bile pigments / salts	Jaundice /Hepatitis	
		Blood	Haematuria- Acute inflammation of urinary organs, T.B., Cancer, Haemolytic jaundice etc.	
		Pus	Pyuria- Inflammation of urinary bladder, urethra, kidney	
4	**d)**	**Explain the importance of water in our body. Mention the routes of excretion of water from the body.** Water is the major body constituent. Adult human contains about 60-70% water. Water provides the aqueous medium to the body which is essential for various biochemical reactions. Water directly participates as reactant in several metabolic reactions. It serves as vehicle for transport of solutes. It is closely associated with the regulation of body temperature. **Routes of excretion of water from the body:** Kidney-urine Skin Lungs Faeces		**Imp. 2 M** **Routes 2M**

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<tr><td>4</td><td>e)</td><td>What are coenzymes? Give full names of six vitamins & their respective coenzymes.
Co-enzymes are the organic molecules often derived from vitamin B complex group that participate directly in enzymatic reaction. Or Many enzymes catalyse the reactions only in presence of specific non protein organic molecules called the co-enzyme.

<table><tr><td>Vitamin B1- Thiamine</td><td>Thiamine pyrophosphate</td></tr><tr><td>Vitamin B2- Riboflavin</td><td>FAM (Flavin adenine mononucleotide),
FAD (Flavin adenine dinucleotide)</td></tr><tr><td>Vitamin B3- Niacin</td><td>NAD(Nicotinamide adenine dinucleotide),
NADP(Nicotinamide adenine dinucleotide phosphate)</td></tr><tr><td>Vitamin B5- Pantothenic acid</td><td>Coenzyme-A</td></tr><tr><td>Vitamin B6- Pyridoxine</td><td>Pyridoxal phosphate</td></tr><tr><td>Vitamin B7- Biotin</td><td>Biotin</td></tr><tr><td>Vitamin B9- Folic acid</td><td>Tetrahydrofolate</td></tr><tr><td>Vitamin B12- Cyanocobalamin</td><td>Deoxyadenosine cobalamin</td></tr><tr><td>Vitamin C (Ascorbic acid)</td><td>Ascorbic acid</td></tr></table></td><td>Defn 1M
