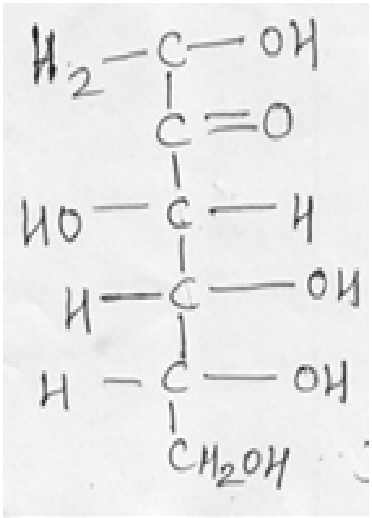
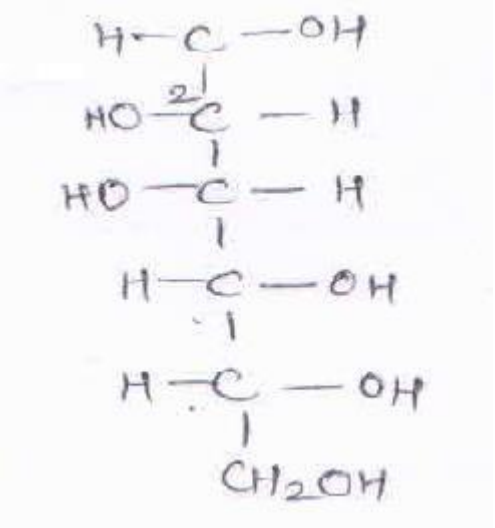
WINTER – 19 EXAMINATION

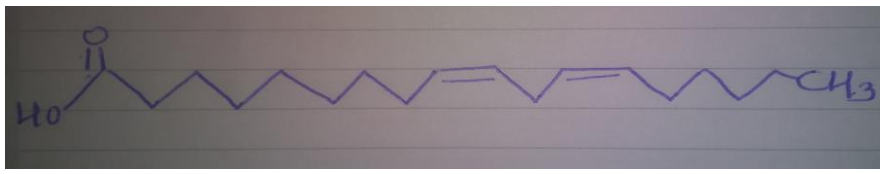
Subject Name: Biochemistry & Clinical Pathology **Model Answer** Subject Code : 0808

Important Instructions to examiners:

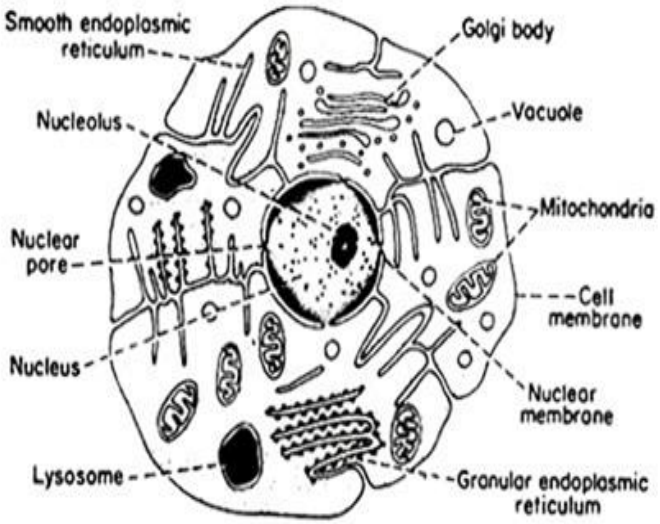
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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 any equivalent 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.

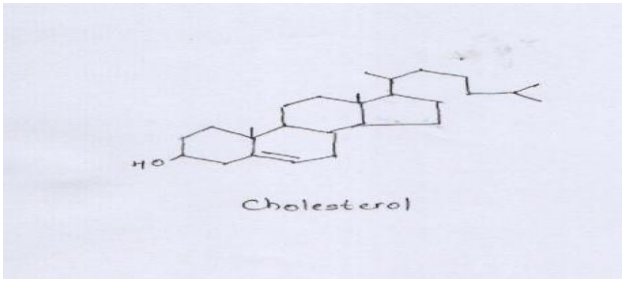
Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Attempt any Eight of the followings:**	**8×2=16M**
1	a)	**Define the terms biochemistry and biomolecules.** **Biochemistry-** The study dealing with the chemistry of living organism in its different phases of activity is called as biochemistry. **Biomolecules-** Biomolecules are molecules and ions present in organisms that are essential to one or more biological processes, such as cell division, development etc. Biomolecules include large macromolecules (or polyanions) such as proteins, carbohydrates, lipids, and nucleic acids, as well as small molecules such as primary metabolites, secondary metabolites, and natural products.	**1M each**
	b)	**Define enzyme inhibition. Give its types.** Compounds or agents which inactivate the enzymes, & thus adversely affect the rate of enzyme catalysed reactions are called as inhibitors & this process is known as enzyme inhibition. **Types:**	**1 M DEF.** **1 M Types** **Any 2**

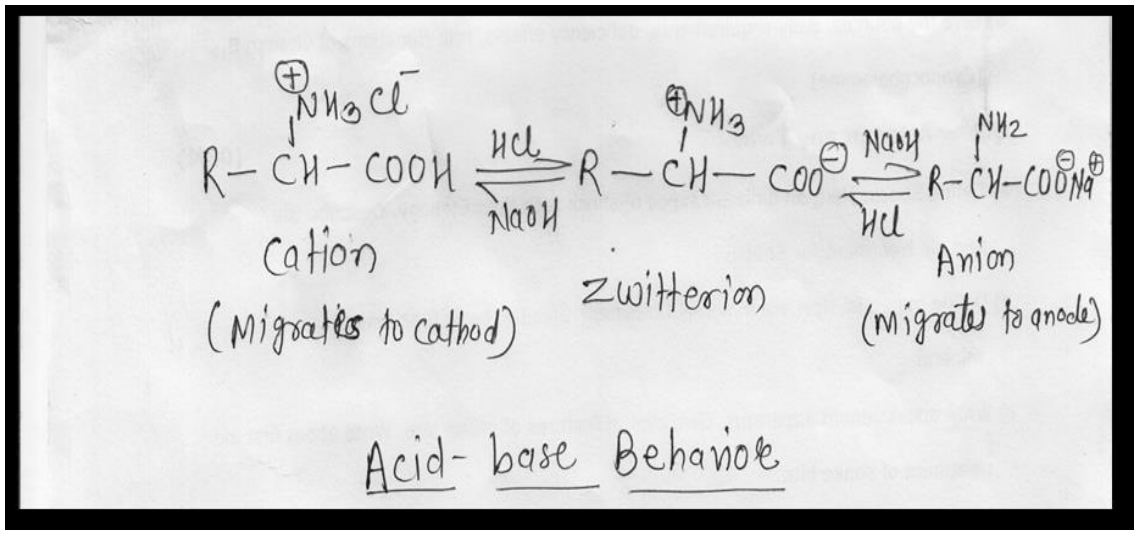
		1.Reversible inhibition **2.Irreversible inhibition** **3.Allosteric Inhibition**	
	c)	**Give physiological role of sodium in body** o To maintain acid base balance. o Required for maintenance of osmotic pressure & fluid balance o Required for normal muscle irritability & cell permeability o Required for initiating & maintaining heart beat	**2M**
	d)	**Define the terms Thrombocythemia and Lymphocytosis** Thrombocythemia: Increase in numbers of platelets above the normal range. Having too many platelets makes it hard for our blood to clot normally. It may be due to anaemia, malignancy. Lymphocytosis: Increase in number of lymphocytes count above normal range in blood & is observed in viral infection like Hepatitis A, Bordetella pertussis.	**1M each**
	e)	**Draw structures of fructose and Mannose** **Fructose** **Mannose**  	**1Meach**

