MODEL ANSWER

SUMMER– 17 EXAMINATION

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 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.

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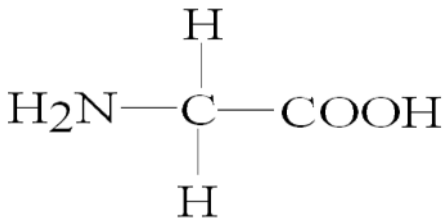
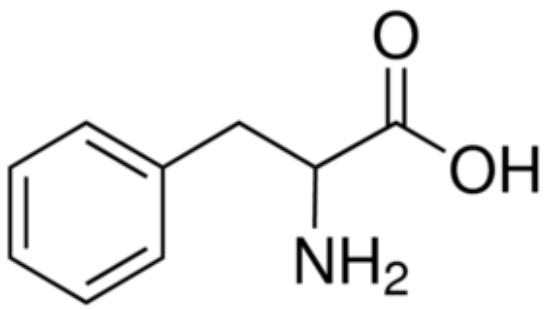
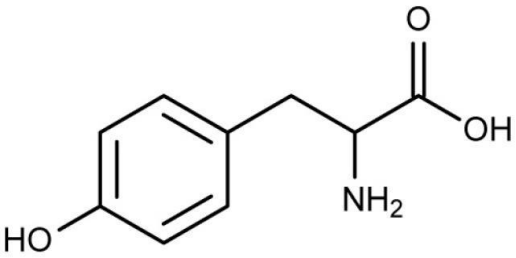
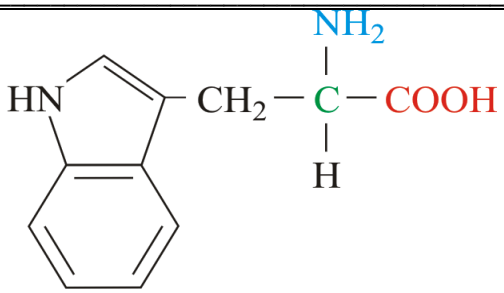
Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Solve any EIGHT of the following:**	**8×2=16**
	a)	**Define Biochemistry. State the importance in pharmacy.** Biochemistry -The study dealing with the chemistry of living organism in its different phases of activity is called as biochemistry. Significance:(Any 2) 1) It deals with study of living system and its working. 2) Study of nature and working of biomolecules. 3) Diagnosis of various metabolic disorder. 4) Study of various deficiency diseases. 5) Helps in synthesizing new molecules.	1 M Def. 1M imp.
	b)	**Give functions of mitochondria& endoplasmic reticulum.** i) Mitochondria Mitochondria are engaged in oxidative metabolism, and are responsible for the transportation of chemical energy into biological energy, in the form of ATP compounds. All enzymes involved in Kreb's cycle are present in mitochondria. ii) Endoplasmic reticulum : • Give mechanical support, by forming skeletal network. • Involves in the intracellular transport. • Involves in the cellular metabolism. • Carries protein synthesis, ATP synthesis, etc.	1 M each

	c)	**Give the structure of optically inactive amino acid & any one aromatic amino acid.**  glycine Optically inactive amino acid **Any one of these examples for aromatic amino acid:**  Phenylalanine  Tyrosine	1 M for each



Tryptophan

d) **What is non-reducing sugar? Give suitable examples.** — 1.5 M for Exp^{n}

Non reducing sugar

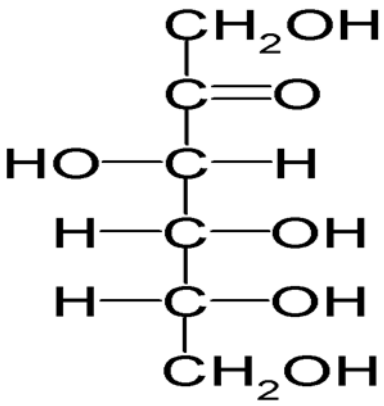
Carbohydrate without free & potential carbonyl function(aldehyde or ketone group) is called as non-reducing sugar — 0.5 M for e.g.

It gives Fehlings, Benedicts ,Tommers and Osazone test negative

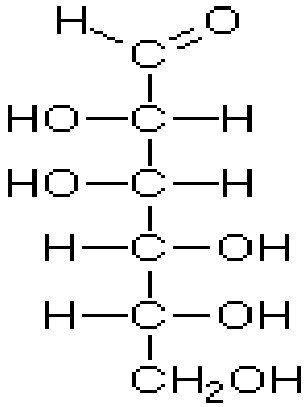
Eg, Sucrose,

e) **Give the structure of D-Fructose & D-Mannose.** — 1 M each

D-Fructose



D-mannose



	f)	**Differentiate between peptide linkage & glycosidic linkage.** A peptide linkage or bond (amide bond) is a covalent chemical bond linking two consecutive amino acid monomers along a peptide or protein chain. This linkage is strong. Amino group of an amino acid combines with the carboxylic group of another amino acid & a peptide bond is formed A glycosidic bond or glycosidic linkage is a type of covalent bond that joins a carbohydrate (sugar) molecule to another group, which may or may not be another carbohydrate. A glycosidic bond is formed between the hemiacetal or hemiketal group of a saccharide (or a molecule derived from a saccharide) and the hydroxyl group of some compound such as an alcohol. Glycosidic bonds are found in sugar molecules and peptide bonds are found in peptide chain or protein molecule.	2 M.
	g)	**Define essential & non- essential fatty acid with example.** i) Essential fatty acids.(At least 2 examples) The unsaturated fatty acids which are not synthesized in the body and are required for the normal growth of body are called as essential fatty acids. e.g. Arachidonic acid, linoleic acid, linolenic acid.etc ii) Non-essential fatty acids. (At least 2 examples) The saturated fatty acids which are synthesized in the body and containing only single bond are called as nonessential fatty acids. e.g. palmitic acid , stearic acid, arachidic acid. etc	1 M each
	h)	**Give symptoms due to deficiency of ascorbic acid.** Symptoms weakness, pain in bones and joints , loosening of teeth, poor healing of wound, internal hemorrhage, swelling of long bone, Easy facturability of bones	2 M

		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. • In advanced scurvy there are open, suppurating wounds and loss of teeth, sluggish hormonal function of adrenal cortex, swollen joints, and osteoporosis.	
	i)	**What are co-enzymes & name coenzymes derived from i) Vitamin B_1 ii) Vitamin B_3.** Co enzymes are the organic molecules often derived from vitamin B complex group that participate directly in enzymatic reaction. Many enzymes catalyze the reactions only in presence of specific non protein organic molecules called the co enzyme. i) Vitamin B_1 TPP (Thiamine pyrophosphate) ii) Vitamin B_3 NAD(Nicotinamide adenine dinucleotide) or NADP(Nicotinamide adenine dinucleotide phosphate)	1 M Def. 1 M Coenzy.
	j)	**Define & classify Vitamins.** The naturally occurring micronutrients present in food and are required for normal functioning and growth of the living organisms are called as a Vitamins. Classification • Fat soluble vitamins: these are soluble in fat and are stored in liver. e.g. Vitamin A, Vitamin D, Vitamin E and Vitamin K • Water soluble vitamins: These are soluble in water and are not stored in body. e.g. Water soluble vitamin includes B-complex group (B_1, B_2 , B_3, B_5, B_6,B_{12}) and Vit C	1M def. 1 M class^n

	k)	**Give biological functions of calcium.** Calcium plays important role in: • Formation & development of bones & teeth • Muscle contraction • Blood clotting • Growth of children • Responsible for transmission of nerve impulse • Activation of enzymes • Regulation of permeability of membranes.	Any four 2 M
	l)	**Write deficiency disease of Iron & Potassium.** Iron: Iron deficiency anaemia: It's a nutritional disorder. It is characterized by microcytic hypochromic anaemia. It may be due to inadequate intake, defective iron absorption, chronic blood loss, hook worm infections, and repeated pregnancies. Potassium: Hypokalemia: Decrease in concentration of serum potassium is due to over activity of adrenal cortex(Cushing's syndrome),prolonged cortisone therapy, prolonged diarrhea & vomiting, I.V. administration of potassium free liquids, treatment of diabetic coma with insulin	1 M each

