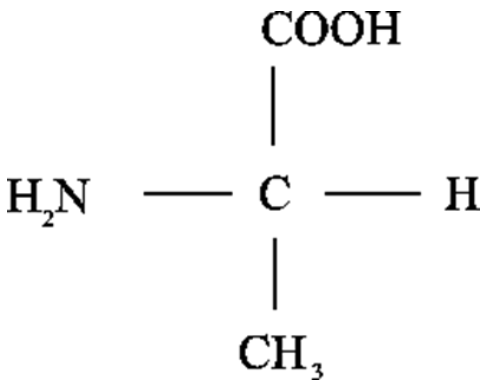
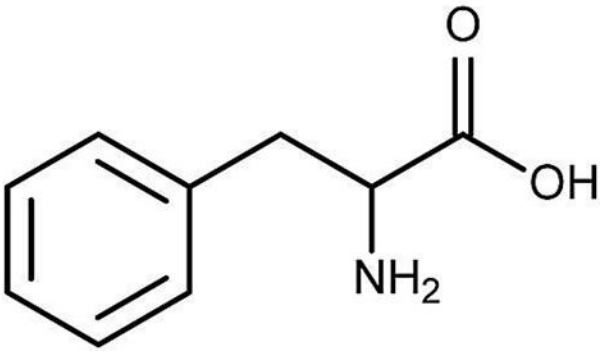
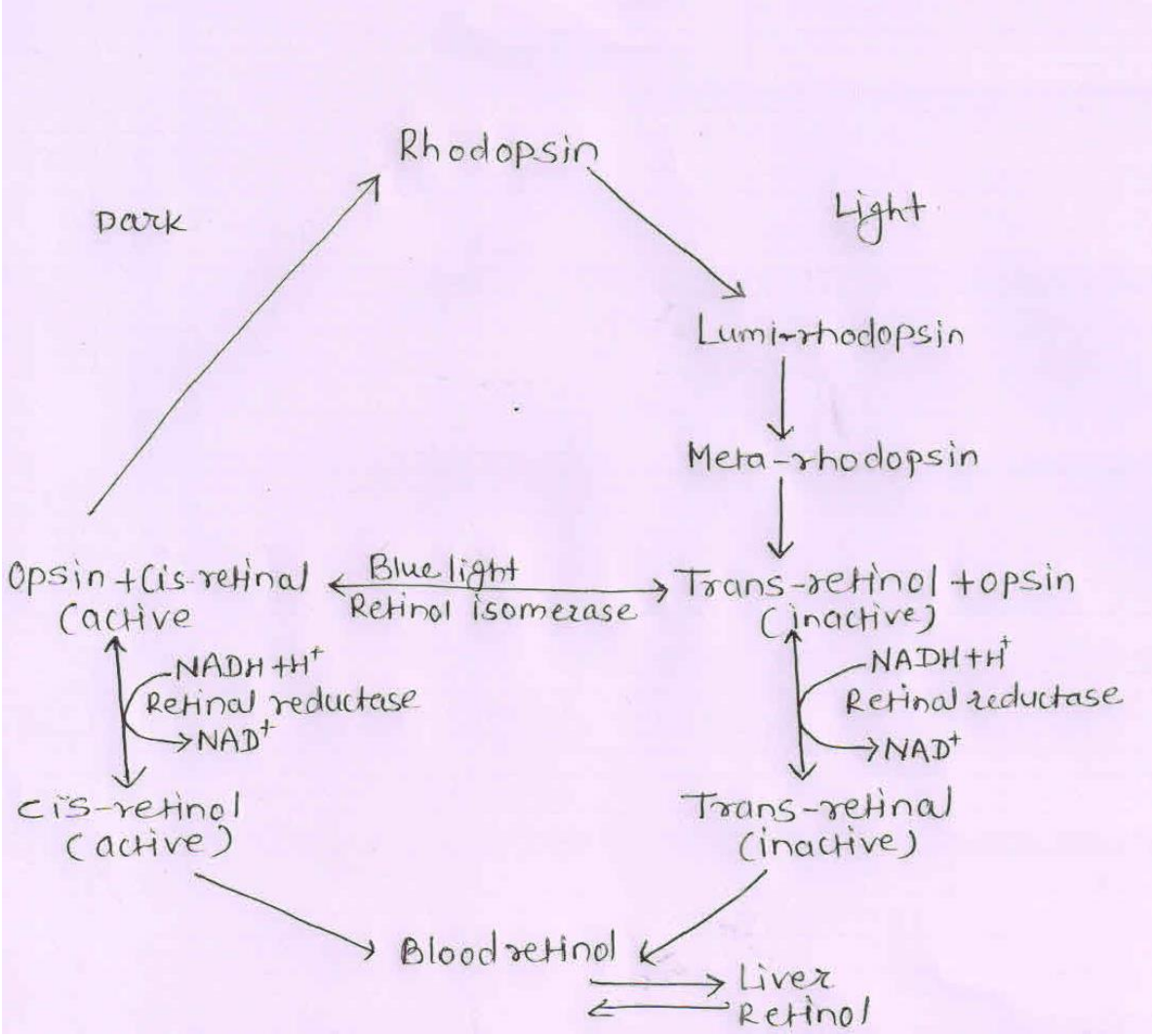
Subject Title: Biochemistry & Clinical Pathology Subject Code: 0808

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.