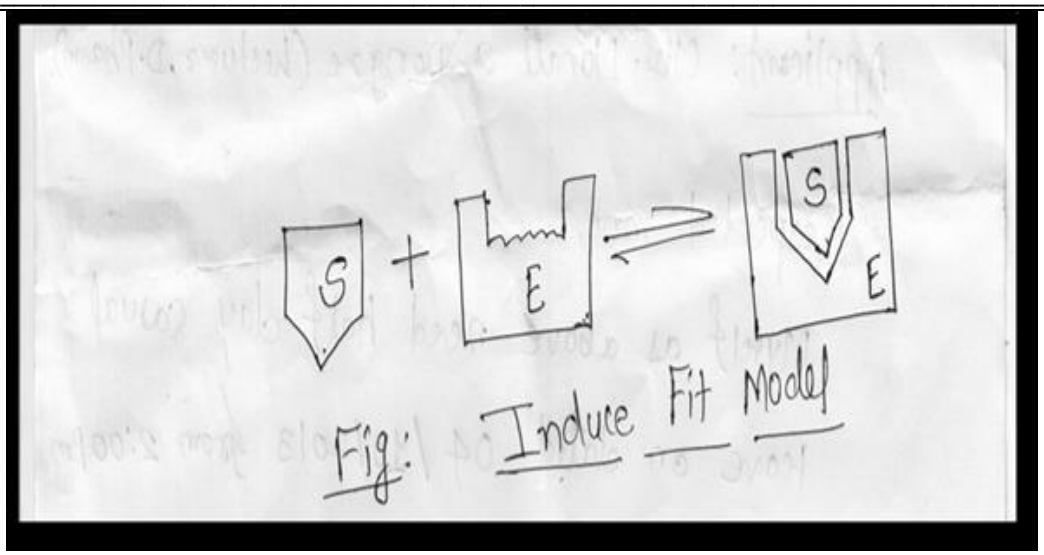
	f)	**Write tests for detection of Glucose in urine** i) Benedict's test: 5ml urine+ 5ml Benedict's reagent boil for 2 minutes &cool Green/ yellow/ red ppt obtained indicates presence of sugar according to concentration ii) Fehling's test: 2ml Fehling's A+ 2ml Fehling's B, boil for few minutes, add 2-3 ml of urine ,boil again. red/ yellow ppt obtained indicates presence of sugar.	**2M**
	g)	**Define essential fatty acids? Draw structures of any one.** 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. E.g. Arachidonic acid, linoleic acid, linolenic acid. Etc. Structure: Linoleic acid  Arachidonic acid  (**Any other structure can also be considered)**	**1M Def.** **1M for any 1 stru.**
	h)	**Define Ketonemia. How it occurs?** The presence of high ketone bodies in blood is called as Ketonemia. In starvation, degradation of fatty acid increases to meet the energy need of the body. This	**0.5M def.** **1.5M expl.**

		causes an overproduction of acetyl CoA which cannot be fully handled by citric acid cycle. TCA cycle is also impaired due to deficiency of oxaloacetate, since most of it is diverted for glucose synthesis to meet the essential requirements for tissues like brain. This results in accumulation of acetyl CoA, its diversion for over production of ketone bodies and thereby increased level of ketone bodies in blood.	
	i)	**Name deficiency disorder of Niacin and give its signs and symptoms.** **Pellagra** is a vitamin deficiency disease caused by dietary lack of niacin **The signs & symptoms of pellagra include:** • Dermatitis: found in areas of the skin exposed to sunlight, oedema ,Red skin lesions, inflammation of skin • Dementia is associated with degeneration of nervous tissue. Symptoms include anxiety, irritability, poor memory, insomnia etc. Diarrhoea: in the form of loose stools, often with blood and mucus. **The main results of pellagra can easily be remembered as "the three D's": diarrhoea, dermatitis and dementia.**	**0.5M name** **1.5M sym.**
	j)	**Define Isoelectric point of amino acids** At the isoelectric pH, the amino acid exists as Zwitter ion or dipolar ion which carries equal number of positive and negative charges and net charge becomes zero, this point of pH is called as isoelectric point of amino acids.	**2M**
	k)	**Define Holoenzymes and Multienzymes.** **Holoenzymes:** The apoenzymes in combination with its prosthetic group constitute holoenyzme. **Multienzyme:** Composed of or involving two or more enzymes that function together in a biosynthetic pathway OR **It** is a group of different enzymes.	**1M each**
	l)	**Draw a well labelled diagram of a typical animal cell.**	**2M**

			
2		**Attempt any FOUR of the following:**	**4×3=12M**
2	**a)**	**Define and classify carbohydrates with example of each class.** Carbohydrates- They are large group of organic compounds which are polyhydroxy aldehydes or ketones which on hydrolysis give these derivatives. **Classification-** 1) Sugars (saccharides) 2) Non sugars (poly saccharides) 1) Sugars (saccharides)- a) Monosaccharides Depending upon number of carbon atoms, they are subdivided in following types: i) trioses-e.g. D-Glycerose ii) tetroses-e.g. D-erythrose iii) pentoses-e.g. D-ribose iv) hexoses- e.g. glucose, fructose Depending on functional group : i) aldoses : Glucose ii) ketoses : Fructose b) Disaccharides- e.g. lactose, maltose, sucrose. c) Oligosaccharides- e.g. raffinose, maltotriose. 2) Non sugars (poly saccharides)-	**1M def. 1M classes, 1M e.g.**

		a) Homopolysaccharides-e.g. starch, cellulose. b) Heteropolysaccharides e. g. hyaluronic acid	
2	**b)**	**Draw structure of cholesterol and give its colour reactions.**  **1) Liebermann-Burchard test:** When chloroform solution of cholesterol is treated with acetic anhydride & concentrated sulphuric acid, green colour is formed. **2) Salkowaski test:** When chloroform solution of cholesterol is treated with concentrated sulphuric acid, upper layer gives red colour and H_2SO_4 layer gives green colour. **3) Formaldehyde-H_2SO_4 Test:** To a solution of cholesterol in chloroform in dry test tube If 2ml of formaldehyde-sulphuric acid solution is added, cherry colour develops.	**1M stru, 2M for any 2 tests**
2	**c)**	**Describe acid base properties of amino acids.** i. Amino acids are amphoteric in nature ii. The amino group (NH2) can accept proton (H+) and form cation (NH3). iii. The carboxyl group can donate H+ and form anion (COO-). iv. At acidic pH the amino acids are positively charged. v. At basic pH they are negatively charged. vi. At intermediate pH, the charge is zero; it carries both positive and negative charges.	**1M reaction 2M properties**

		vii. This pH is called isoelectric pH. At the isoelectric pH , the amino acid exists as Zwitter ion which carries equal number of positive and negative charges and net charge becomes zero. viii. At the Isoelectric pH, that amino acid becomes insoluble and precipitates out. E.g. Aspartic acid 2.77 and alanine 6.02 (consider any example)  	
2	**d)**	**Explain Koshland theory of enzyme action.** **Induced fit model is called as Koshland theory of enzyme action.** In this case the shape of active site of an enzyme is flexible so as to accommodate with wide variety of substrate molecules. In this, interaction of the substrate with the enzyme induces a fit or conformation change in the enzyme, resulting in the formation of a strong substrate binding site. The shape of active site of enzyme is made complementary to the substrate molecule.	**1M dig,** **2M expl.**



2	e)	**Write functions of blood and briefly describe its composition.** 1) Blood transports oxygen from lungs to tissues, carbon dioxide from tissue to lungs. 2) Blood acts as vehicle for transportation of hormones, vitamins, and other essential chemicals. 3) It maintains water balance of body 4) It maintains acid base balance of body 5) It maintains the ion balance between the cells and surrounding fluids. 6) Blood regulate the body temperature. 7) Blood acts as defensive system by producing WBC and various antibodies. 8) Blood regulate the blood pressure by changing its volume and viscosity. 9) It transports the cellular waste products to excretory organs which are kidney, lungs. **Composition:** Plasma : watery fluid portion of blood .55% Blood cells:45%	**2M Fun. Any 4, 1M compositio n**

1) RBC: Red blood cells (RBCs), also called erythrocytes, carry oxygen throughout the body.

2) WBC **:** White blood cells (WBCs), also called leukocytes or leucocytes, are the cells of the immune system that are involved in protecting the body against both infectious disease and foreign invaders.

3) PLATELETS: Platelets are tiny blood cells that help your body form clots to stop bleeding.

2 f) Enlist abnormal constituents of urine and give their significance. **3M**

Abnormal constituents	**Significance**
Sugar/ Glucose	Glycosuria, diabetes mellitus
Ketone bodies	Ketonuria- Diabetes mellitus, Pregnancy, Carbohydrate starvation
Protein/ albumin	Proteinuria- Pregnancy, severe exercise, high protein meal, Nephritis
Bile pigments	Jaundice /Hepatitis
Blood	Haematuria- Acute inflammation of urinary organs, T.B., Cancer, Haemolytic jaundice etc
Pus	Pyuria- Inflammation of urinary bladder, urethra, kidney