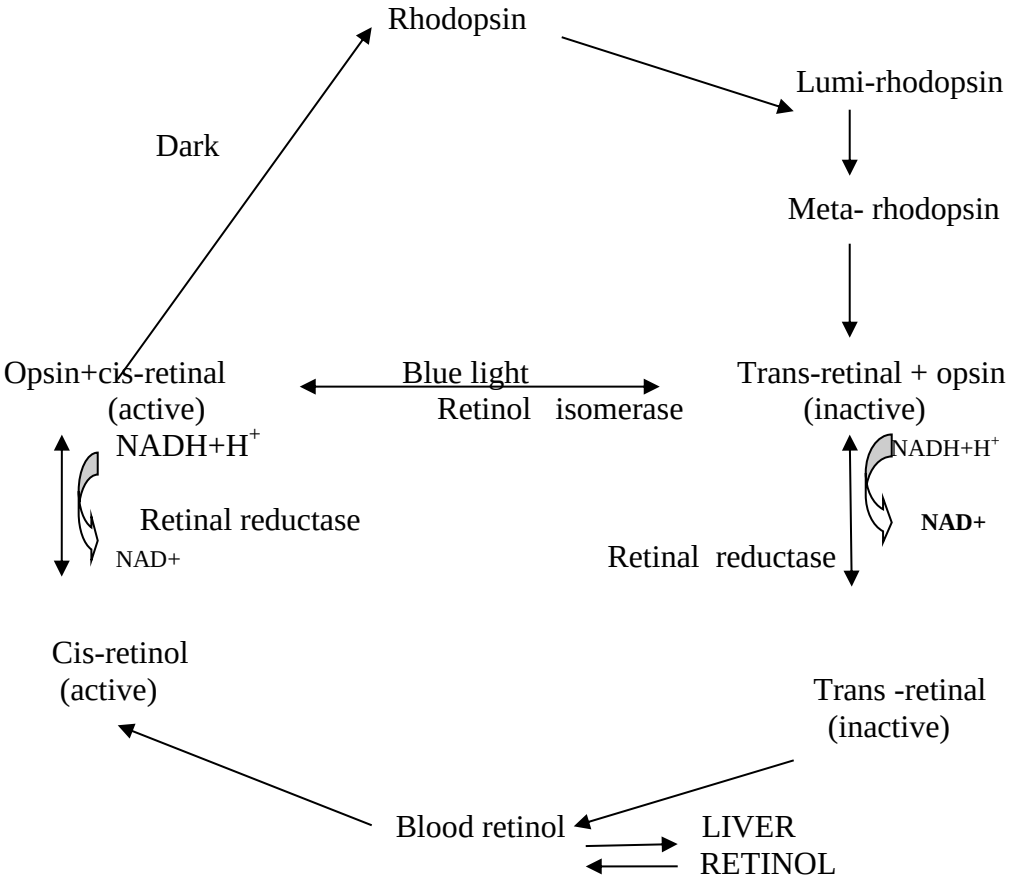
2		**Solve any FOUR Of the following:**	**4×3=12**
	a)	**Define & classify amino acids with examples.** Amino acids- these are a group of organic compounds containing two functional groups, amino group and carboxyl group. These are basic units of proteins Classification of amino acids: **1) Neutral amino acid** (a) Aliphatic amino acids: e .g. Glycine, Alanine (b) Aromatic amino acids: e. g. Phenyl alanine, tyrosine (c) Heterocyclic amino acids/Imino acids e. g. Proline, Hydroxy proline (d) Sulphur containing amino acids: e.g. Cysteine, Methionine. (e) Amino acid containing hydroxyl group: e.g. Serine, Threonine **2) Acidic amino acids:** e.g. Aspartic acid, Aspargine. **3) Basic amino acids:** e.g. Arginine, Lysine **Classification based on polarity or based on nutritional value with all examples can also be considered**	**1M def.** **2 M class^{n}**

	b)	**Define Proteins. Mention biological functions of Proteins.** Proteins are the naturally occurring highly complex compounds of amino acids joined together with peptide linkage (-CONH-) Functions: 1] Some proteins act as hormones and hence regulates 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 act as oxygen carrier in mammals. 5] Some blood proteins help to form antibodies which provide resistance to disease so called as antibodies or defense proteins. 6] Nucleoproteins act as carrier of genetic characters. 7] Muscle Proteins carry out mechanical work	**1 M def.** **2 M** **Any 4** **Functions**
	c)	**Define & classify carbohydrates with examples.** Carbohydrates are defined as polyhydroxy aldehydes or ketones or compounds derived from their hydrolysis. Classification- **1) Sugars (saccharides)-** a) Monosaccharides (depending upon number of carbon atom, it is subdivided in following types) i) Trioses-e.g. D-Glycerose	**1M def.** **2 M class^{n}**

		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 (polysaccharides)** i) Homopolysaccharides-e.g. starch, cellulose. ii) Heteropolysaccharides e. g. hyaluronic acid **Schematic representation can also be considered**	
	d)	**Explain Rhodopsin cycle for vision.** 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 coverted 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.	**1.5 dig.** **1.5 exp^{n}**

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.



e) Explain Water balance of normal individual. **1.5 M Expl^{n}**

(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 sand a loss of 20% is fatal. **1.5 M Table**

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

Water intake	Ml	Water loss	Ml
Drinking water	1500ml	Urine	1500ml
Solid food	1000ml	Faeces	100ml
Oxidation of carbohydrates Fats, Proteins	300ml	Skin	800ml
		lungs	400ml
Total	2800ml	Total	2800ml

	f)	**Discuss diagnostic & therapeutic applications of enzymes.**	**1.5 each**

Diagnostic Applications:

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. such enzymes are called 'marker enzyme'.

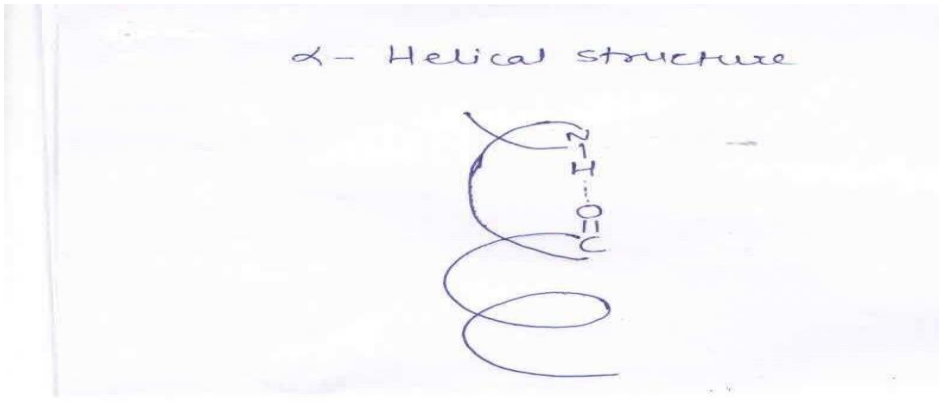
In disease condition level of these enzymes increases in blood or in other body fluids, hence we can identify the disease.

- The level of SGOT rises rapidly after a heart attack.
- The level of SGPT increases in infectious hepatitis
- Activity of Creatine-kinase increases in the plasma, during infection in cardiac muscle.