3M for List of any 6</td></tr>
<tr><td>5</td><td></td><td>Attempt any THREE of the followings</td><td>4×3=12M</td></tr>
<tr><td>5</td><td>a)</td><td>Discuss in brief the reactions involved in β-oxidation of fatty acids.
(Detailed diagrammatic representation can be considered for full marks)
Beta oxidation is the main pathway used to liberate energy by oxidation of fatty acid It takes place in the beta carbon of fatty acid with removal of 2 carbons at a time from the carboxyl end of the molecule. The process repeats itself until the fatty acid with</td><td>4M</td></tr>
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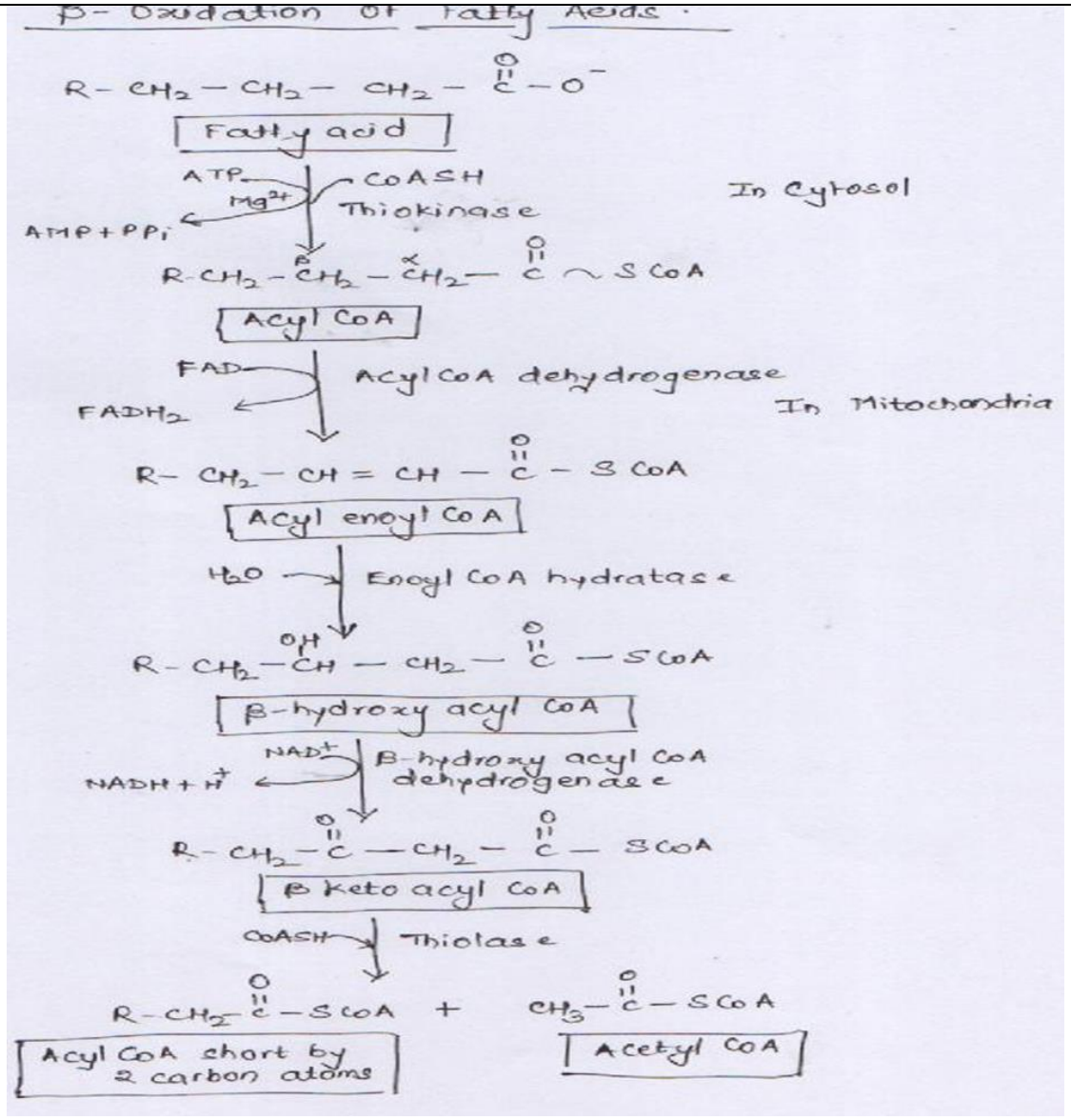
		even number of carbon is completely converted to acetate molecules. Fatty acid containing even & odd number of carbon atoms as well as unsaturated fatty acids are oxidised by beta oxidation. It takes place in 5 steps in mitochondria of liver. 1. Activation of fatty acid. Long chain fatty acid gets activated to fatty acyl CoA in presence of CoASH, Thiokinase &ATP 2. Fatty acylCoA undergoes dehydrogenation in presence of acyl CoA dehydrogenase &FAD to give alpha,beta unsaturated fatty acyl CoA 3. Addition of water molecule across the double bond results into formation of Beta hydroxy acyl CoA in presence of Enoyl CoA dehydratase 4. Hydroxyl group of Beta hydroxy acyl CoA gets oxidised to keto group forming Beta keto acyl CoA in presence of Beta hydroxy acyl CoA dehydrogenase & NAD+ 5. Thiolytic cleavage of acyl CoA takes place in presence of Beta keto acyl CoA Thiolase & CoASH. Acyl CoA thus formed contains 2 Carbons less than original acyl CoA which undergoes further oxidation by Beta-oxidation. Acetyl CoA is also formed which enters TCA cycle.	