3 Attempt any FOUR of the following: **4×3=12M**

3 a) Define and classify minerals with examples. **3M**

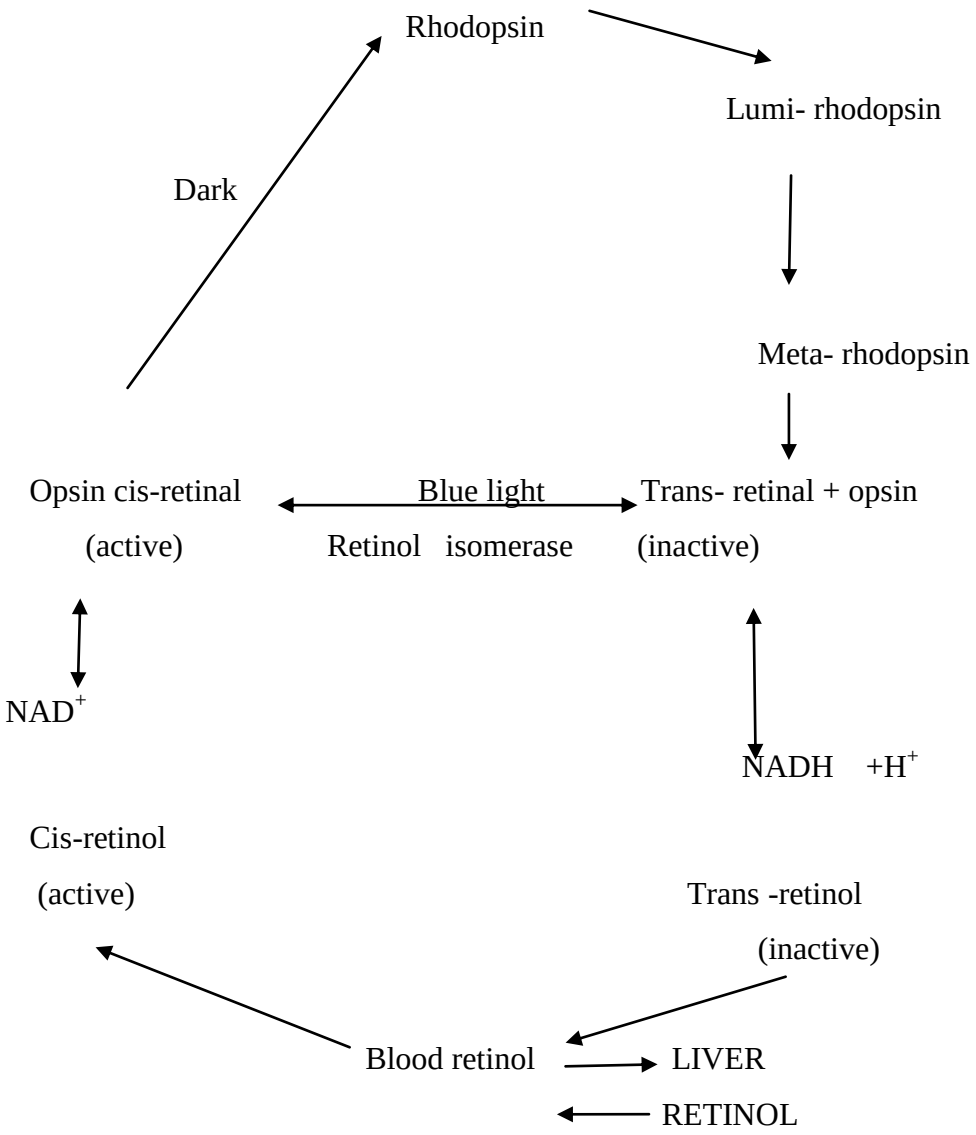
Definition-These are inorganic homogenous substances which must be supplied by the diet to perform various physiological functions.

Classification- The minerals are classified as principal and trace elements.

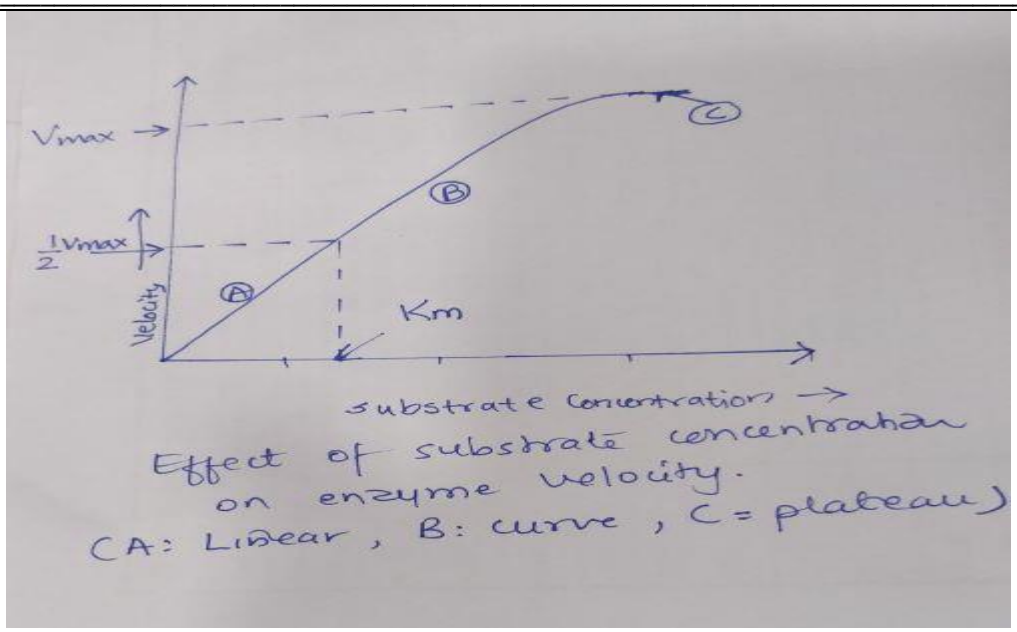
(Definition-1M and Classification -1 M

		1. Principal trace elements- (macro elements) They are required in amounts greater than 100mg/day. E.g. calcium, phosphorus, magnesium, sodium, potassium, chloride, sulphur. 2. The trace elements (microelements) are required in amounts less than 100mg/day. They are subdivided into three categories- i. Essential trace elements: These are the elements which are not synthesized in the body but are required for performing biochemical functions in the body in trace amounts only. E.g.- iron, copper, iodine, manganese, zinc, molybdenum, cobalt, fluorine, selenium, chromium. ii. Possibly essential trace elements: e.g. Nickel, vanadium, cadmium, chromium iii. Non-essential trace elements: e.g.-aluminium, lead, mercury, boron, silver, bismuth.	**and Examples 1M)**
3	**b)**	**Explain water balance of normal individual.** (Balance may be given for 2500ml/2800ml) Water is very essential for living system. There is no life without water. Total body water accounts for 70%of body weight. However, a loss of 10% of water in our body is serious and a loss of 20% is fatal. Therefore, a balance should be maintained between water intake and output. **Water intake source -** 1) Drinking water -1500ml 2) Solid food -1000ml 3) Oxidation of carbohydrates, fats and protein- 300ml **Water loss from body -** Water is lost continuously from the body in the following ways. 1) via kidney as urine -1500ml 2) via skin -800ml 3) via lungs in expired air -400ml 4) via faeces -100 ml	**3M (1.5M Explanation and 1.5M Table)**

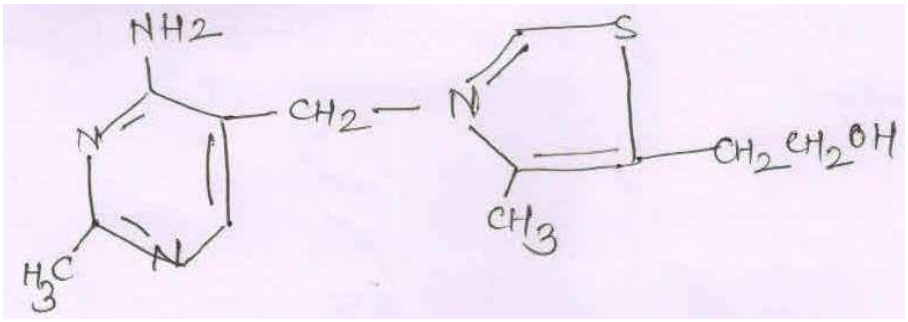
			Water Intake	**ml**	**Water Loss**	**ml**	
			Drinking water	1500	Urine	1500	
			Solid food	1000	Faces	100	
			Oxidation of Carbohydrates, Fats and Proteins	300	Skin	800	
					Lungs	400	
			Total	**2800**	**Total**	**2800**	
3	**c)**	**Describe the role of Vitamin A in vision cycle** The retina of the eye contains two types of receptor cells, Rod cells which are responsible for dim light vision & the cones, responsible for bright light vision. Cones are also responsible for colour perception. The deficiency of cone pigments makes the individual colour blind. In retinal pigments, the rod cells contain rhodopsin. Under the influence of light, rhodopsin is converted to lumirhodopsin which is further converted into metarhodopsin. Then hydrolysed to protein opsin & trans retinal. Trans-Retinal (trans-retinene) is inactive in the synthesis of rhodopsin; it must be converted to the active cis-isomer. In the eye, the trans-retinal is reduced to trans-retinol by the enzyme retinal reductase & NADH. The trans retinol which is too inactive in rhodopsin synthesis is passed into blood stream, and then carried to liver. It is then converted to cis isomer. In dim light active cis-retinol from the blood enters the retina where it is oxidized to cis-retinal by reverse action of retinal reductase in the presence of NAD+. Finally, the cis-retinal combines with protein opsin to give back rhodopsin and thus cycle is repeated.					**3M (1.5M Explanation and 1.5M Diagram)**