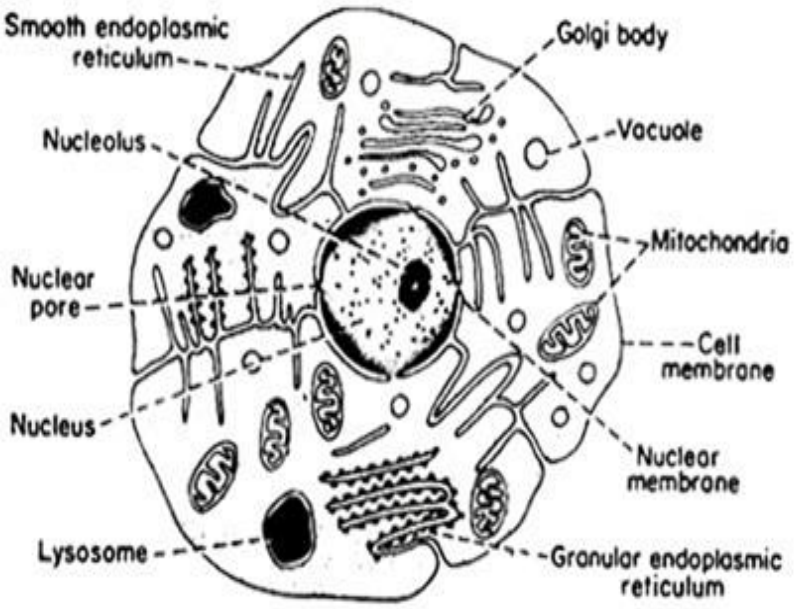
Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Answer any *Eight* of the followings:**	**2*8=16**
1	**a)**	**Write the functions of mitochondria and nucleus.** **Mitochondria**: Mitochondria are engaged in oxidative metabolism Are responsible for the transportation of chemical energy into biological energy, in the form of ATP All enzymes involved in Kreb's cycle are present in mitochondria. **Cell nucleus**: It is involved in the synthesis of RNA. In the biogenesis of ribosomes. Transmission of hereditary characters	**1M each for any 2 functions**
1	**b)**	**Draw the structure of alanine and phenylalanine.**  Alanine	**1 M each**

		 Phenylalanine	
1	**c)**	**Explain mutarotation with example.** 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 +1120 and on standing specific rotation falls to +52.50 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 +190 which on standing also changes to 52.50 For example: α—D—Glucose → D—Glucose ← β—D—Glucose. ($+112^0$) ($+52.5^0$) ($+19^0$)	**2M**
1	**d)**	**Write Liebermann burchard and Salkowski tests.** **These tests confirm presence of cholesterol** **Liebermann-Burchard test:** When 2ml of chloroform solution of cholesterol is treated with 10 drops of acetic anhydride & 2 drops of concentrated sulphuric acid, deep red colour is formed ,it rapidly changes to blue & finally to green colour **Salkowaski test:**	**1M each**

		When 2 ml of chloroform solution of cholesterol is treated with 2ml of concentrated sulphuric acid, after waiting for 3 mins layers separate. Chloroform layer turns red & acid layer shows greenish fluorescence	
1	**e)**	**Give diagrammatic representation of Wald's visual cycle** 	**2M**
1	**f)**	**Discuss functions of electrolytes in life processes** 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.	**2M**

		• 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	
1	**g)**	**Explain the term Enzyme specificity with examples.** One of the important characteristic of enzyme is that they are highly specific in their action. Each enzyme is capable pf bringing out only one or small group of reactions. **1.Reaction Specificity:** Different enzymes bring out different reactions on same substrate. Oxidase bring about oxidation of amino acid Decarboxylase bring about decarboxylation of amino acid **2.Substrate Specificity** **i) Absolute specificity:** Particular enzyme acts on a particular substrate Urease on Urea give ammonia & carbondioxide **ii) Relative specificity:** **Group specificity:** Particular enzyme acts on particular chemical groupings Glycosidase on glycosides or Esterase on ester linkages **3.Optical Specificity/ Stereospecificity** Enzymes show absolute optical specificity for at least a portion of substrate molecule**.** L-amino acid oxidase & D- amino acid oxidase act only on L&D –amino acids respectively. **Explanation in connection to binding of substrate at active site of enzyme can be considered.**	**2M**
1	**h)**	**Write in short about Alkaptonuria.** **Alkaptonuria**: This is a metabolic disorder of phenyl alanine due to lack of enzyme	**2M**