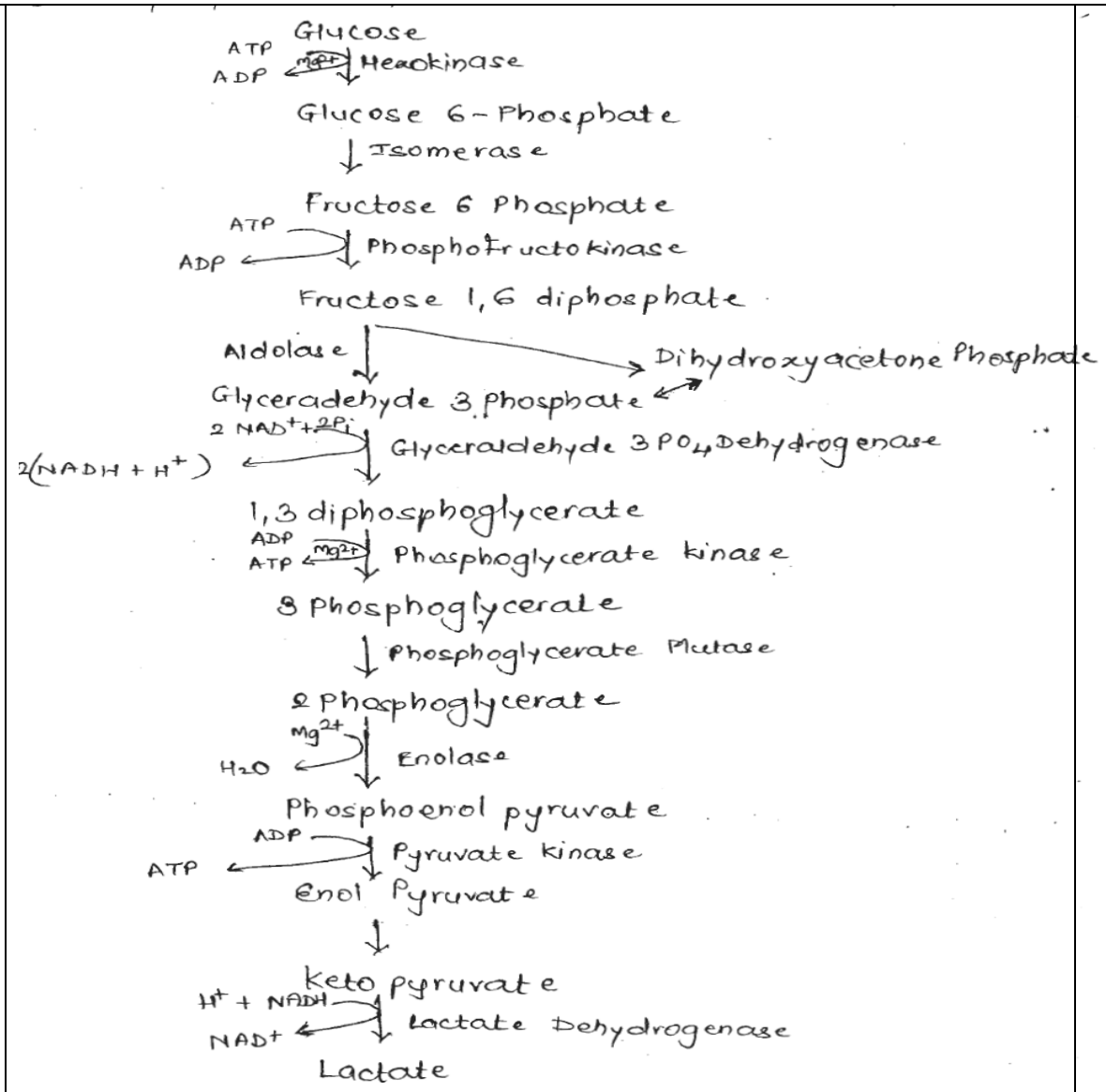
			
5	**b)**	**Explain in short :** i. **Acid value**- It is the number of milligrams of KOH required to neutralize the free fatty acids present in 1 gram of fat or oil. Free fatty acids increase due to decomposition ii. **Acetyl Number**- It is the number of milligrams of KOH required to neutralize the acetic acid obtained by saponifying 1 gram of an acetylated fat or oil. By	**4M** **(Each explanation 1M)**

		this method the hydroxyl groups are measured. iii. **Phospholipids**- the Compound lipids containing phosphorus are called as phospholipids. Phospholipid contains phosphoric acid, fatty acids, alcohol and generally a nitrogenous base. E.g .Glycerophospholipids Sphingophospholipids. iv. **Iodine Number** -It is the number of grams of iodine absorbed by 100g of fat or oil. It is the measure of the amount of unsaturated fatty acid present in total fat or oil.	
5	**c)**	**Explain the biochemical role of calcium. Mention its deficiency manifestations and remedy.** • **Biochemical role of Calcium- (any four can be considered)** i. It is required for formation and development of bones and teeth. ii. It is required for blood coagulation process. iii. It is required for regulation of muscle contraction. iv. It is necessary for transmission of nerve impulses. v. Calcium influences the membrane structure (i.e. maintains the membrane integrity) and helps in transport of water and several ions (i.e membrane permeability). vi. It is needed for the direct activation of enzymes like lipase, ATPase and succinate dehydrogenase. vii. It is responsible for release of hormones like insulin, PTH, calcitonin from the endocrine gland. viii. Calcium acts an intracellular messenger for certain hormones like epinephrine and ADH. ix. Cell to cell contact & adhesion of cells in a tissue	**4M (Role-2M, deficiency-1M and remedy -1M)**