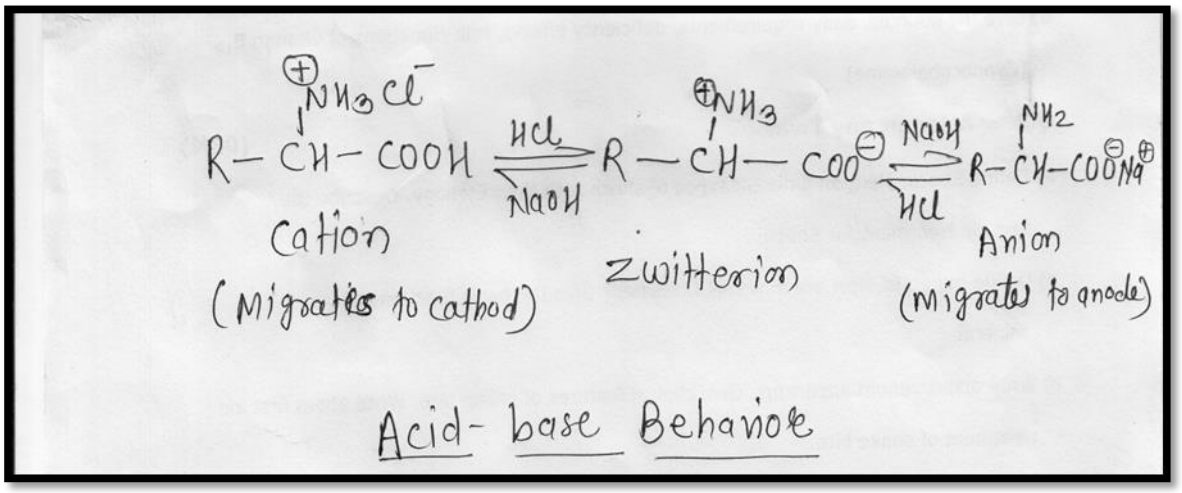
Therapeutic Significance of enzymes (Any 3 can be considered for 1.5 M)

- Trypsin: Purified enzyme is used orally or parenterally or intramuscularly in treatment of acute thrombophlebitis
- Streptokinase: Bacterial enzyme causes fibrinolysis & dissolution of clot.
- Pepsin is used in treatment of gastric achylia
- Lysoenzyme useful in treatment of eye infection
- Galactosidase useful in treatment of lactose intolerance.
- Sulphanilamide because of its similarity with PABA competes with it & inhibits enzyme folic acid synthatase & selectively kills pathogenic organisms.
- Allopurinol acts as competitive inhibitor of xanthin &reduces its conversion to uric acid .So it is useful in treatment of gout.

Other correct related examples can be considered

3		**Solve any four of the following**	**4×3=12**
	a)	**Explain α helix structure of protein** 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 4^{th} amino acid residue along the chain 	**3M With Diagm.**
	b)	**Explain acid base behavior of amino acids.** i. Amino acids are amphoteric in nature ii. The amino group (NH_2) can accept proton (H^+) and form cation (NH_3^+). iii. The carboxyl group can donate H^+ and for 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. 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 .	**1.5M Expln & diagm Each**

viii. At the Isoelectric pt that amino acid becomes insoluble and precipitates out.



c) **Explain Mutarotation with examples**

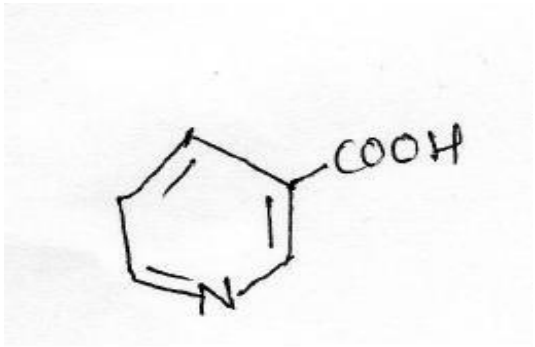
Mutaroation: Change in specific rotation on standing aqueous solution of sugar is known as mutarotation.

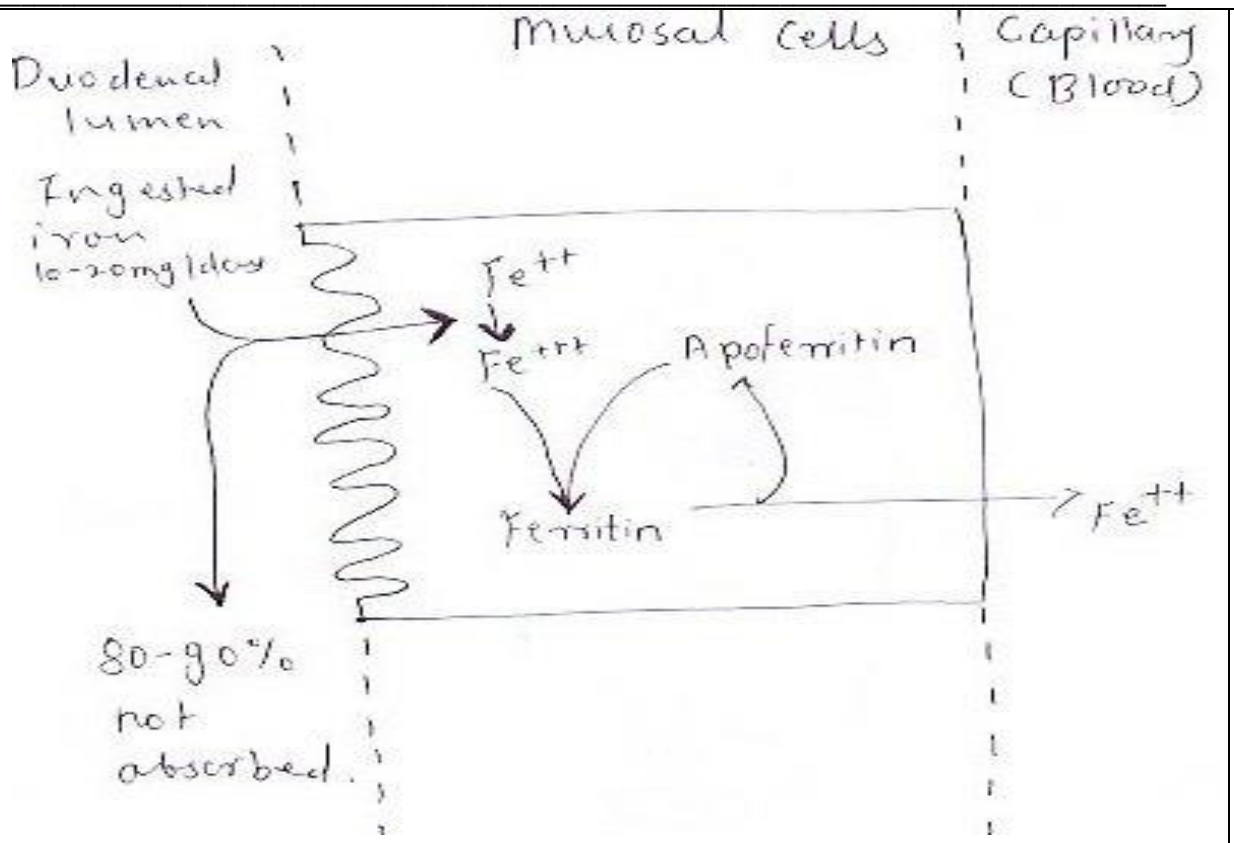
When monosaccharide (glucose) is dissolved in water, its optical rotation gradually changes until it reaches a constant value, for eg. Freshly prepared solution of alpha D- glucose has a specific rotation of $+112^0$ and on standing specific rotation falls to $+52.5^0$ and remains constant at this value. 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. **3M**

Fresh solution of beta D-glucose has rotation value of +190 which on standing also changes to +52.50For example:

α—D—Glucose → D—Glucose ← β—D—Glucose.

$(+112^0)$ $(+52.5^0)$ $(+19^0)$

	d)	**Give structure, biochemical role and deficiency disease of Nicotinic acid.**  **Biochemical role :** • Helps in maintaining healthy skin, healthy nerves & healthy digestive system. • Reduced coenzyme helps in production of high energy compounds like ATP. • $NADP^+$ helps in pentose phosphate pathway. • NADPH is involved in biosynthesis of fatty acids **Disease**: **Pellagra** is a vitamin deficiency disease caused by dietary lack of niacin	**1m** **Stru.** **1.5 m** **Role** **0.5 m** **disease**
	e)	**Explain Mucosal block theory of iron absorption.** Mucosal block theory of iron absorption. Ferrous Fe2+ forms chelate with ascorbic acid,sugar& amino acids & remains 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.	**1.5m** **Expln** **&** **Diagm** **each**



f) **What is physiological urine? Mention abnormal constituents of urine and their significance in disease.** **1Mdef.**

2M expl.