		DIAGRAM: 	
3	**d)**	**Briefly describe denaturation of proteins.** Denaturation of proteins involves the disruption and possible destruction of both the secondary and tertiary structures. Since denaturation reactions are not strong enough to break the peptide bonds, the primary structure remains the same after a denaturation process. Agents causing denaturation • Physical agents: Temperature, Cooling • Chemical agents: Acetic acid, Sulfosalicylic acid, X ray. Changes after denaturation: - • Loss of biological activity	**3M**

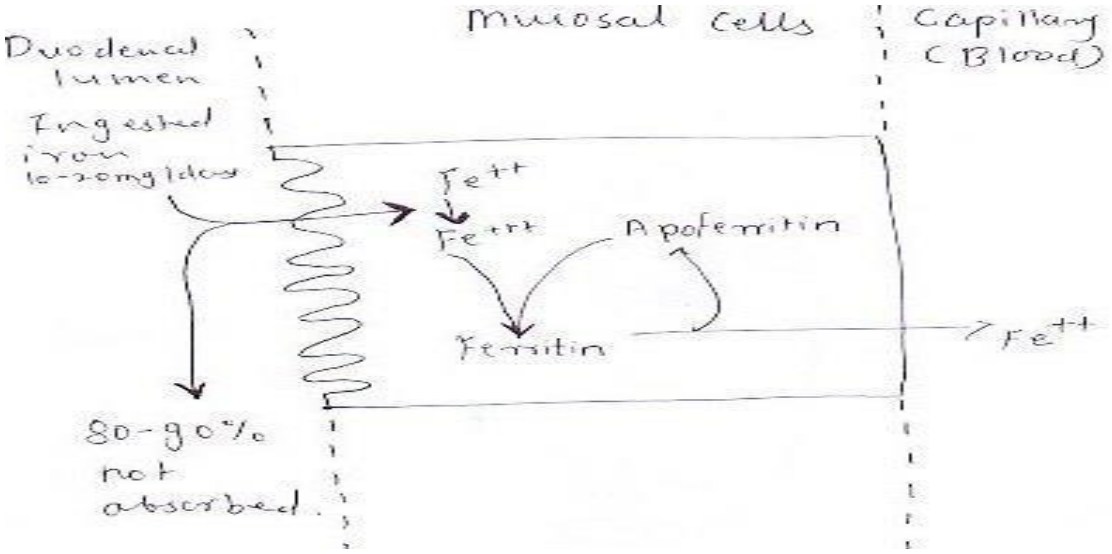
		• Change in surface tension • Changes in solubility • Destruction of secondary and tertiary structures E.g. Boiled eggs become hard, skin formed on curdled milk.	
3	**e)**	**Enlist the factors affecting the rate of enzyme catalysed reaction and explain effect of substrate concentration on the rate.** Factors that affect velocity of enzyme catalysed reaction are- • Hydrogen ion concentration • Concentration of enzymes • Concentration of substrate • Temperature • Time • Products of reaction • Effect of light & other physical factors • Allosteric factors • Effect of hormones & other biochemical agents. **Effect of Substrate concentration-** Increase in the substrate concentration gradually increases the velocity of enzyme reaction within the limited range of substrate levels. A rectangular hyperbola is obtained when velocity is plotted against the substrate concentration. Three distinct phases of the reaction are observed in the graph, first in linear fashion, later the curve flattens and becomes plateau. Thus, by increasing the concentration of the substrate indefinitely, the velocity of the reaction cannot be increased beyond a certain stage. The rate of the enzyme reaction is independent of the concentration of substrate and enzyme. Diagram of graph –	**3M (1M Enlist 1M explanation 1M graph)**

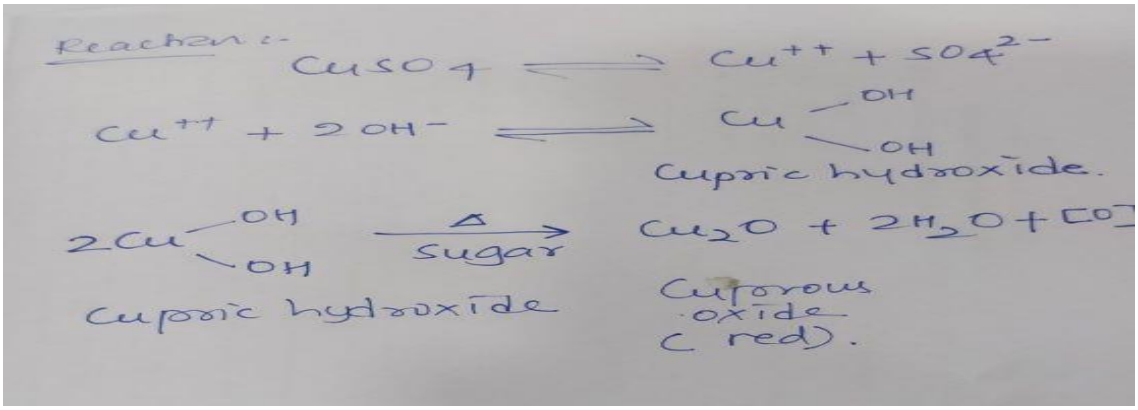


Effect of substrate concentration on enzyme velocity.
(A: Linear, B: curve, C = plateau)

3	f)	**Give structure, physiological functions and deficiency disorders of Thiamine** Structure-  **Physiological functions-** 1- The coenzyme , thiamine pyrophosphate (TPP) or cocarboxylase is intimately connected with the energy releasing reactions in the carbohydrate metabolism • The enzyme pyruvate dehydrogenase catalyses the irreversible conversion of pyruvate to acetyl CoA. This reaction is dependent on TPP. • α -Ketoglutarate dehydrogenase is an enzyme of citric acid cycle. This enzyme is comparable with pyruvate dehydrogenase and requires TPP. • Transketolase reaction in HMP pathway is dependent on TPP. 2- TPP plays a major role in the transmission of nerve impulses and muscle contraction.	**1M Struc.** **1 M any 2 functions** **1 M disorder**

		Deficiency disorders- 1- The deficiency of thiamine results in condition called Beri-Beri. The symptoms include loss of appetite, weakness, constipation, nausea, mental depression, irritability, etc. 2- Carbohydrate metabolism is impaired. There is accumulation of pyruvate in the tissues and excreted in urine.	
4		**Attempt any FOUR of the following:**	**4×3=12M**
4	**a)**	**Define and classify proteins with examples.** Proteins are the naturally occurring highly complex compounds of amino acids joined together with peptide linkage (-CONH-). Classification -Based on chemical nature & solubility • Simple: Composed of only amino acid residues. • Conjugated: besides amino acid residues they contain nonprotein moiety known as prosthetic group or conjugating group. • Derived: They are denatured or degraded products of simple or conjugated proteins. PROTEINS Simple: Globular : • Albumins • Globulins; Scleroproteins: • Elastins • Keratins Conjugated: Nucleoproteins, Glycoproteins, Lipoproteis, Phosphproteins Derived: Primary: Coagulated p. Proteans; Secondary: Peptones Peptides Classification Based on the functions that they carry out OR Classification Based on nutritional value can also be considered.	**1 M Define** **1 M Class.** **1M Egs**

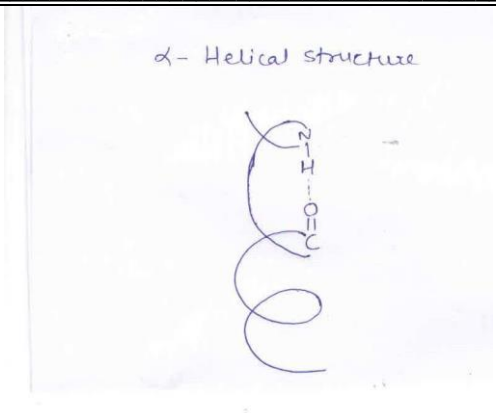
4	b)	**Describe mucosal block theory of iron absorption.** Mucosal block theory of iron absorption: - Ferrous Fe2+ forms chelate with ascorbic acid, sugar& amino acids & remain soluble, so absorption is enhanced. It is possible that mucosal receptors in upper small intestine (apoferritin) control absorption of iron. Whenever there is need of iron, it is removed from intestinal mucosa cell receptor & increased absorption of food iron occurs to replace it. This continues until body's stores of iron especially that of intestinal mucosal cells are replenished. The iron saturated mucosal receptor then once again refuses to absorb available iron.  	**3M (1.5M Explanation & 1.5M Diagram)**
4	c)	**Explain the term Acid value and Iodine number of lipids with their significance** **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. During storage fats may become rancid as a result of peroxide formation at the double bonds by atmospheric oxygen and hydrolysis by microbial growth with the liberation of free acids. **Significance**: It indicates degree of the rancidity.	**3M (Each explanation 1.5M)**