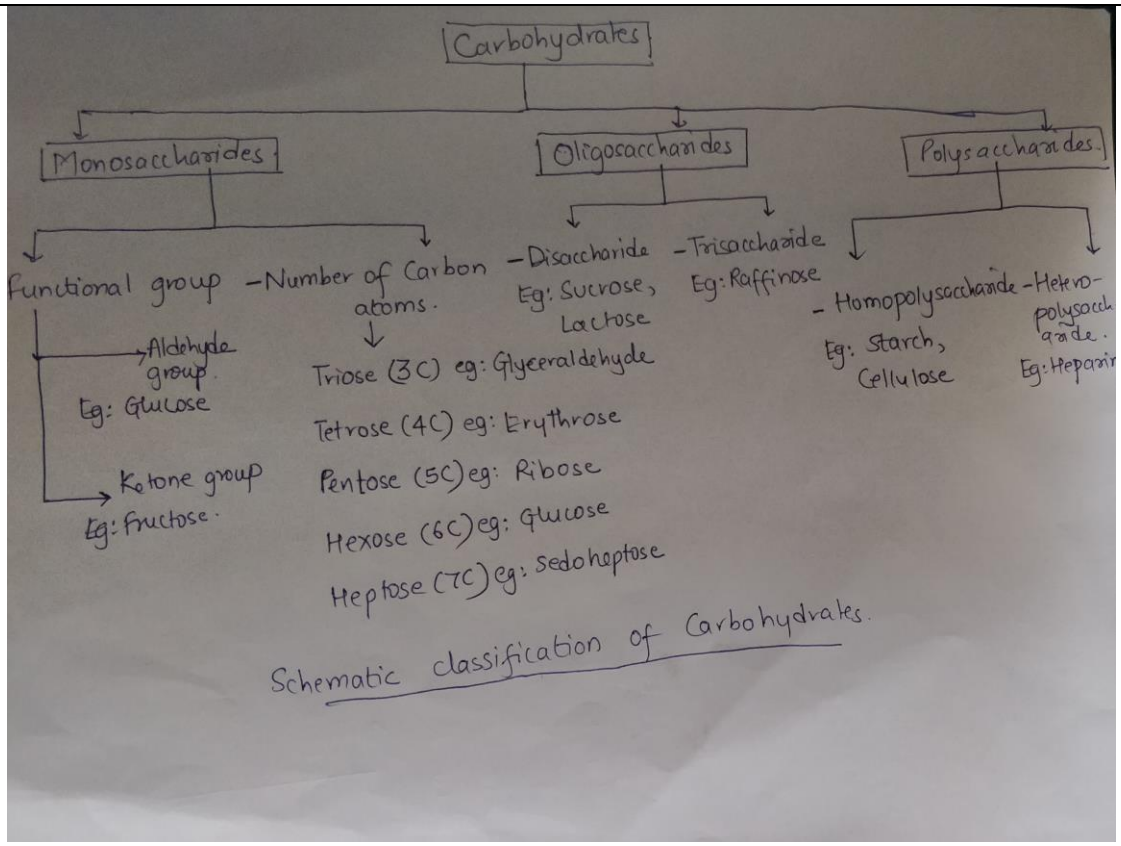
		x. Calcium acts on myocardium & prolongs systole. • **Deficiency** of calcium causes hypocalcemia (tetany), hypoparathyrodism rickets , osteoporosis. • **Remedy-** i. Higher dietary intake of calcium ii. Calcium supplements.	
5	**d)**	**Write Short Note on:** i. **Arteriosclerosis-** is a complex disease characterised by thickening or hardening of arteries due to accumulation of lipids (particularly cholesterol, free and esterified) collagen, fibrous tissue, proteoglycans, calcium deposit etc in the inner arterial wall. Arteriosclerosis is a progressive disorder that narrows and ultimately blocks the arteries. Coronary arteries-the arteries supplying blood to the heart are the most commonly affected leading to myocardial infarction or heart attacks. The development of arteriosclerosis & risk of coronary heart disease (CHD) is directly correlated with plasma cholesterol and LDL (bad cholesterol). On the other hand, plasma HDL is inversely correlated with CHD. Certain diseases which are associated with arteriosclerosis include diabetes mellitus, hypothyroidism, hyperlipoproteinaemia. Obesity, excessive smoking, lack of exercise, hypertension, stress and high consumption of saturated fats etc. may lead to arteriosclerosis. ii. **Hyperammonemia**- is a metabolic defect associated with enzymes of urea cycle which lead to a build-up of ammonia in blood. Such condition in which there is rise in ammonia levels in blood is termed as hyperammonemia.It may be due to hepatitis ,alcoholism etc.	**4M** **(Each short note 2M)**