Physiological urine: Urine that contains normal organic and inorganic substances is called as physiological urine or normal urine.

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

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

4. **Solve any Four of the Following** **4×3=12**

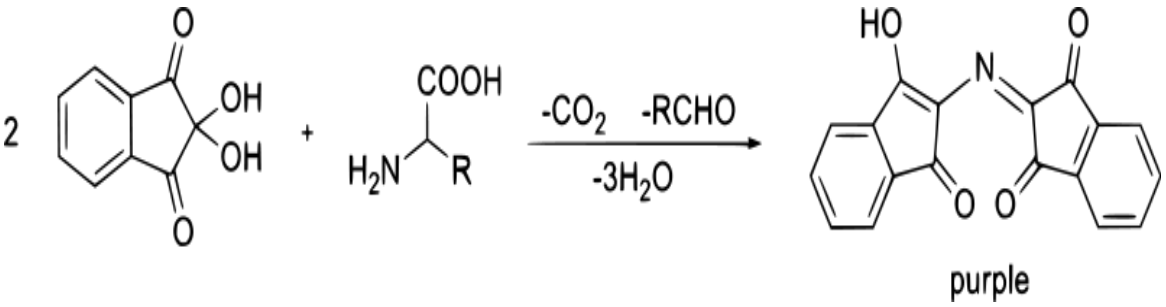
a) **Explain following reactions**

i)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. **1M each**

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)

ii)Ninhydrine test: In acidic condition amino acid reacts with ninhydrin to give blue to violet colour, at 60-70 ^{0}C.

(Reaction is optional)



Ninhydrin **Amino acid**

A deep blue or purple color known as Ruhemann's purple is evolved. It's an identification test for amino acids

iii)Xanthoproteic test:

Principle: It is based on nitration of aromatic ring which shows color change when treated with NAOH.

Procedure: test solution + conc. HNO3+ boil test tube add NAOH to make alkaline drop by drop. Yellow color appear which changes to orange on addition of NAOH.

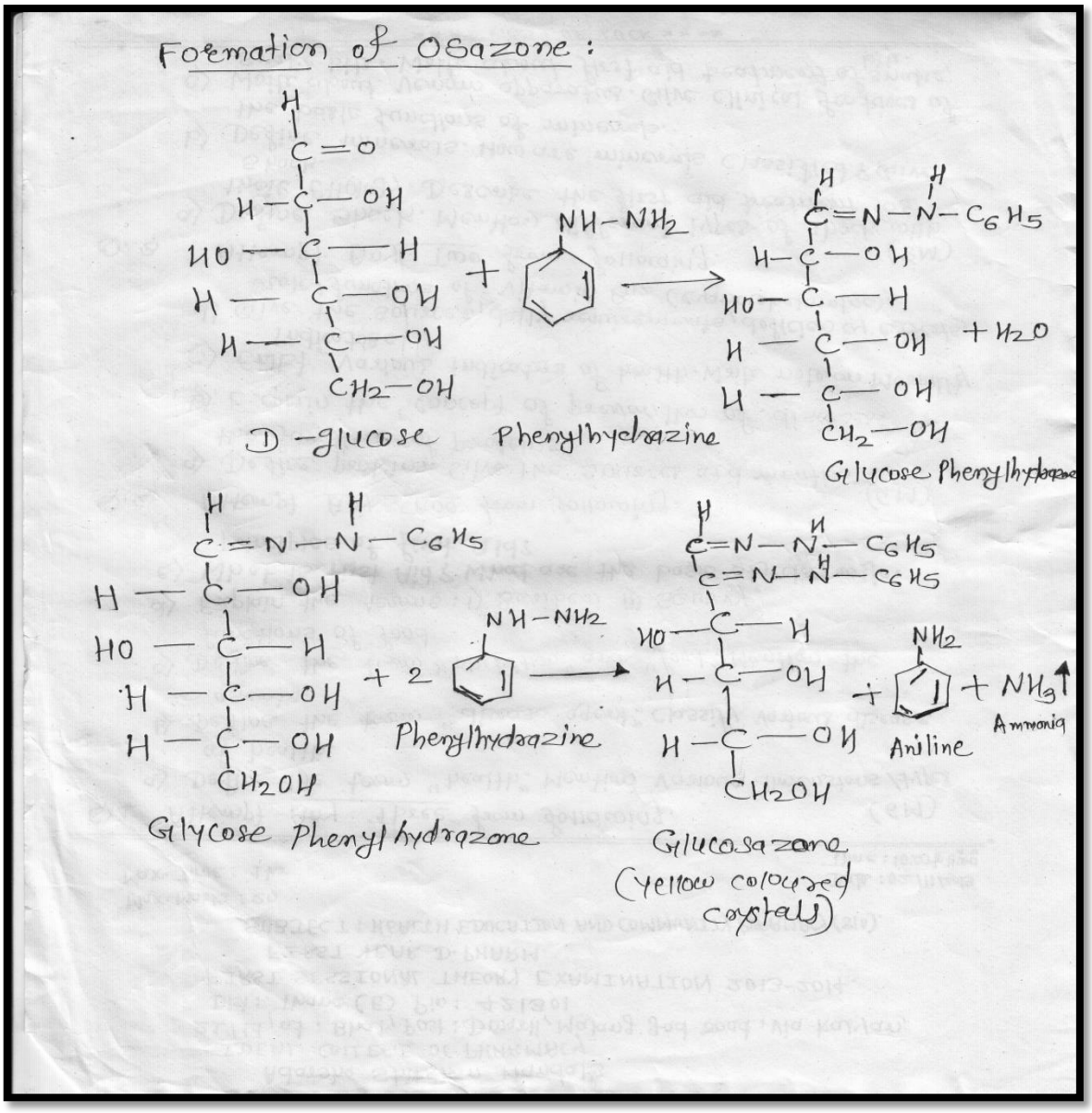
Indicates presence of aromatic amino acids

b) **Explain the osazone reaction of carbohydrate with their significance.** **2M**

Explanation: **Expln**

i. When reducing sugar (glucose) is treated with phenyl hydrazine, it gives reaction product (glucose) phenylhydrazone. **1M**

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



Significance:

i. Osazone test helps to differentiate reducing sugars from non reducing sugars like starch, dextrin, sucrose.

ii. It also helps in differentiating particular type of reducing sugars.

It is used to identify and confirm reducing sugars, e.g. glucose, fructose, galactose, maltose, lactose

	c)	**Explain the following term with their significance** **i) Acid value:** It is the number of milligram of KOH required to neutralize the free fatty acids present in 1 gram of fat or oil. Free fatty acid content increases due to action by lipase from microbial growth **Significance**: It indicates degree of the rancidity. **ii) 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	**1.5 M each**
	d)	**Name the vitamins, deficiency of which leads to** i) Beri Beri Vit B1(Thiamin) ii) Egg White injury Vitamin H (Biotin). (iii) Rickets Vitamin D (Calciferol) (iv) Pernicious anaemia Vitamin B12 (Cyanocobalamine). (v) Scurvy Vitamin C (Ascorbic acid) vi) Blood clotting disorder Vitamin K	**0.5M each**
	e)	**Define enzyme and classify enzymes with examples** 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	**1M defn** **2M** **Classfn.**

• 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.