		homogentisate deoxygenase resulting into accumulation of homogentisate, which is excreted via urine. Homogentisate gets oxidized to corresponding quinone which polymerizes to give black or brown pigment 'alkaptone' & this colours urine. In cartilage and connective tissues, homogentisate gets polymerized and results into arthritis.	
1	**i)**	**Give different types of Leucocytes.** 1.**Granular leucocytes:** i)Basophil ii)Neutrophil iii)Eosinophil **2.Agranular leucocytes:** i)Lymphocytes a) T-cell b) B-cell ii)Monocytes	**2M**
1	**j)**	**Explain isoelectric pH 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. This pH is called isoelectric pH of amino acid. It is specific for every amino acid. vii. At the isoelectric pH, the amino acid exists as Zwitter ion which carries equal number of positive and negative charges.	**2M**
1	**k)**	**Justify sucrose is non-reducing sugar.** Because this is a carbohydrate without free & potential carbonyl function (aldehyde or ketone group). Both the functional groups are involved in glyosidic bond formation.so unable to reduce reagents containing metal ion. **OR** As both the anomeric carbon atoms are involved in forming the glycosidic bond when glucose and fructose join, there are no	**2M**

		potentially free anomeric carbon atoms available to reduce Benedict's solution or any other solution.	
1	**l)**	**Differentiate between fats and oil.** Fats — Oils Fats are solids at room temp — These are liquid at room temp Contain greater amounts of — Contain greater amounts of Saturated fatty acids — unsaturated fatty acids Act as food reservoir — Mostly protective in functions e. g. bees wax. — e. g. castor oil	**2M**
2		**Attempt any FOUR from following:**	**3*4= 12**
2	**a)**	**Draw neat, well labelled diagram of animal cell.**  	**3M**
2	**b)**	**Discuss biological role of proteins.** 1] Some proteins act as hormones and hence regulate various metabolic process e.g. insulin is responsible for maintaining blood sugar level.	**3M**

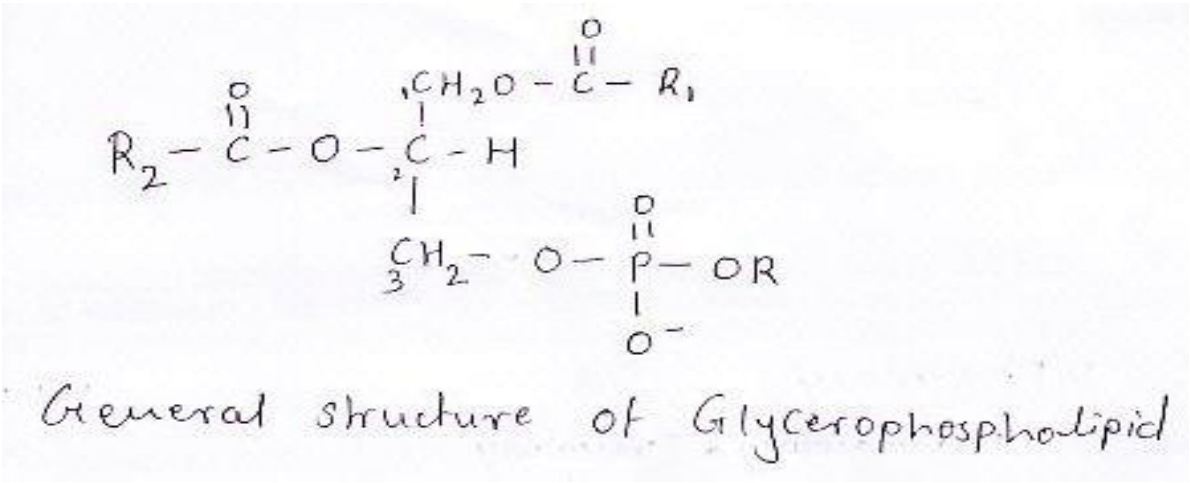
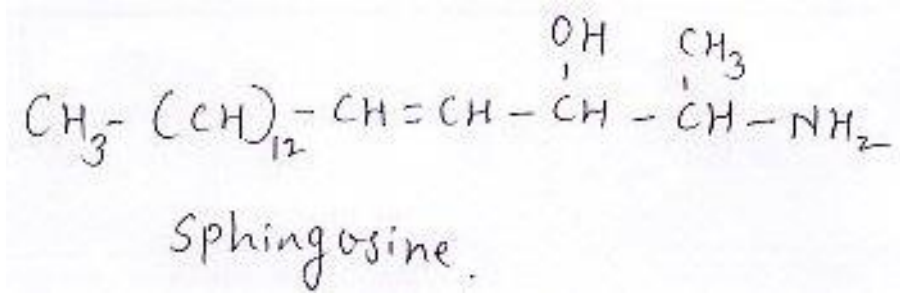
		2] Some proteins act as catalyst for biological reaction. 3] Some proteins act as biological structural materials viz collagen in connective tissue, keratin in hair. 4] Haemoglobin acts as a oxygen carrier in mammals. 5] Some blood proteins help to form antibodies which provide resistance to disease 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.	
2	**c)**	**Classify Carbohydrates with examples.** Classification- **1) Sugars (saccharides)-** **a) Monosaccharides** (depending upon number of carbon atom, it is subdivided in following types) i)Ttrioses-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)** **a) Homopolysaccharides**-e.g. Starch, Cellulose. b) **Heteropolysaccharides** e. g. Hyaluronic acid **Schematic representation can also be considered**	**3M**
2	**d)**	**Define the terms:** **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.	**1M each**