		Types – Hyperammonemia Type I -It is caused due to deficiency of carbamoyl phosphate synthetase. Hyperammonemia Type II- It is caused due to deficiency of ornithine transcarboxylase. Both disorders exhibit hyperammonemia with elevated glutamine levels in blood, CSF and urine.	
5	**e)**	**What is enzyme inhibition? Explain competitive inhibition with one example** Compounds or agents which inactivate the enzymes, & thus adversely affect the rate of enzyme catalysed reaction are called as inhibitors & this process is known as enzyme inhibition. **Competitive inhibition:** In Competitive inhibition structure of inhibitor (I) closely resembles with that of the substrate (S). The inhibitor thus competes with the substrate to combine with an enzyme (E) forming the enzyme inhibitor complex (EI) rather than (ES) complex. The degree of inhibition depends upon the relative concentration of the substrate & the Inhibitor. Thus, by increasing the substrate concentration & keeping the inhibitor concentration constant the amount of inhibition decreases & decrease in substrate concentration result in increased enzyme inhibition. In this type of inhibition, enzyme can either bind with substrate (ES) or inhibitor (EI) but not both. V_{max} is unchanged K_M is increased. Example: Sulpha drugs when given as antibacterial agent compete with para-amino benzoic acid (PABA) and folic acid synthesis gets inhibited. **Consider any other correct example**	**4M (definition-1M, explanation 2M, eg-1M)**
6		**Attempt any TWO of the followings**	**6×2=12**
6	**a)**	**Explain Glycolysis cycle** Schematic representation and explanation both to be considered.	**6M**

		It's a main pathway for glucose oxidation 1. Phosphorylation of glucose to glucose 6 phosphate in presence of enzyme hexokinase & ATP & Mg 2. Isomerisation of Glucose 6 phosphate to fructose 6 phosphate in presence of phosphohexo isomerase 3. Phosphorylation of fructose 6 phosphate to fructose 1,6 diphosphate in presence of phosphor-fructokinase, ATP& Mg 4. Cleavage of fructose 1,6 diphosphate to dihydroxy acetone phosphate & glyceraldehyde 3 phosphate in presence of aldolase. These 2 products are interconvertible in presence of triose phosphate isomerase 5. Glyceraldehyde 3 phosphate further undergoes oxidation to 1,3 diphosphoglycerate in presence of glyceraldehyde 3 phosphate dehydrogenase & NAD+ 6. Transformation of 1,3 diphosphoglycerate to 3- phosphoglycerate in presence of phosphoglycerate kinase, Mg & ADP 7. 3- phosphoglycerate changes to 2-phosphoglycerate in presence of phosphoglycerate mutase 8. Loss of water molecule from 2-phosphoglycerate results into formation of phosphoenol pyruvic acid in presence of enolase 9. Loss of phosphate from phosphoenol pyruvic acid results into formation of Enol pyruvic acid in presence of pyruvate kinase, Mg & ADP 10. Enol pyruvic acid gets converted to keto form of pyruvic acid in presence of pyruvate kinase 11. Keto pyruvic acid under aerobic conditions enter TCA cycle in mitochondria. Pyruvic acid forms main end product of glycolysis in those tissues which are supplied with sufficient Oxygen. 12. But tissues where oxygen is not supplied, lactic acid is formed as an end product of glycolysis by reduction in presence of lactate dehydrogenase & NADH. Net reaction for glycolysis is: Glucose + 2NAD+ + 2 ADP + 2 Pi $\rightarrow$ 2 Pyruvate + 2 ATP + 2 NADH + 2 H_2O	