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

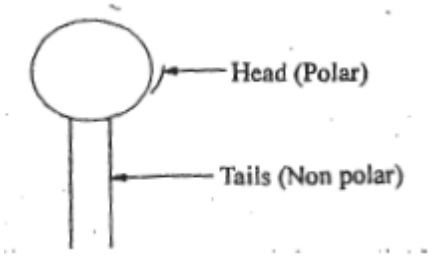
• **Hydrolases:**

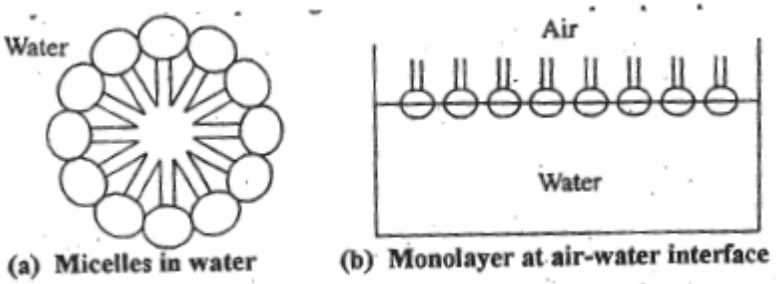
Bring about hydrolysis or condensation of substrate by addition or removal of water.
Eg. Esterases, Peptidases

		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 .	
	f)	**What are abnormalities of red cells? Explain.** **1)Anaemia:** Decrease in oxygen carrying capacity of blood can be called as anaemia. It depends on haemoglobin content of erythrocytes . Reduction in blood haemoglobin level & number of circulating erythrocytes indicates anaemia. Types of anaemia: **Pernicious anaemia** In this type of anaemia essential factors are absent which are required for the formation of RBC. So RBC count is decreased .	**2M** **Anaemia** **1m** **Polycythemia**

		Sickle cell anaemia: It is a genetic disorder, in this the bone marrow produce abnormal type of Hb. The shape of a large no. of red cells is like a sickle cell Patients with sickle cell show marked susceptibility to infection . **Iron deficiency anaemia:** Due to inadequate absorption of iron, excessive loss of iron, insufficient intake of iron **Aplastic anemia:** It is due to destruction of red bone marrow **Haemorrhagic anaemia:** Excessive bleeding due to large wounds,ulcers, heavy menstruation **Haemolytic anaemia:** Due to premature rupture of RBC plasma membrane **2) 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	
5.	**a)**	**Solve any four of the following.** **Explain the diseases caused by dietary deficiency of proteins.** Kwashiorkor Marasmus Nutritional edema	**4x3=12** 1M each

		Kwashiorkor 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, Diarrhea , 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 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.	
b)		**Describe glycogen storage disease and Diabetes Mellitus.** **i) Glycogen storage diseases:** Glycogen storage disease (GSD, also glycogenosis and dextrinosis) is the result of defects in the processing of glycogen synthesis or breakdown within muscles, liver, and other cell types.	1.5M Each

		Glycogen storage disease has two classes of cause: genetic and acquired. Genetic GSD is caused by any inborn error of metabolism (genetically defective enzymes) involved in these processes. Acquired GSD is caused by intoxication with a particular alkaloid To name a few: I) von Gierke's disease ii) Pompe's diseases iii) Cori's disease iv) Hers' disease **i)Diabetes mellitus** –It is a metabolic disorder in which body is unable to utilize the glucose. It is characterized by hyperglycemia, glucosuria, polyuria, polydipsia ,polyphagia, ketosis, loss of weight, light color of urine Types of DM Insulin dependent diabetes mellitus Non Insulin dependent diabetes mellitus	
c)		**Explain role of lipids in biological membrane.** Phospholipid is a type of lipid .The major component of biological membrane is phospholipid. Phospholipid has 2 long chains of hydrocarbon of fatty acids. The chains are hydrophobic and have strong polar group i.e. phosphate at 3rd carbon of glycerol. When phospholipids are added to aqueous medium they form micelles, monolayer & bilayer, depending on the concentration of phospholipids. The hydrophilic & hydrophobic interaction of phospholipids is forming bilayer in water. Hydrophobic tails are hidden from aqueous environment and form an internal hydrophobic phase where as hydrophilic heads are exposed to the surface. Bilayer system of this type is extensively studied as model of natural membrane. 	1.5M Expln 1.5M Diagm



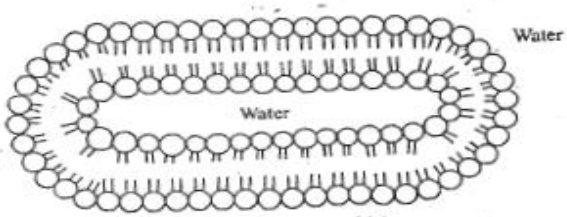


Fig. Phospholipid bilayer

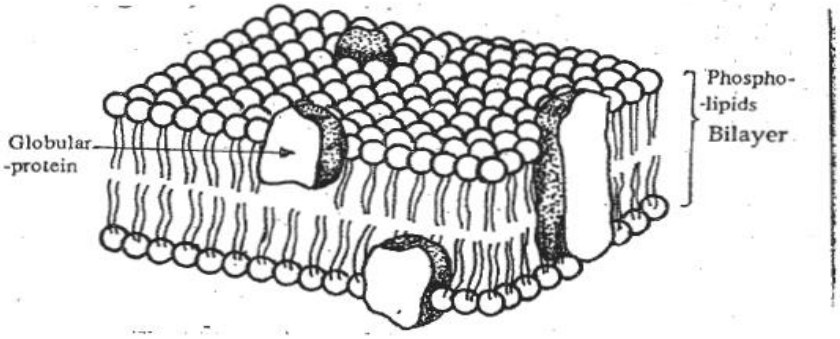


Fig. Fluid mosaic model of plasma membrane

Biomembranes are made up phospholipids lipoproteins, glycoproteins and proteins all these components are assembled together by non covalent interactions

d) **What are electrolytes? Explain functions of electrolytes.** 1.5M

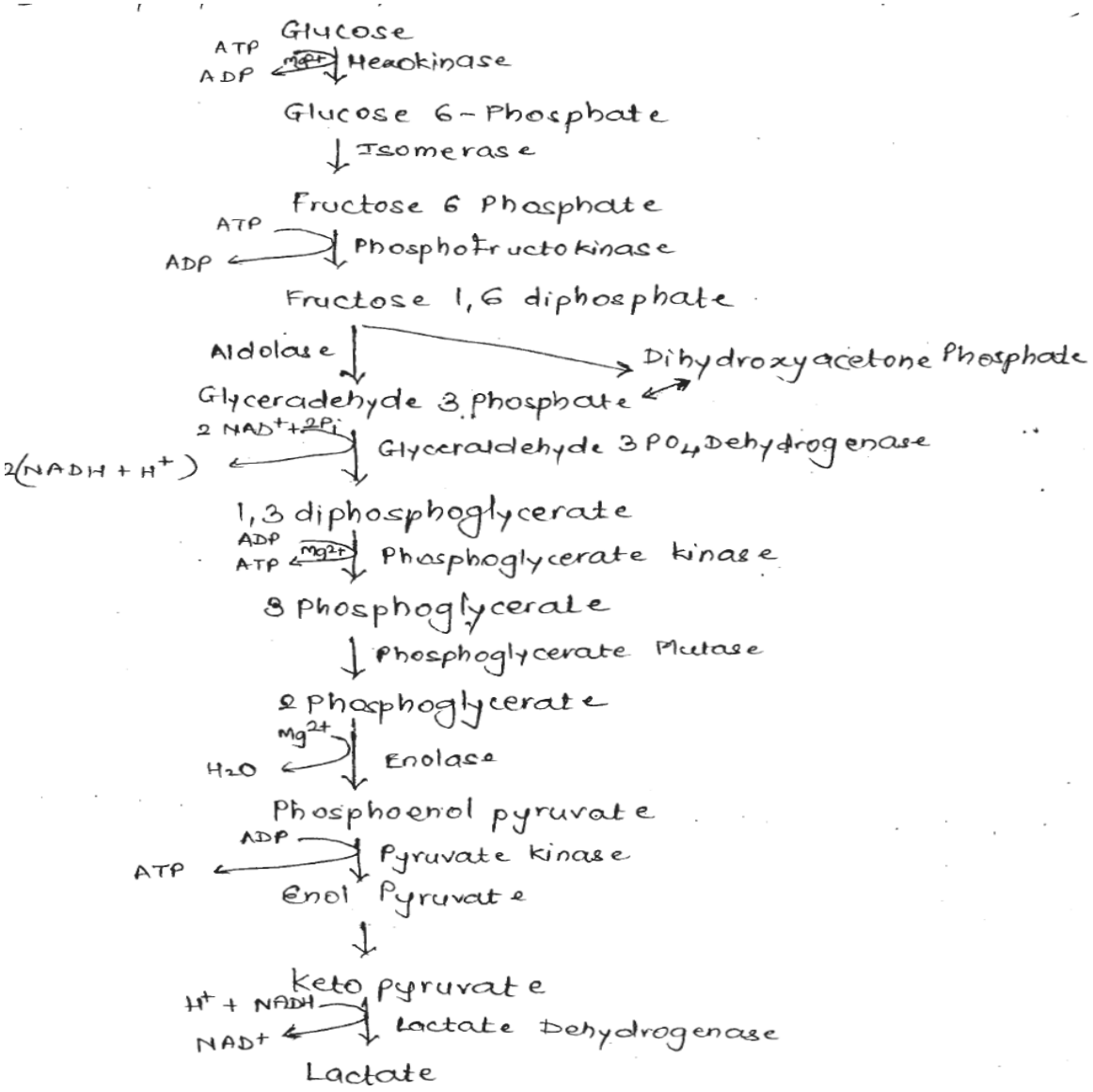
Electrolyte is a substance that ionizes when dissolved in suitable ionizing solvents such as water. Electrolytes affect the amount of water in your body. Expln