		ii)Saponification value It is the number of milligram of KOH required to saponify i.e. hydrolyse the free and combined fatty acids in one gram of given fat or oil. **iii) Iodine value:** It is the number of grams of iodine required to saturate or absorbed by 100gms of fat.	
2	**e)**	**Explain denaturation of proteins in detail.** 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, Sulfosalicyclic acid, X ray. **Changes after denaturation** • Loss of biological activity • Change in surface tension • Changes in solubility • Destruction of secondary and tertiary structures E.g . Boiled eggs become hard, skin formed on curdled milk	**3M**
2	**f)**	**Describe diabetes mellitus in detail.** Diabetes mellitus –It is a metabolic disorder in which there are high blood sugar levels over a prolong period. It is characterized by hyperglycaemia, glycosuria, polyuria, polydipsia ,polyphagia, ketosis, loss of weight, light colour of urine Types of DM	**3M**

		Type 1: Absolute deficiency of insulin due to destruction of beta cells of pancreas. Previously referred to as "insulin-dependent diabetes mellitus" (IDDM) or "juvenile diabetes". The cause is unknown. Type 2: Caused due to peripheral resistance to insulin action & inadequate secretion of insulin by beta cells of pancreas. Previously referred to as "non insulin-dependent diabetes mellitus" (NIDDM) or "adult-onset diabetes". The primary cause is excessive body weight and not enough exercise.	
3		**Attempt any FOUR from following:**	**3*4=12**
3	**a)**	Explain nutritional deficiency diseases of proteins. **Kwashiorkor** **Marasmus** **Nutritional oedema** **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	**1M each**

		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.	
3	**b)**	**Describe polysaccharides in detail.** Carbohydrates that give many monosaccharide molecules on hydrolysis are called as polysaccharides. All monomeric units are linked to each other by glyosidic linkage. Polysaccharides are having high molecular weight & are insoluble in water Classification: 1.Homopolysaccharides: On hydrolysis give similar monomeric units.The monomeric units are arranged in the form of long chain ,either unbranched or branched •Starch •Glycogen •Cellulose 2. Heteropolysaccharides: Polysaccharides which give two or more monomers on hydrolysis. •Hyaluronic acid •Chondroitin sulphate •Heparin	**3M**
3	**c)**	**Classify lipids with examples.** Simple lipids: Esters of fatty acids with alcohol. • Fats & oils : Castor oil • Waxes : Bees wax	**3M**

		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, triacylglycerols, cholesterol, cholesteryl esters. **Schematic representation can be considered**	
3	**d)**	**Give coenzyme forms of following vitamins:** i)**Thiamine** TPP (Thiamine pyrophosphate) ii**) Riboflavin** :FAM (Flavin mono nucleotide) FAD (Flavin adenine dinucleotide) iii)**Niacin:** NAD(nicotinamide adenine dinucleotide) or NADP(nicotinamide adenine dinucleotide phosphate)	**1m each**
3	**e)**	**Describe phospholipids with examples.** The Compound lipids containing phosphorus are called as phospholipids. Phospholipid contains phosphoric acid, fatty acids, alcohol and generally a nitrogenous base. Phospholipids are classified into 2 classes on the basis of alcohol present as follows: 1)Glycerophospholipids 2)Sphingophospholipids **1) Glycerophospholipids(Phosphoglycerides):** These contain glycerol as alcohol	**3M**

		All phosphoglycerides are derived from δn-Glycero -3-phosphoric acid Phosphoric acid is esterified with hydroxyl group of C3,C1,C2 hydroxyl group get esterified with fatty acids.  General structure of Glycerophospholipid **2)Sphingophospholipids** Sphingophospholipids are obtained from sphingosine,an amino alcohol Hydroxyl group of sphingosine is esterified with phosphocholine and sugar. e.g. Sphingomyelines  Sphingosine.	
3	**f)**	**Give biochemical role of pyridoxine and folic acid** **Pyridoxine:** • The active form of pyridoxal phosphate as a coenzyme involves in the number of reactions such as amino acid Decarboxylation ,Transamination, Racemisation and Elimination reactions. • It is essential for growth of infants. • It is involved in immune function.	**1.5M any 3 functions**

		• It is useful in the dermatitis. **Folic acid:** • 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. **Any other correct function can be considered**	
4		**Attempt any FOUR from following:**	**3x4=12**
4	**a)**	(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. 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	**3 M**

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

4 b) Classify enzymes on the basis of reaction catalysed by them. **3M**

• 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. Dextroseisomerase

Ligases/Synthatases:

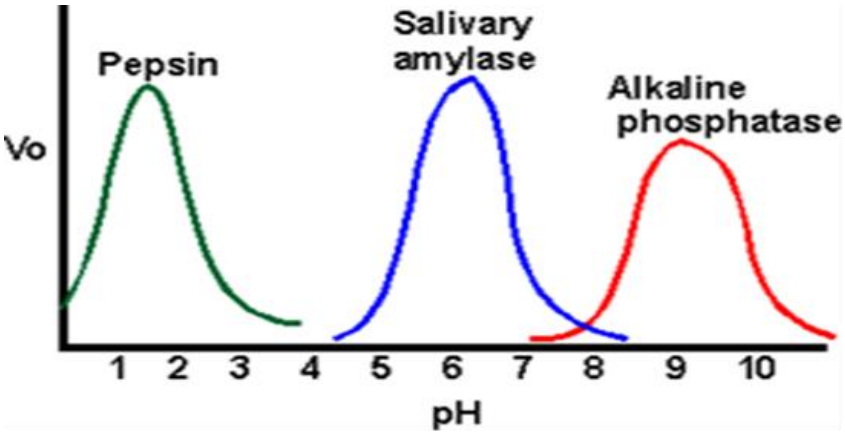
• Catalyse the linking or synthesizing together of2 compounds. Forming C-S bonds, C-N bonds, C-C bonds. E.g: Lysases, Isomerases, Ligases / Synthatases .

<table>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>c)</td><td>Explain the terms:
Gluconeogenesis: It is the process of synthesis of glucose from non-carbohydrate sources such as amino acids, lactic acid and glycerol, etc.
Glycogenolysis: The breakdown of glycogen into glucose is called as glycogenolysis.
Glycogenesis: It is the process of conversion of glucose into glycogen in the liver.</td><td>1M each</td></tr>
<tr><td>4</td><td>d)</td><td>Enlist different abnormal constituents of urine, give significance of constituent
<table>
<tr><th>Abnormal constituents</th><th>Associated ailment</th></tr>
<tr><td>Sugar (glucose)</td><td>Glycosuria- Diabetes mellitus</td></tr>
<tr><td>Ketone bodies</td><td>Ketonuria- Diabetes mellitus, Pregnancy, Carbohydrate starvation</td></tr>
<tr><td>Albumin</td><td>Proteinuria- Pregnancy, severe exercise, high protein meal, Nephritis</td></tr>
<tr><td>Bile pigments</td><td>Jaundice /Hepatitis</td></tr>
<tr><td>Blood</td><td>Haematuria- Acute inflammation of urinary organs, T.B., Cancer, Haemolytic jaundice etc.</td></tr>
<tr><td>Pus</td><td>Pyuria- Inflammation of urinary bladder, urethra, kidney</td></tr>
</table></td><td>Enlist 1M Significance 2M</td></tr>
<tr><td>4</td><td>e)</td><td>Give biochemical role of the following
i)Sodium:
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</td><td>1M each Any 2 functions</td></tr>
</table>

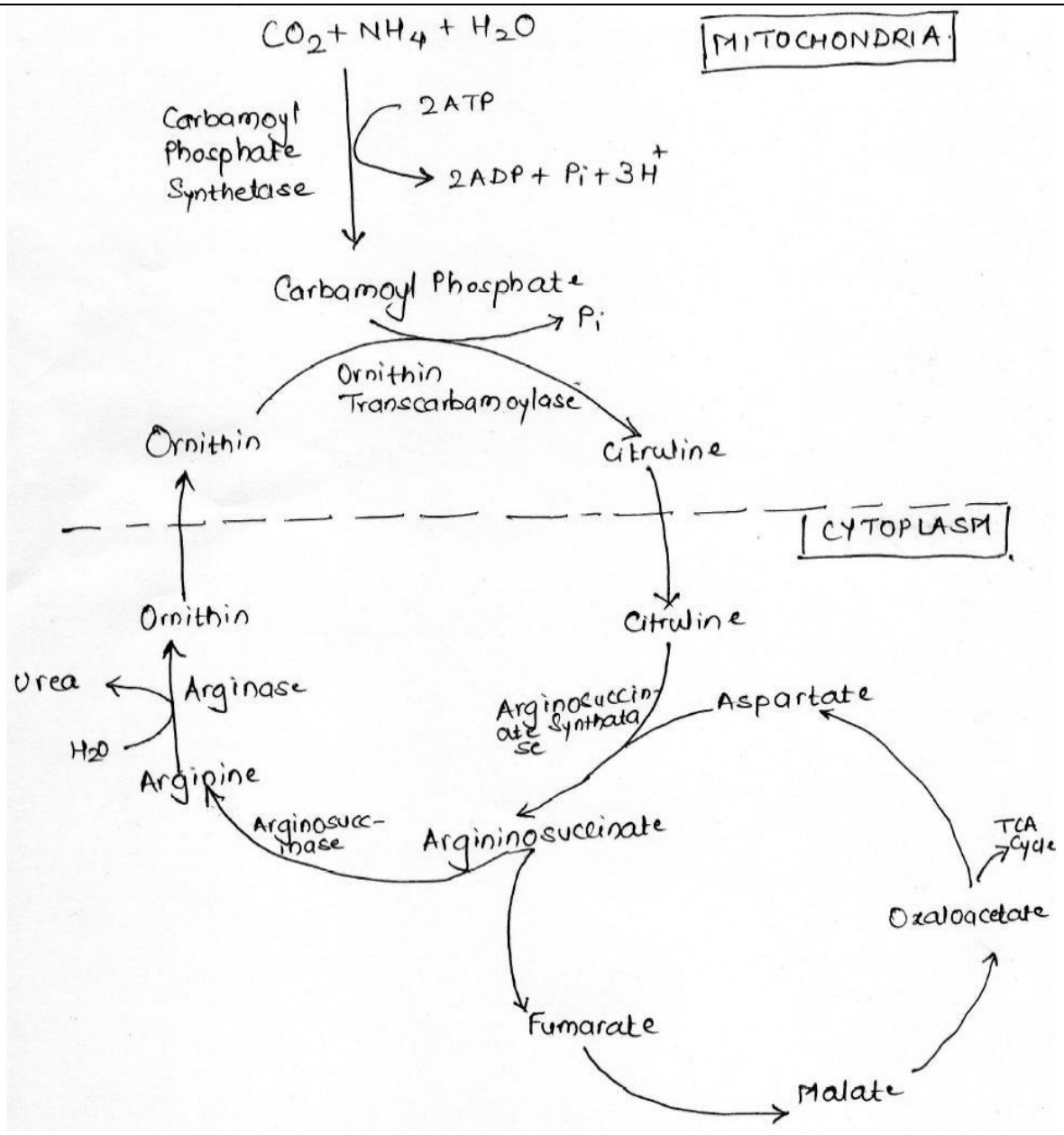
		ii) Phosphorus: • Essential for development of bones & teeth • Acts as coenzyme Pyridoxal phosphate, NADP • It is necessary for absorption & metabolism of carbohydrates. • It is an essential component of several nucleotide coenzymes **iii) Iron** Iron is required for • Formation of Red Blood Cells • DNA synthesis • Formation of myoglobin. • Electron transport chain	
4	**f)**	**Define the terms:** **i) Induced Enzymes**:: The enzymes produced in presence of substrate are called as Induced enzymes. Eg.: hepatic microsomal enzymes. **ii) Constitutive enzymes**: The enzymes produced in absence of substrate are called as Constitutive enzymes .Eg.: Enzymes of glycolytic series. **iii)Isoenzyme:** The enzymes which have multiple molecular forms in the same organism, catalysing the same biochemical reaction are called as Isoenzymes. e.g.Lactate dehydrogenase.	**1M each**
5		**Attempt any FOUR from following**	**3*4=12**
5	**a)**	**Define dehydration; explain types of dehydration.** It is a condition characterized by water depletion in the body There are three main types of dehydration: **Hypotonic (primarily a loss of electrolytes)** It happens when the loss of sodium is greater than water. The decrease in sodium leads to reduced tonicity and so the extracellular fluid becomes hypotonic as compared to the fluid within the cells.	**1M defn 2M types**