		Iodine value: It is the number of grams of iodine required to saturate or absorbed by 100gms of fat. **Significance**: It helps to determine level of unsaturated fatty acids present in total fat or oil.	
4	**d)**	**Write barfoed's test and give its significance and principle.** **Barfoed's test:** 2-3 drops of Barfoed's reagent is added to 1 ml of given sample in a test tube and boiled for 30 seconds and then allowed to cool. If a red precipitate occurs, a monosaccharide is present.. It is based on the reduction of copper (II) sulphate to copper (I) oxide (Cu_2O), which forms a brick-red precipitate. If a red precipitate occurs, a monosaccharide is present. Disaccharides may also react, but the reaction is much slower. OR Reaction-  Principle- Reducing sugars form enediol in alkaline medium. The enediol forms or sugars reduce cupric ions (Cu^{2+}) of copper sulphate to form cuprous ions Cu^{+}, which form a yellow precipitate of cuprous hydroxide or a red precipitate of cuprous oxide. Significance- the reduction is much more efficient in alkaline medium. Mainly strong reducing sugars (monosaccharides) give this test positive. Barfoed's test serves as a key reaction to distinguish monosaccharides from disaccharides.	**3M (test, significance and principle carry equal marks)**
4	**e)**	**Briefly describe diagnostic application of enzymes.** Enzymes are very useful for the diagnosis of various diseases. Enzymes are normally confined within the cell**.** The little amount is present in body fluids like blood & C.S.F. etc.	**3M**

		such enzymes are called 'marker enzyme'. These are used as markers to detect cellular damage which ultimately helps in the diagnosis of disease. Enzymes in the circulation are divided into two groups. 1. Plasma specific or plasma functional enzymes: Certain enzymes are normally present in the plasma and they have specific functions to perform. These enzymes activities are highest in plasma than in tissues. They are synthesised in the liver and enter the circulation for e.g. lipoprotein lipase, plasmin thrombin, choline esterase etc. Impairment in the liver function or genetic disorders often lead to fall in the activities of plasma functional enzymes e.g. deficiency of ceruloplasmin in Wilson's disease. 2. Non-plasma specific or plasma non-functional enzymes: The enzymes are either totally absent or present at a low concentration in plasma compared to their levels found in the tissues. The digestive enzymes of the GIT e.g. amylase, pepsin, trypsin, present in the plasma are called as secretory enzymes. Estimation of the activities of non-plasma specific enzymes is very important for the diagnosis and prognosis of diseases. In disease condition, level of these enzymes increases in blood or in other body fluids, hence we can identify the disease. E.g.- i) The level of SGOT rises rapidly after a heart attack. ii) The level of SGPT increases in infectious hepatitis iii) Activity of Creatine phosphokinase increases in the plasma, during infection in cardiac muscle. iv) The level of Amylase increases in acute pancreatitis. v) The level of alkaline phosphatase increases in rickets, obstructive jaundice, etc.	
4	**f)**	**Define Mutaroation. Explain how it occurs.** Definition- Change in specific rotation on standing of aqueous solution of sugar is known as mutarotation. Explanation-When monosaccharide (glucose) is dissolved in water, its optical rotation gradually changes until it reaches a constant value.	**3M** **(definition-1M and explanation 2M)**

		For e.g. Freshly prepared solution of alpha D-glucose has a specific rotation of $+112^0$ and on standing specific rotation falls to $+52.5^0$ and remains constant at this value. This final stage can be obtained more quickly either by heating or by adding some catalyst like acid or alkali. This change in specific rotation is called as mutarotation. On other hand fresh solution of beta D-glucose has rotation value of $+19^0$ which on standing also changes to 52.5^0 For example: α—D—Glucose ⟶ D—Glucose ⟶ β—D—Glucose. $(+112^0)$ $(+52.5^0)$ $(+19^0)$	
5		**Attempt any FOUR of the following:**	**4×3=12M**
5	**a)**	**Define and Classify Enzymes.** Highly specific proteinous substances that are synthesized in a living cell & catalyze or speed up the thermodynamically possible reactions necessary for their existence. **Classification Of Enzymes: On the basis of site of action:** **Exoenzymes / Extracellular enzymes**: • Secreted outside the cell Decompose complex organic matter like proteins ,fats, cellulose .E.g..: proteoses, lipases. **Endoenzymes / Intracellular enzymes**: • Present inside the cell E.g..: synthetases, phosphorylases **Constitutive Enzymes:** • Produced in absence of substrate. Eg.: Enzymes of glycolytic series. **Induced Enzymes:** • Produced in presence of substrate. Eg.: hepatic microsomal enzymes. **Zymogens / Proenzymes:** • Produced naturally in an inactive form which can be activated when required. Enzymes like pepsin are created in the form of pepsinogen, an inactive zymogen. Pepsinogen is activated when Chief cells release it into HCl which partially activates it. **OR** **Classification of Enzymes: on the basis of reactions they catalyze:** **• Oxidoreductases :** They bring about biological oxidation & reduction between two substrates.	**1M defn** **2M** **Classfn.**

		e.g ; Dehydrogenases, Oxidases, Hydroperoxidases, Oxygenases, Hydroxylases • **Transferases :** Catalyse transfer of some group or radical from one molecule to another. E.g.Transaminases, Transphosphorylases, Transglycosidases • **Hydrolases:** Bring about hydrolysis or condensation of substrate by addition or removal of water. Eg. Esterases, Peptidases **Lysases:** • Catalyse removal of groups from larger substrates by mechanisms other than hydrolysis, leaving double bonds. e.g. Carboxylysases, Aldehydelysases **Isomerases:** Catalyze interconversion of isomers. eg. Dextrose isomerase **Ligases/ Synthatases:** • Catalyse the linking or synthesizing together of 2 compounds. Forming C-S bonds, C-N bonds, C-C bonds. E.g: Lysases, Isomerases, Ligases / Synthatases .	
5	**b)**	**Describe secondary structure of Proteins.** The conformation of polypeptide chain by twisting or folding is referred to as secondary structure . Two types of secondary structures are possible: i) α- helix (α- helical) : 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=0group 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.	**3M**



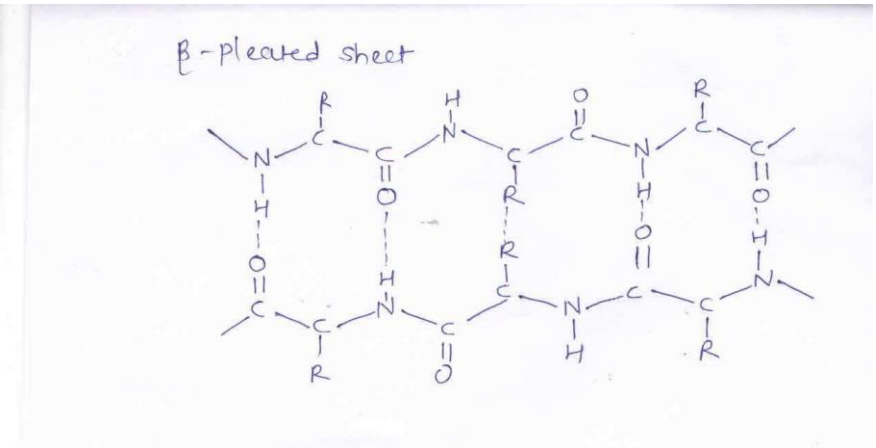
(ii) β-pleated sheet: It is another form of secondary structure, this result from hydrogen bonding between two peptide chains.

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.