Common electrolytes include: Calcium, Chloride, Magnesium, Phosphorous, Potassium, Sodium 1.5M

Electrolytes can be acids, bases, and salts. Any 3 Funs.

		Functions of electrolytes: • Many of them are essential minerals e.g. sodium, potassium etc. They perform important role in our body. • Minerals maintain acid base balance, required for normal cellular activities. • Electrolytes control osmosis & hence volume of various body fluids. • They carry electrical current that allows production of action potential & gradient potential required for nerve impulse transmission	
	e)	**What is enzyme inhibition? Explain Competitive and noncompetitive inhibition with examples.** Compounds or agents which inactivate the enzymes, & thus adversely affect the rate of enzyme catalyzed 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. Vmax is unchanged KM is increased. e.g. Enzyme inhibitors: Thiourea, Ephedrine **Noncompetitive Inhibition:** Here no competition occurs between the substrate (S) & the inhibitor (I). The inhibitor has little or no structural resemblance with the substrate & it binds with an enzyme at place other than active site. This binding impairs the enzyme function. In this inhibition the inhibitor generally binds with enzyme as well as ES complex. In this type of inhibition both EI & ESI complex formation take place. Vmax is lowered but KM value is unchanged. e.g. Enzyme inhibitors: Metal ion , EDTA	1M Defn 1M each expln

	f)	**What are lymphocytes? Explain role of lymphocytes in health and disease.** **Lymphocyte:** Lymphocytes are among agranulocytes (leucocytes/ WBCs). These have spherical nucleus and are nonphagocytic. Types: B –cells: These possess the capability to specifically recognize each antigen & produce antibodies (immunoglobulins) against it. T-cells: These can identify viruses and microorganisms from the antigens .They are responsible for cell- mediated immunity. Role in Health and diseases**:** ➢ These produce antitoxins and antibodies ➢ They help in healing of wounds. ➢ Increase in number of lymphocytes in blood (lymphocytosis) is observed in viral infection like Hepatitis A, Bordetella pertussis.	1.5M Each
6.		**Solve any four of the following:**	**4x4=16**
	a)	**What is E-M Pathway? Give steps involved in E M pathway.** **(Diagrammatic representation can be considered for 3 M)** E-M Pathway is Embden-meyerhof pathway. It is also called as Glycolysis Pathway. It is defined as the breakdown of glucose and glycogen to pyruvate and lactate, under aerobic and anaerobic conditions.	1+3M



It's a main pathway for glucose oxidation

1. Phosphorylation of glucose to glucose 6 phospate in presece ofenzyme 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

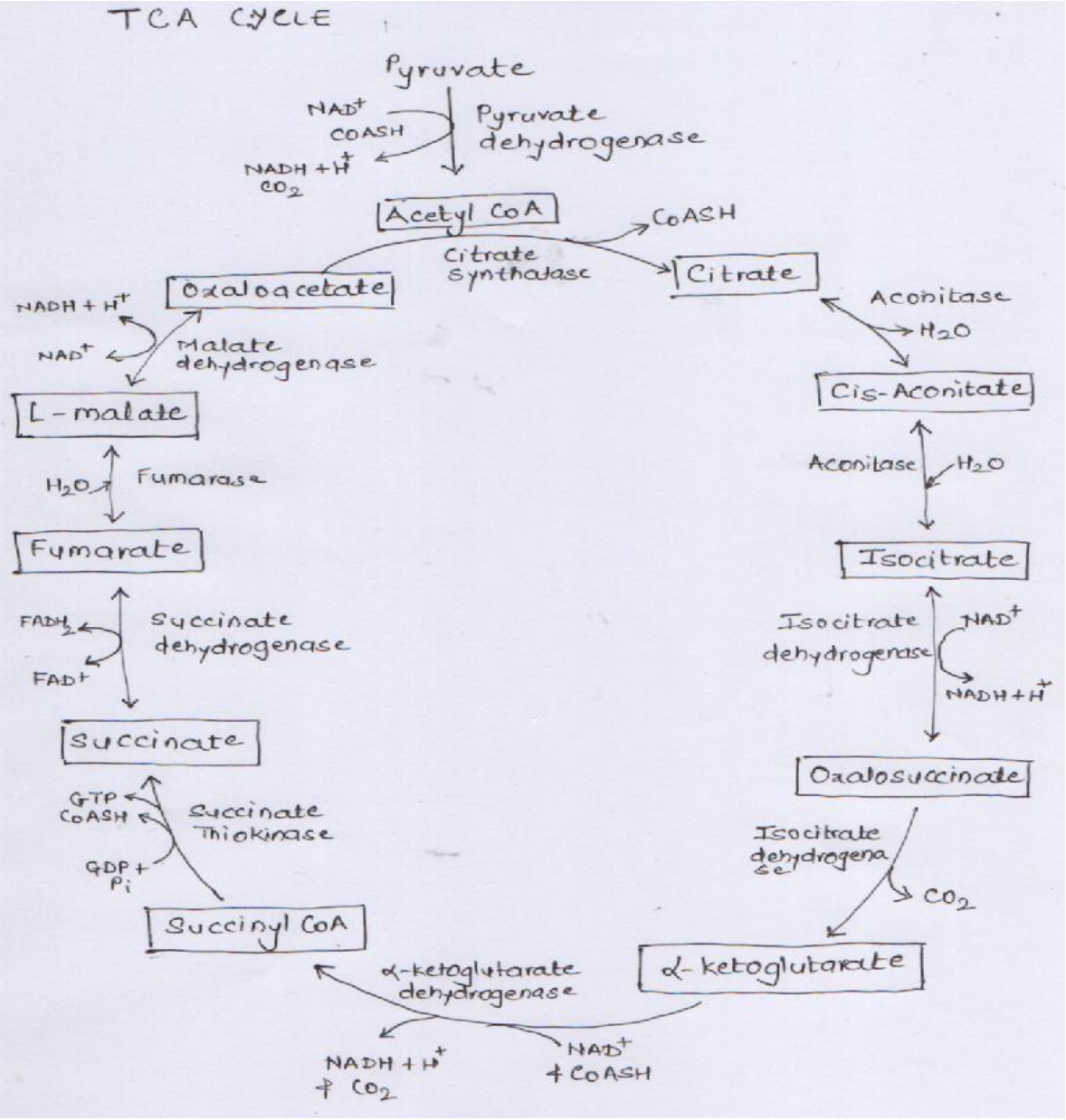
10. Enol pyruvic acid gets converted to keto form of pyruvic acid in presence of pyruvate kinase

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:

$$\text{Glucose} + 2\text{NAD+} + 2\ \text{ADP} + 2\ \text{Pi} \rightarrow 2\ \text{Pyruvate} + 2\ \text{ATP} + 2\ \text{NADH} + 2\ H_2O$$

	b)	**Discuss TCA cycle along with energitics.** **3M Cycle ,1M energetics** 	**3+1 M**

Energetics of TCA cycle

A total of 12 ATP are produced from one acetyl l CoA.