		Causes: Diarrhoea and vomiting, Gastric obstructive diseases, Heat stroke, Muscle damage, Burns **Hypertonic (primarily loss of water)** It occurs when the amount of water loss from the body is more compared to the sodium loss. As a result, the sodium concentration in the cells and extracellular fluid increases making it hypertonic. Cause: Water deprivation, Hyperventilation, Profuse sweating, Diarrhoea in young children especially infants, Diabetes insipidus **Isotonic (equal loss of water and electrolytes).** The patient loses water and salt from the body in equal amounts and so the level of sodium in the extracellular fluid remains the same and there is no change in the tonicity. This is the commonest type of dehydration that is seen Causes: Isotonic dehydration is mostly a result of severe diarrhoea and vomiting where the patient loses a lot of water from the body. Other causes include cholera, excess sweating due to very hot climate and profuse bleeding.	
5	**b)**	**Discuss various diagnostic applications of enzymes.** Enzymes are normally confined within the cell. The little amount is present in body fluids like blood & C.S.F. etc. Certain enzymes come into plasma due to leakage from living cells or from dead or dying cells. Such enzymes are very useful for the diagnosis of various diseases. They are called as 'marker enzymes'. 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.	**3M**
5	**c)**	**Define the terms:** **i)Catabolism** It's a process of degradation of complex matter into simple form thus generating energy & metabolites that provide metabolic fuel & building block for the cell.	**1M each**

		ii) Ketosis Presence of ketone bodies (acetone, acetoacetic acid and beta hydroxyl butyric acid) in blood & urine is called as ketosis. **iii) Arteriosclerosis** It is the thickening, hardening and loss of elasticity of the walls of arteries caused by deposition of cholesteryl esters & other lipids.	
5	**d)**	**Explain megaloblastic anaemia& sickle cell anaemia.** **Megaloblastic anaemia:** It is also called as pernicious anaemia or macrocytic anaemia. In this type of anaemia essential factors are absent which are required for the formation of RBC. So RBC count is decreased i.e. intrinsic factors responsible for absorption of vitamin B_{12} from gastric acid is absent. **Sickle cell anaemia:** It is genetic disorder. Bone marrow produces abnormal type of cells. The shape of large number of red cells is like sickle cell or crescentric and the life span is completely shortened. Patients with sickle cell show marked susceptibility to infection and there is blockage of blood supply to vital organs as sickle cells don't pass through small blood capillaries. These patients should avoid places with low oxygen supply.	**1.5 M each**
5	**e)**	**Enlist different factors affecting rate of enzyme catalysed reaction; explain effect of hydrogen ion concentration in detail.** **Factors that affect velocity of enzyme catalyzed reaction** • 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**.**	**1M enlist 1m expln 1m graph**