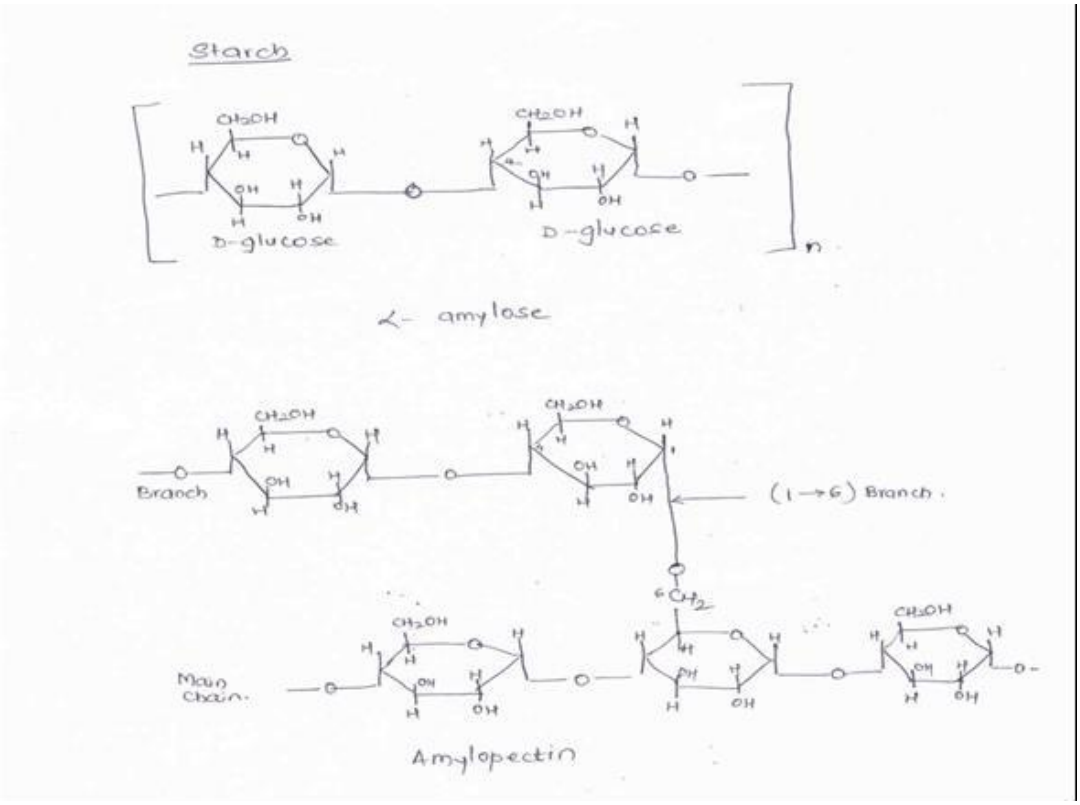
b) anti- parallel pleated sheet-



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.

Other correct representation can also be considered.

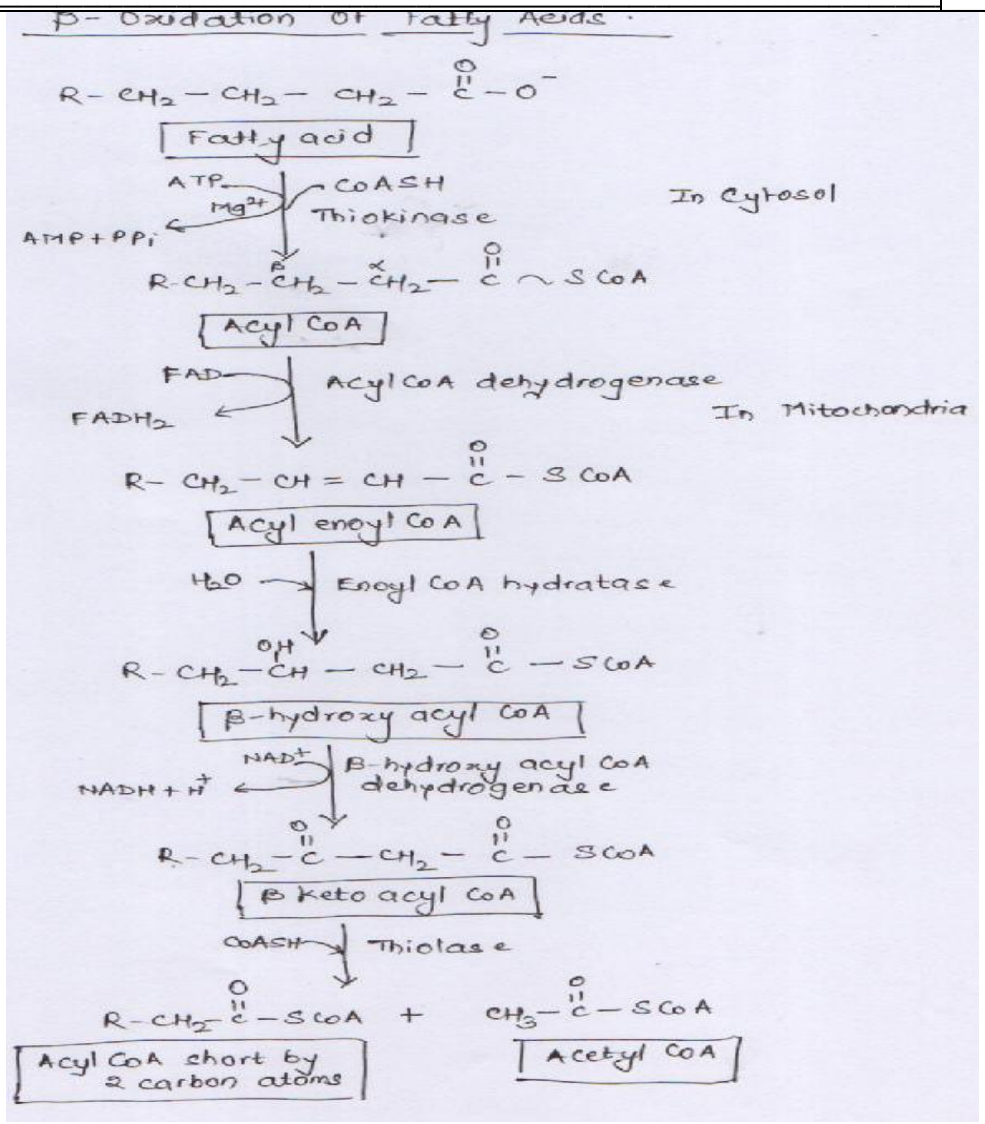
5	c)	**Write biological role of calcium and give its deficiency disorders** Calcium is involved in: □ Formation & development of bones &teeth □ Muscle contraction □ Blood clotting □ Growth of children □ Transmission of nerve impulse □ Activation of enzymes □ Regulation of permeability of membranes □ Release of hormones □ Cell to cell contact & adhesion of cells in a tissue □ Calcium acts on myocardium & prolongs systole. **Deficiency of Calcium** 1. Hypocalcemia:- When the plasma conc. Of calcium is below normal is called Hypocalcemia. 2. Rickets :- it is due to faulty calcification of bones in children 3. Osteomalacia:- Due to the inadequate diet and limited exposure to sunlight. This disease found in adults 4. Renal Rickets :- Reabsorption of calcium and activation of vit D does not take place. 5. Osteoporosis:- Decalcification of bones	**2M for any 4 functions + 1M any 2 deficiency disorders**
5	d)	**Explain structure of Starch.** Explanation: Starch is homopolysaccharide of D-glucose, it is widely distributed throughout the vegetable kingdom occurring in grains, fruits and tubers. On complete hydrolysis yields glucose. The two major constituents of starch granule, amylose and amylopectin differ in molecular structure. Amylose is linear or unbranched chain of d – glucose molecules, while amylopectin is branched.in partial structure. The glucose units are joined by the alpha 1- 4 linkages. Only the alpha 1- 4 linkages are present in amylose whereas in addition to the alpha 1- 4 linkages, the alpha 1- 6 linkages are also seen in amylopectin. (Partial structure can also considered for few marks). Amyloses are water soluble and amylopectin are water	**Expl. 1 M + Struct. 2M**

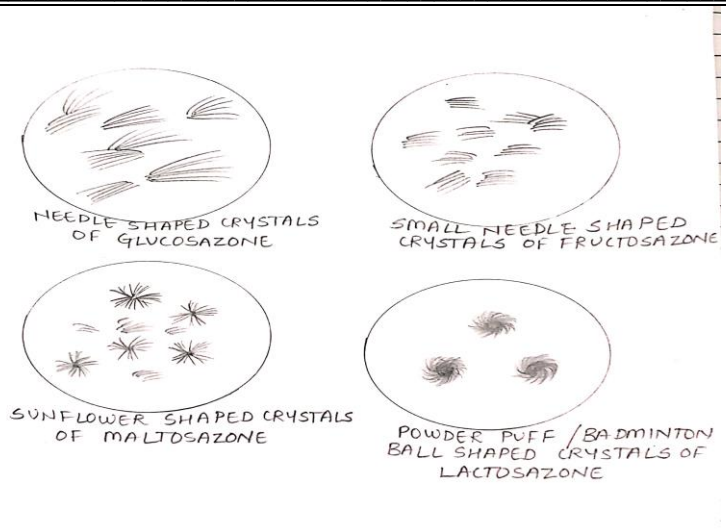
		insoluble.  	
5	e)	**What is Anemia? Give its types and explain Megaloblastic anemia** **Anemia** occurs when the number of healthy red blood cells (RBCs) decreases in the body. Red cells carry oxygen to all the body's tissues, so a low red blood cell count indicates that the amount of oxygen in the blood is lower than normal. **Types of anaemia:** Pernicious anaemia Megaloblastic anaemia Sickle cell anaemia: Iron deficiency anaemia: Aplastic anemia: Haemorrhagic anaemia: Haemolytic anaemia:	**1M for Def.** **1 M Types** **Expl. 1M**