Reactions	No. of ATP formed
Isocitrate to oxalosuccinate	3
Alpha keto glutarate to succinyl Co-A	3
Succinyl Co-A **to** Succinate	1
Succinate to Fumarate	2
Malate to oxaloacetate	3
Total	12

Kreb's cycle: It's a central pathway for release of energy from acetyl CoA whch is produced from glycolysis, catabolism of fatty acids or amino acids

1. Condensation of acetylCoA obtained from pyruvic acid with oxaloacetate to form citric acid in presence of citrate synthatase

2. Conversion of citric acid to cis aconitate in presence of aconitase &fe2+

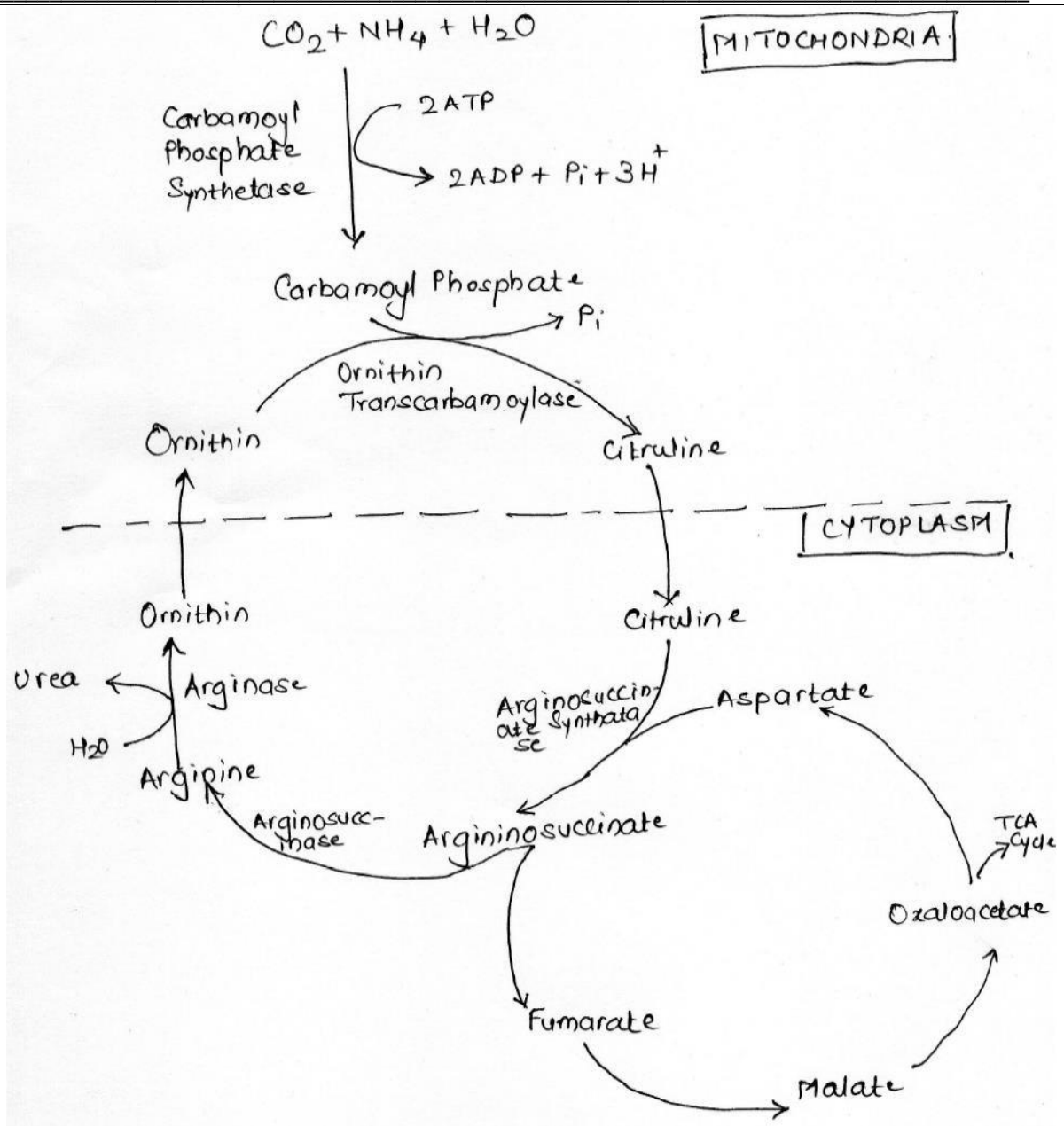
3. Cis acotinic acid accepts water to give isocitric acid in presence of acotinase & Fe2

4. Isocitric acid undergoes oxidation in presence of isocitric dehydrogenase & NAD+ to give Oxalosuccinic acid

5. Decarboxylation of oxalosucccinic acid to alpha ketoglutaric acid in presence of isocitri dehydrogenase, Mg/ Mn

6. Oxidative decarboxylation of alpha ketoglutaric acid to succinyl CoA in presence of alpha keto glutarate dehydrogenase, CoA-SH, NAD+, Mg

		7. Succinyl Coa gets converted to succinic acid in presence of succinate thiokinase, GDP, Mg 8. Succinic acid undergoes dehydrogenation in presence of succcinate dehydrogenase, FAD+ to form fumaric acid 9. Fumaric acid takes up water molecule in presence of fumarase to form maleic acid 10. Maleic acid undergoes oxidation in presence of malate dehydrogenase, NAD+ to form oxaloacetic acid. 11. Cycle gets repeated again by entrance of another molecule of Acetyl CoA	
	c)	**Explain Urea cycle.** 1) Molecule of ammonia, CO2 & phosphate are condensed to form 'Carbamoyl phosphate' in presence of enzyme 'carbamoyl-phosphate synthetase.) Carbamoyl phosphate transferred to ornithine forms citrulline in presence of an enzyme ornithine transcarboxylase. This reaction takes place in mitochondria. The citrulline formed in this reaction enters in cytoplasm & the next reactions take place in cytoplasm 3) Citrulline condenses with Aspartate to form argininosuccinate. The reaction is catalysed by an enzyme Arginosuccinate synthetase. 4) Arginosuccinate is now cleaved into 'arginine' & 'fumarate' by the enzyme 'arginosuccinase'. Fumarate formed may be converted to oxaloacetate via the actions of enzymes 'fumerase'& malate dehydrogenase & then transmitted to regenerate aspartate. 5) Finally arginine is cleaved into ornithine & urea by the enzyme arginase. With this reaction cycle is completed & ornithine molecule accepts molecule of carbamoyl phosphate to repeat the cycle. the overall equation of the urea cycle is: $NH_3 + CO_2 +$ aspartate $+ 3$ ATP $+ 2 H_2O \rightarrow$ urea + fumarate $+ 2$ ADP $+ 2$ Pi + AMP + PPi	**4 M**