		Effect of Hydrogen ion concentration: •Enzyme reactions are influenced by varying H ion concentration. •The optimum pH is that pH at which a certain enzyme causes a reaction to progress most rapidly. •On either side of the optimum, the rate of reaction is lower & at certain pH enzyme may be inactivated or even destroyed. •Buffers are used to keep enzyme at an optimum or at least a favourable H ion concentration. •Optimum pH is dependent on kind of buffer, particular substrate, source of enzyme. •Eg.: optimum pH of sucrase is 6.2 ; pepsin is 1.5- 2.5  	
5	**f)**	**Describe biosynthetic pathway of urea in body.** 1)Molecule of ammonia, CO2 & phosphate are condensed to form 'Carbamoyl phosphate' in presence of enzyme 'carbamoyl-phosphate synthetase. 2) Carbamoyl phosphate transferred to ornithine forms citrulline in presence of an enzyme ornithine transcarbamoylase. This reaction takes place in mitochondria. The citruline 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.	**3M**

		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: $NH3 + CO2 + aspartate + 3\ ATP + 2\ H2O \rightarrow urea + fumarate + 2\ ADP + 2\ Pi + AMP + PPi$	

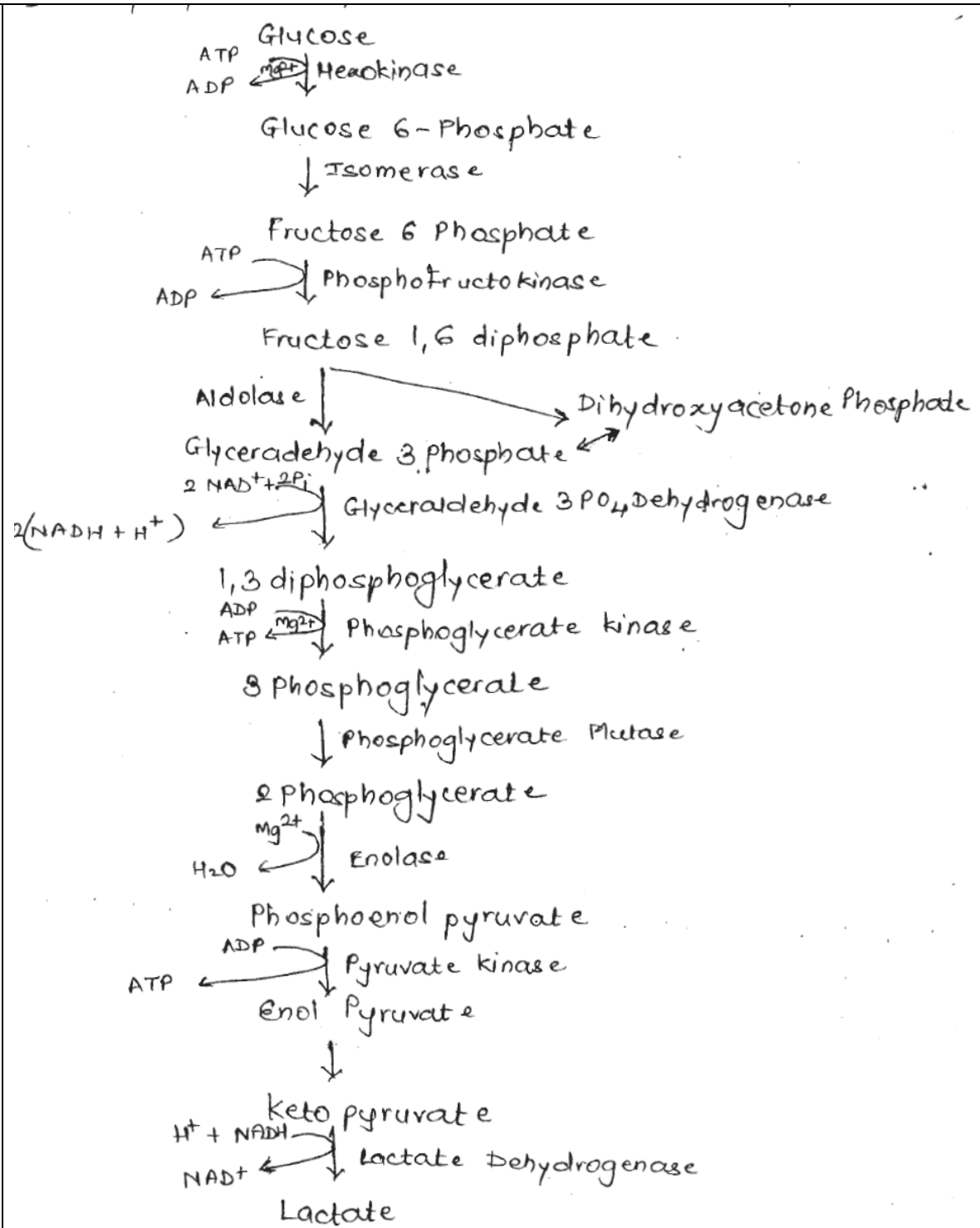


6		**Attempt any FOUR from following:**	**4*4=16**
6	**a)**	**Write deficiency symptoms of Vit-A, Vit-D, Vit-E, Vit-K.** **VitaminA** Bitot's spots.	**1M each**