			
6	**b)**	**Explain:** i. **Phenylketonuria (PKU)** - It is the most common disorder in amino acid metabolism. The incidence of PKU is 1 in 10000 births. It is due to the deficiency of hepatic enzyme, phenylalanine hydroxylase. Phenylalanine metabolism in PKU -Phenylketonuria primarily causes the accumulation of phenylalanine in the tissues and blood, and results in increased excretion in urine. Due to the disturbances in the routine	**6M** **(Each explanation 3M each)**

		metabolism, phenylalanine is diverted to the alternate pathways, resulting in the excessive production of phenylpyruvate, phenylacetate, phenyllactate and phenylglutamine. All these metabolites are excreted in urine in high concentration in PKU. Clinical manifestations of PKU: Mental retardation, failure to walk or talk, failure of growth, seizures and tremors are observed Treatment of PKU: the maintenance of plasma phenylalanine concentration within the normal range is done by selecting foods with the low phenylalanine content and or feeding synthetic amino acid preparation, low in phenylalanine. ii. **Ketosis**- Normally acetyl CoA formed from pyruvate, beta oxidation & amino acids gets condensed with oxaloacetate & oxidised to carbon dioxide & water. During impaired carbohydrate metabolism or low carbohydrate intake, fate of acetyl CoA changes if oxaloacetate is available in limited supply or large quantity of fatty acid is oxidised to Acetyl CoA. Excess acetyl CoA is diverted for production of ketone bodies. When the rate of synthesis of ketone bodies does not cope with the rate of utilisation in extrahepatic tissues, the concentration in the blood increases this is known as ketonemia followed by the increase urinary excretion known as ketonuria & the overall condition together is called as Ketosis. Conditions associated with Ketosis- Starvation, high fat diet, Diabetes mellitus and impaired carbohydrate metabolism. Acetone, Aceto acetic acid and Beta hydroxybutyric acid are the ketone bodies that are excreted in ketosis.	
6	**c)**	**Give schematic representation of classification of carbohydrates. Explain each class with examples**.	**6M (Scheme 2M, Explanation 2M and egs 2M)**



Classification of carbohydrates: Carbohydrates are classified into two groups based on the number of sugar units-

I) Monosaccharides are the simplest group of carbohydrates and are often referred to as simple sugars. They have general formula CnH2nOn and they cannot be further hydrolysed. they are further classified as-

- On basis of functional groups-

i. Aldoses: when the functional group of monosaccharides is an aldehyde they are known as aldoses

E.g. Glyceraldehyde, glucose.

ii. Ketoses: when the functional group of monosaccharides is a ketone they are known as ketoses

- On basis of number of carbon atoms-

Trioses -three carbon atom e.g.- glyceraldehyde, dihydroxyacetone.

Tetroses- four carbon atom e.g. Erythrose, erythrulose.

		Pentoses- five carbon atom e.g. Ribose, ribulose. Hexoses- six carbon atom e.g. Glucose, fructose, galactose, mannose, etc. Heptoses- seven carbon atom e.g. Sedoheptose, sedoheptulose. II) Oligosaccharides contain two to ten monosaccharide molecules. Based on the number of monosaccharide units present, the oligosaccharides are further subdivided into- i. Disaccharide- class of oligosaccharide consisting of two monosaccharide units. eg. Sucrose (glucose+ fructose), lactose (galactose+ glucose) , maltose (glucose + glucose). ii. Trisaccharide- class of oligosaccharide consisting of three monosaccharide units. E.g. Raffinose (three galactose sugar units), maltotriose (three glucose sugar units). III) Polysaccharides are the polymers of monosaccharide units with higher molecular weight held together by glyosidic bonds Polysaccharides are of two types- i) Homopolysaccharide - these on hydrolysis yield only a single type of monosaccharide unit. E.g.- Starch, cellulose, glycogen etc ii) Heteropolysaccharide - these on hydrolysis yield mixture of few monosaccharides or their derivatives unit. E.g.- Hyaluronic acid, heparin, chondroitin sulphate etc **Carbohydrates classification can also be shown under the heading of Sugars and Non-Sugars**	