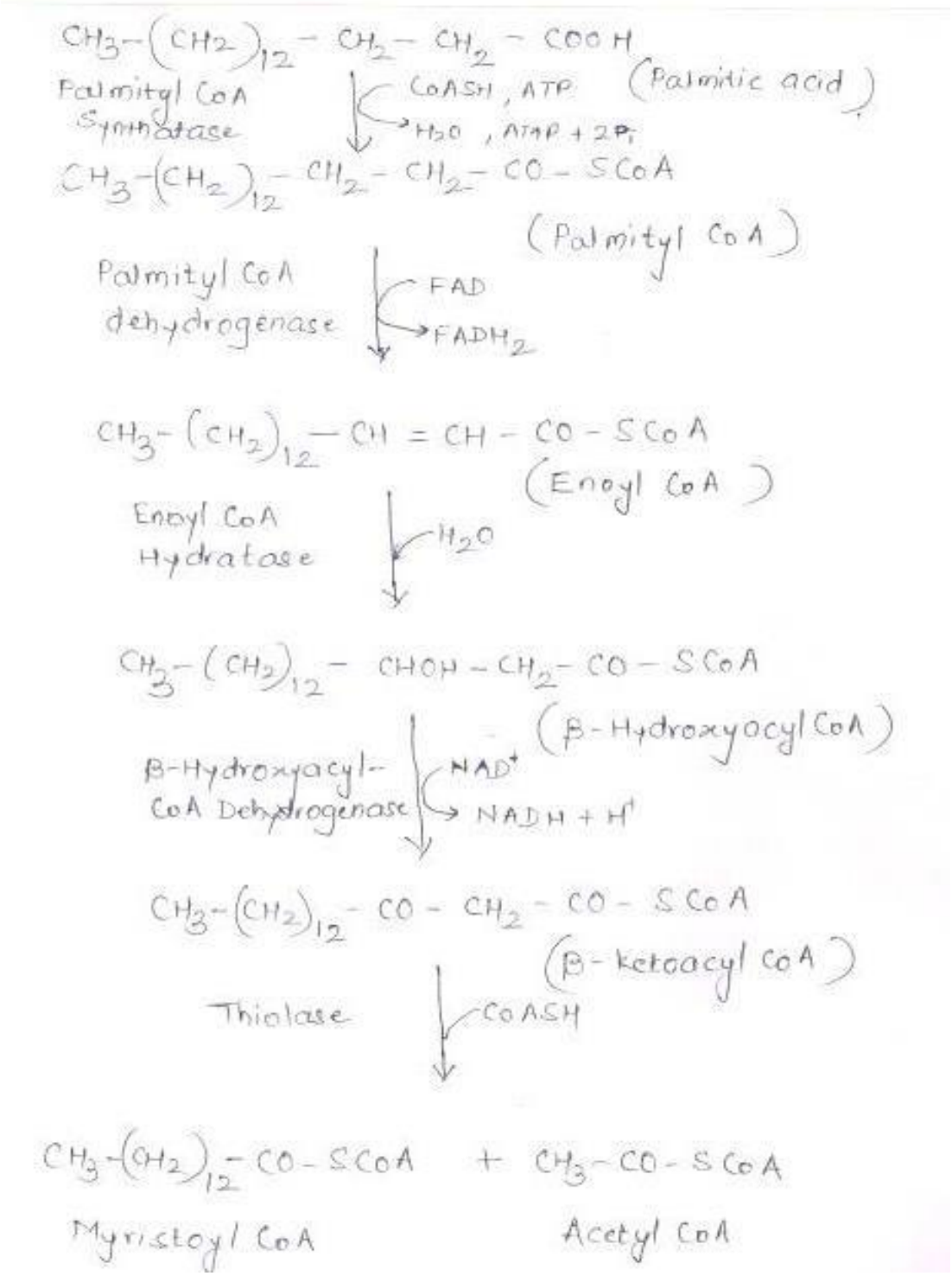
(Digrammatic representation can be considered for full marks)

d) **Discuss in brief the reactions involved in Beta oxidation of fatty acids**

(1M for Palmitic acid structure and Detailed diagramatic representation can be considered for 3 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 Palmitic acid Palmitic acid gets activated to Palmityl CoA in presence of CoASH, Palmityl CoA synthatase & ATP 2. PalmitylCoA undergoes dehydrogenation in presence of Palmityl CoA dehydrogenase & FAD to give alpha,beta unsaturated compound-Enoyl 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(Myristoyl 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.	**1+3 M**


CH3-(CH2)12-CH2-CH2-COOH
Palmityl CoA Synthatase
CoASH, ATP
H2O, ATP + 2Pi
(Palmitic acid)
CH3-(CH2)12-CH2-CH2-CO-SCoA
(Palmityl CoA)
Palmityl CoA dehydrogenase
FAD
FADH2
CH3-(CH2)12-CH=CH-CO-SCoA
(Enoyl CoA)
Enoyl CoA Hydratase
H2O
CH3-(CH2)12-CHOH-CH2-CO-SCoA
(β-Hydroxyacyl CoA)
β-Hydroxyacyl-CoA Dehydrogenase
NAD+
NADH + H+
CH3-(CH2)12-CO-CH2-CO-SCoA
(β-ketoacyl CoA)
Thiolase
CoASH
CH3-(CH2)12-CO-SCoA + CH3-CO-SCoA
Myristoyl CoA
Acetyl CoA

	e)	**Define:** **i) Isoenzyme** 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 **ii) Multienzyme** Composed of or involving two or more enzymes that function together in a biosynthetic pathway **or** **It** is a group of several different enzymes. **iii) Allosteric enzymes** The enzymes whose catalytic activity is regulated by itself are called allosteric enzymes. These are also called as regulatory enzymes, e.g. phosphofructokinase is an allosteric enzyme which convert fructose-6-phosphate to fructose-1,6-diphosphates. **iv) Metalloenzymes:** (Cofactors): Some enzymes requires a non-protein metal group for catalytic activity which is called as cofactors, e.g. Mg^{++}, Mn^{++}, Ca^{++}.	**1 each**
	f)	**What are lipids? Classify lipids with examples. Give one structure of unsaturated fatty acid.** 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: **Simple lipids:** Esters of fatty acids with alcohol.	**1+2+1 M**

- Fats & oils : Castor oil
- Waxes : Bees wax

Compound Lipid

- Glycerophospholipids., Sphingophospholipids, Glycolipids:.
- Lipoprotiens: Contain protiens
- Sulpholipids
- Aminolipids
- Lipoprotiens: Contain protiens
- Sulpholipids:
- Aminolipids:

Derived Lipids:

- Eg: Alcohols, Glycerol, Fatty acids etc

Miscellaneous Lipids:

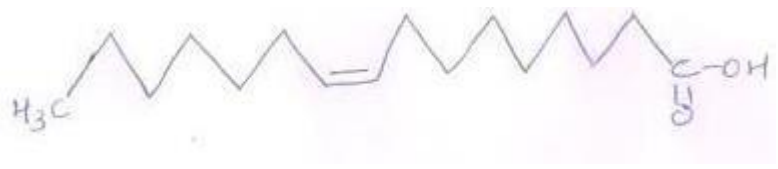
- Eg : Carotenoids, Squalene.

Neutral Lipids:

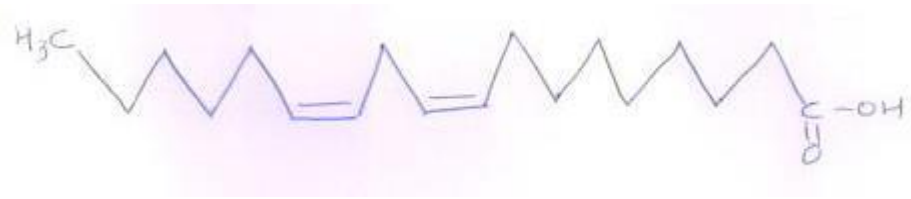
- They are mono, di, triacyl glycerols, cholesterol, cholesteryl esters.

(Schematic classification can be considered.)

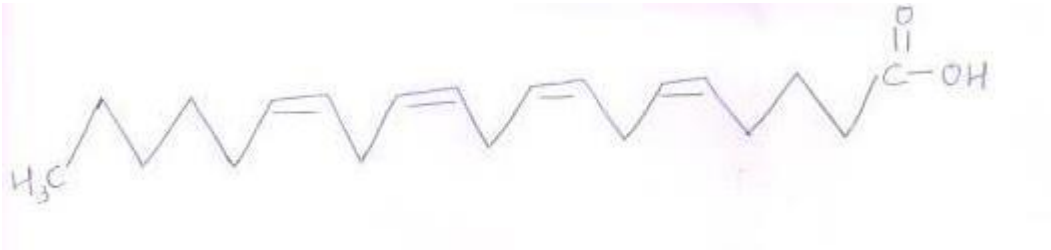
Any one of the following or any related structure can be considered



Palmitoleic acid



Linolenic acid



Arachidonic acid