		Megaloblastic Anemia- Megaloblastic anemia is a blood disorder having unusually large, structurally abnormal, immature red blood cells .These red blood cells do not function like healthy red blood cells. Causes: Deficiencies of folic acid, or vitamin B12. Alcohol abuse, chemotherapy, certain medications, and some genetic conditions. Symptoms : Fatigue, muscle weakness ,loss of appetite/weight loss, tingling in hands and feet, numbness in extremities Treatment for Megaloblastic anemia • Vitamin B_{12} &/or Folic acid supplements • Diet with more vitamin B_{12}.,Folic acid	
5	**f)**	**Name protein deficiency disorders? Explain any two** The protein deficiency diseases are:- Kwashiorkar Marasmus Nutritional edema Kwashiorkar-It is predominantly found in children between 1-5 yrs. It is due to insufficient intake of proteins as the diet of a weaning child consists of carbohydrate. Symptoms: Stunted growth, Edema on legs & hands, Diarrhoea , Discoloration of hair, skin, Anemia , Apathy, Moon face, Decreased plasma albumin concentration. Treatment: Protein rich food. Marasmus- Occurs in children below 1 yr age. Symptoms: Growth retardation, Muscle wasting, Anaemia , Weakness, No edema ,No decreased concentration of plasma albumin Treatment: Mother's milk. Nutritional Edema- Results from long continued deprivation of proteins & usually occurs in	**1M for Names + expl. of any two, each 1M**

		famine areas. This Protein deficiency in adults is very rare. Symptoms: Weight loss, General lethargy, Frequent loose stools, Delay in wound healing, Edema Treatment: Food items like soyabean, milk, eggs.	
6		**Attempt any FOUR of the following:**	**4×4=16M**
6	**a)**	**Define Lipids and give classification of lipids** The lipids are a large and diverse group of naturally occurring organic compounds that are related by their solubility in non-polar 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 compounds which are chemically esters of fatty acids. **Classification:** **Simple lipids:** Esters of fatty acids with alcohol. • Fats & oils: Castor oil • Waxes: Bees wax **Compound Lipid** • Glycerophospholipids., Sphingophospholipids, Glycolipids:. • Lipoprotiens: Contain protiens • Sulpholipids • Aminolipids **Derived Lipids:** • Eg: Alcohols, Glycerol, Fatty acids etc **Miscellaneous Lipids:** • Eg : Carotenoids, Squalene. **Neutral Lipids:** • They are mono, di, triacyl glycerols, cholesterol, cholesteryl esters. (Schematic classification can be considered.)	**1 M Def.+ 3M for Class.**

6	**b)**	**Explain B- oxidation of unsaturated fatty acids.** Explain in brief 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 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. **OR**	**4M**

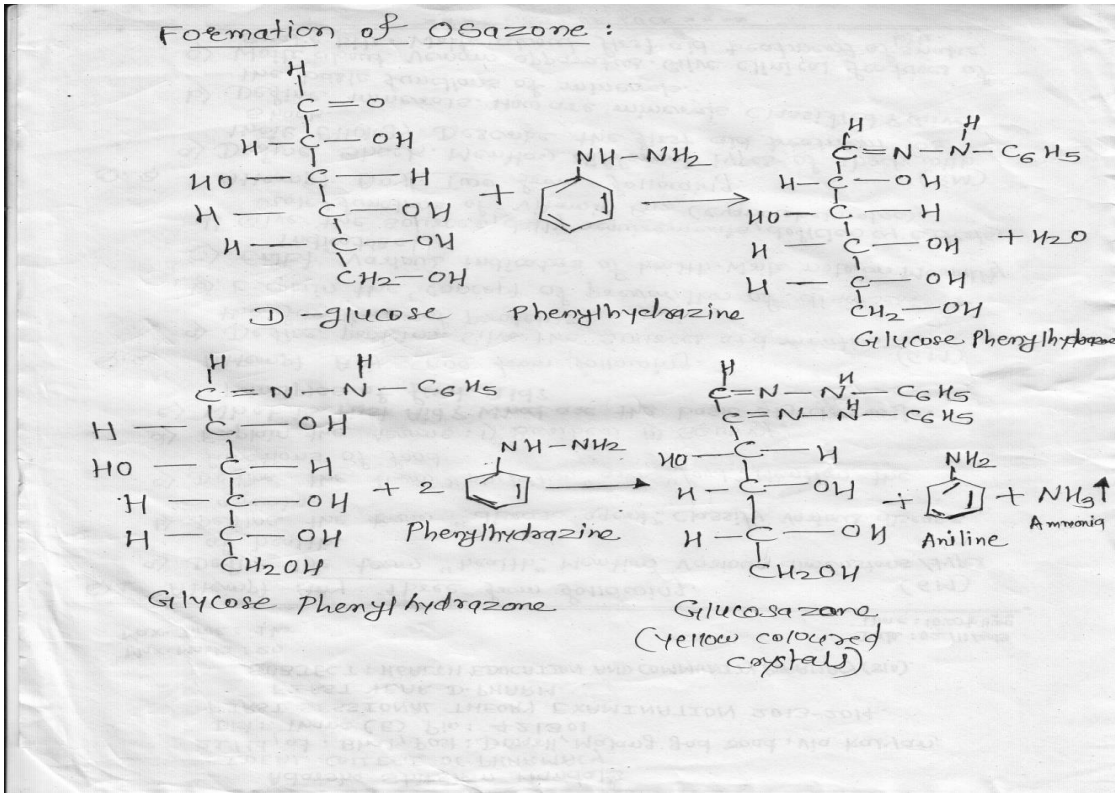
			
6	**c)**	**Draw shapes of various osazones of Carbohydrates and write reaction involved in Osazone formation of Glucose.** **Shapes of various Osazones of Carbohydrates**	**2 M for Shapes + 2M Osazone Reaction**



Reaction involved in Osazone formation of Glucose.

i. When reducing sugar (glucose) is treated with phenyl hydrazine, it gives reaction product (glucose) phenylhydrazone.

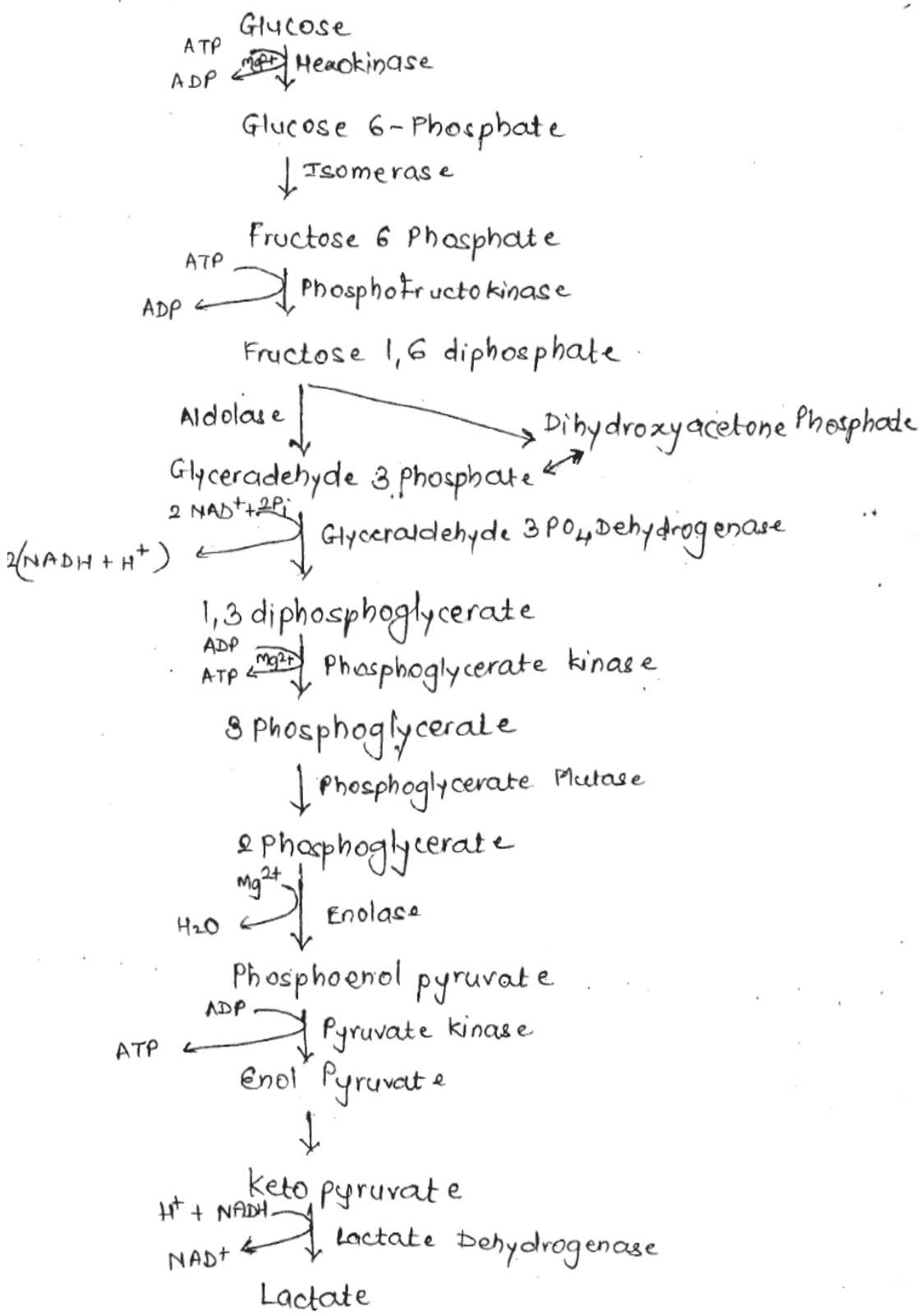
ii. Two molecules of phenyl hydrazine are heated again with (glucose) phenylhydrazone, it gives products like ammonia, aniline, (glucosazone) osazone.



(Explaination or Digramatic representation can be considered)

6	d)	**Describe the steps involved in Glycolysis and give its energetic.** (Detailed diagrammatic representation can be considered for 3 marks) It's a main pathway for glucose oxidation 1. Phosphorylation of glucose to glucose 6 phospate in preseceofenzyme 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 phosphofructokinase,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 → 2 Pyruvate + 2 ATP + 2 NADH + 2 H2O	**3M Cycle + 1M Energetics**

OR


Glucose
ATP
ADP
Mg2+
Hexokinase
Glucose 6-Phosphate
Isomerase
Fructose 6 Phosphate
ATP
ADP
Phosphofructokinase
Fructose 1,6 diphosphate
Aldolase
Dihydroxyacetone Phosphate
Glyceradehyde 3 phosphate
2 NAD+ + 2Pi
2(NADH + H+)
Glyceraldehyde 3PO4 Dehydrogenase
1,3 diphosphoglycerate
ADP
ATP
Mg2+
Phosphoglycerate kinase
3 Phosphoglycerate
Phosphoglycerate Mutase
2 Phosphoglycerate
Mg2+
H2O
Enolase
Phosphoenol pyruvate
ADP
ATP
Pyruvate kinase
Enol Pyruvate
Keto pyruvate
H+ + NADH
NAD+
Lactate Dehydrogenase
Lactate

Energetics of Glycolysis

Reaction	No. of ATP formed
Glucose → Glucose -6- Phosphate	-1
Fructose-6-Phosphate → Fructose 1,6-Diphosphate	-1
2 (Glyceraldehyde -3-Phosphate) → 2 (1,3 Diphosphoglycerate)	+6 (2×3)
2 (1,3 Diphosphoglycerate) → 2 (3 Phosphoglycerate)	+2
2 (Phosphoenol pyruvate) → 2 (Pyruvate)	+2
TOTAL ATP formation in Aerobic Glycolysis	08 ATP
2 (Pyruvate) → Lactate	-6 (2×3)
TOTAL ATP formation in Anaerobic Glycolysis	02 ATP

6 e) Describe biological role and deficiency disorder of Riboflavin and Folic acid — **Each 2M (2Pts. Of each functions & defic.)**

Riboflavin

A) Biological Function:-

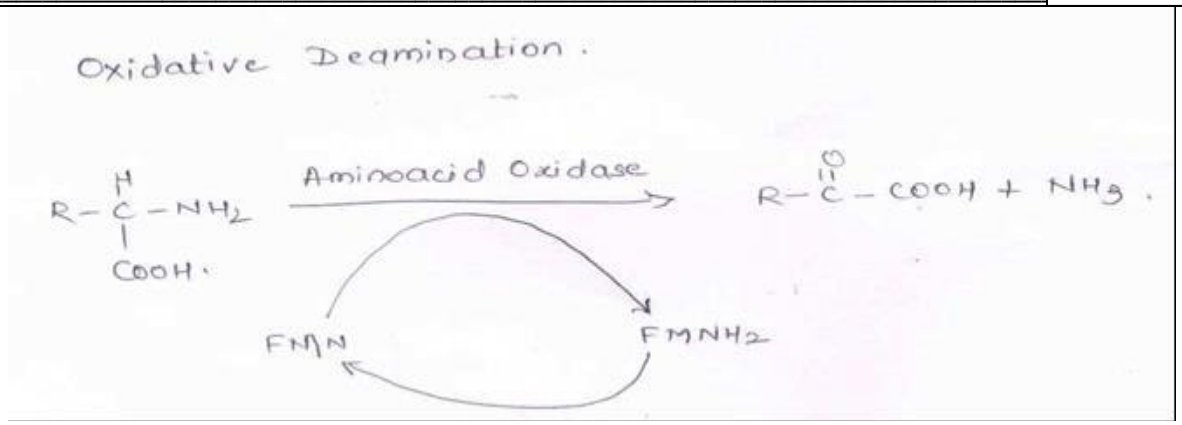
- Coenzyme-FMN (Flavin mononucleotide) & FAD (Flavin Adinine Dinucleotide), participate in redox reactions.
- They are involved in carbohydrate, lipid & protein metabolism
- Succinate dehydrogenase require FAD for its action
- Amino acid oxidase require FMN for deamination of amino acid

B) Deficiancies:-

CHEILOSIS- skin become rough dry & scaly, lips become bright red in colour & swollen

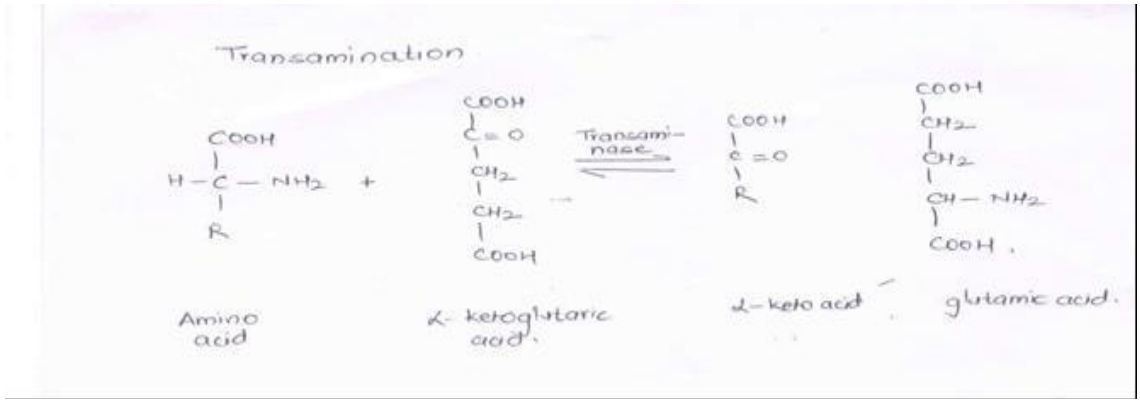
ANGULAR STOMATITIS corner of the lip are swollen & CRACKED

		GLOSSISTIS –tongue become enlarged & magenta in colour **Folic Acid** Biological Functions: Folic acid is used in the treatment of anaemia due to folic acid deficiency. □ Tetrahydrofolate, coenzyme of folic acid is involved in one carbon group transfer reactions. □ It is involved in biosynthesis of nucleic acid. □ It is involved in synthesis of amino acids like methionine, serine □ It is essential for growing & multiplying cells. □ Folic acid is required for synthesis of RBC in bone marrow. Deficiency: Its deficiency causes destruction of Intestinal bacteria. Macrocytic Anaemia Megaloblastic Anaemia Retarded growth Infertility Inadequate Lactation in Female	
6	**f)**	**Explain "oxidative deamination" and transamination of Amino acids.** **Oxidative deamination** An amino acid is converted into the corresponding keto acid by the removal of the amine functional group as ammonia and the amine functional group is replaced by the ketone group. The ammonia eventually goes into the urea cycle. The main sites for this reaction are liver and kidney. The reaction is catalyzed by amino acid oxidase enzymes. Importance: It provides ammonia for urea synthesis and alpha keto acid for variety of reactions including energy generation. Reaction:	**1M for Explanation or Reaction 1M Importa**



Transamination of Amino acids:

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