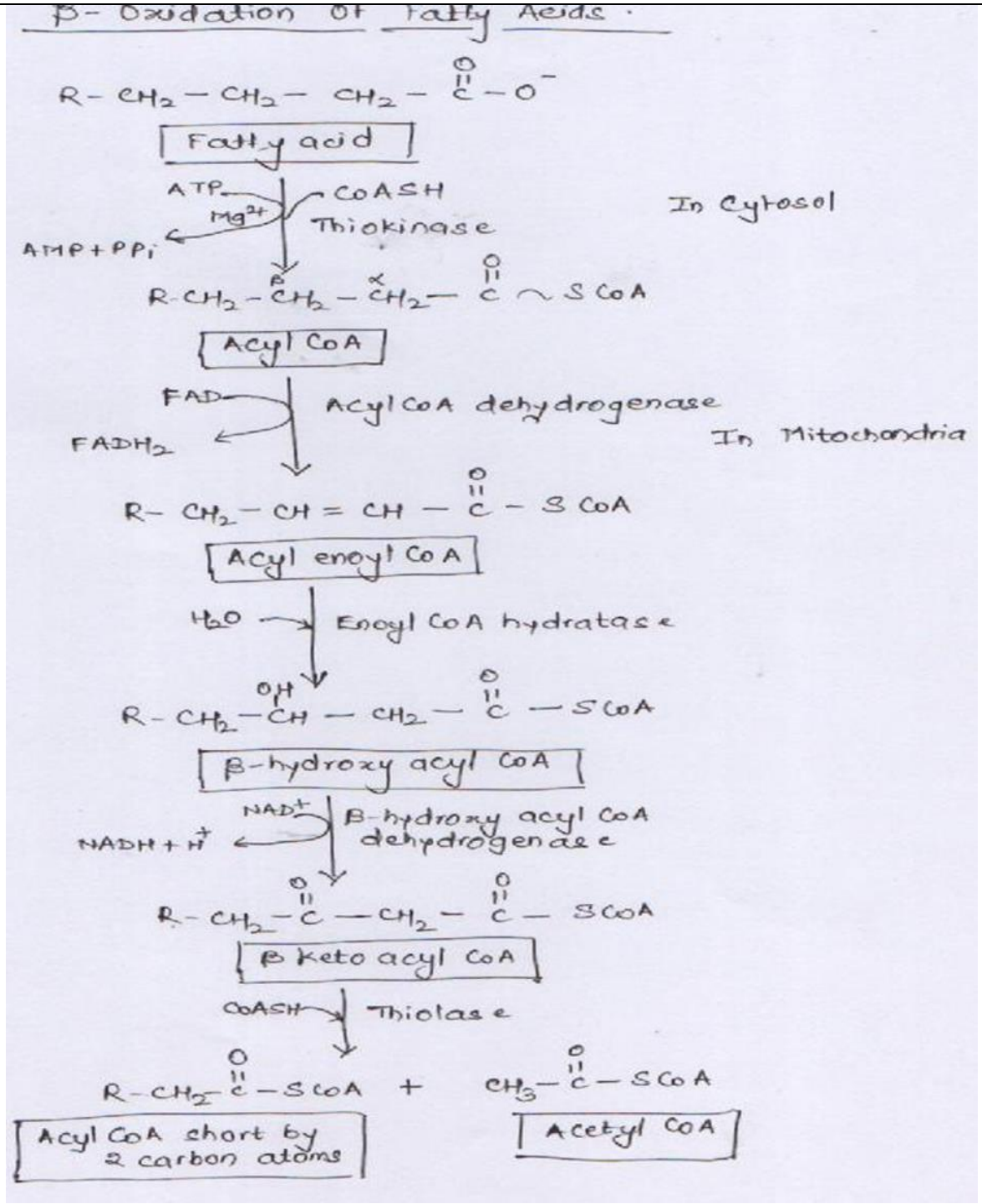
		Xeropthalmia (Drynes of eyes) Keratomalcia Night blindness. Growth retardation. Susceptibility to respiratory tract infections. Skin becomes dry, scaly & rough. **VitaminD** Rickets: Bone pain or tenderness Skeletal deformity Growth disturbance Hypocalcemia ,Tetany Osteomalacia Osteoporosis **VitaminE** Degenerative changes in muscles. Minor neurological symptoms. Changes in CNS. Increased fragility of erythrocytes. Megaloblastic anaemia. Sterility. **VitaminK** Lack of active prothrombin in the circulation. Blood coagulation gets adversely affected. Profuse bleeding even on minor injuries. Blood clotting time is increased. **Tabular format can also be considered**	
6	**b)**	**Describe importance of calcium in human body.** Plays important role in: Formation & development of bones &teeth	**4M** **Any 8**

		Muscle contraction Blood clotting Growth of children Responsible for 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.	
6	**c)**	**Explain pathway of glycolysis in detail.** **(Detailed diagramatic representation can be considered for full marks)** 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	**4M**

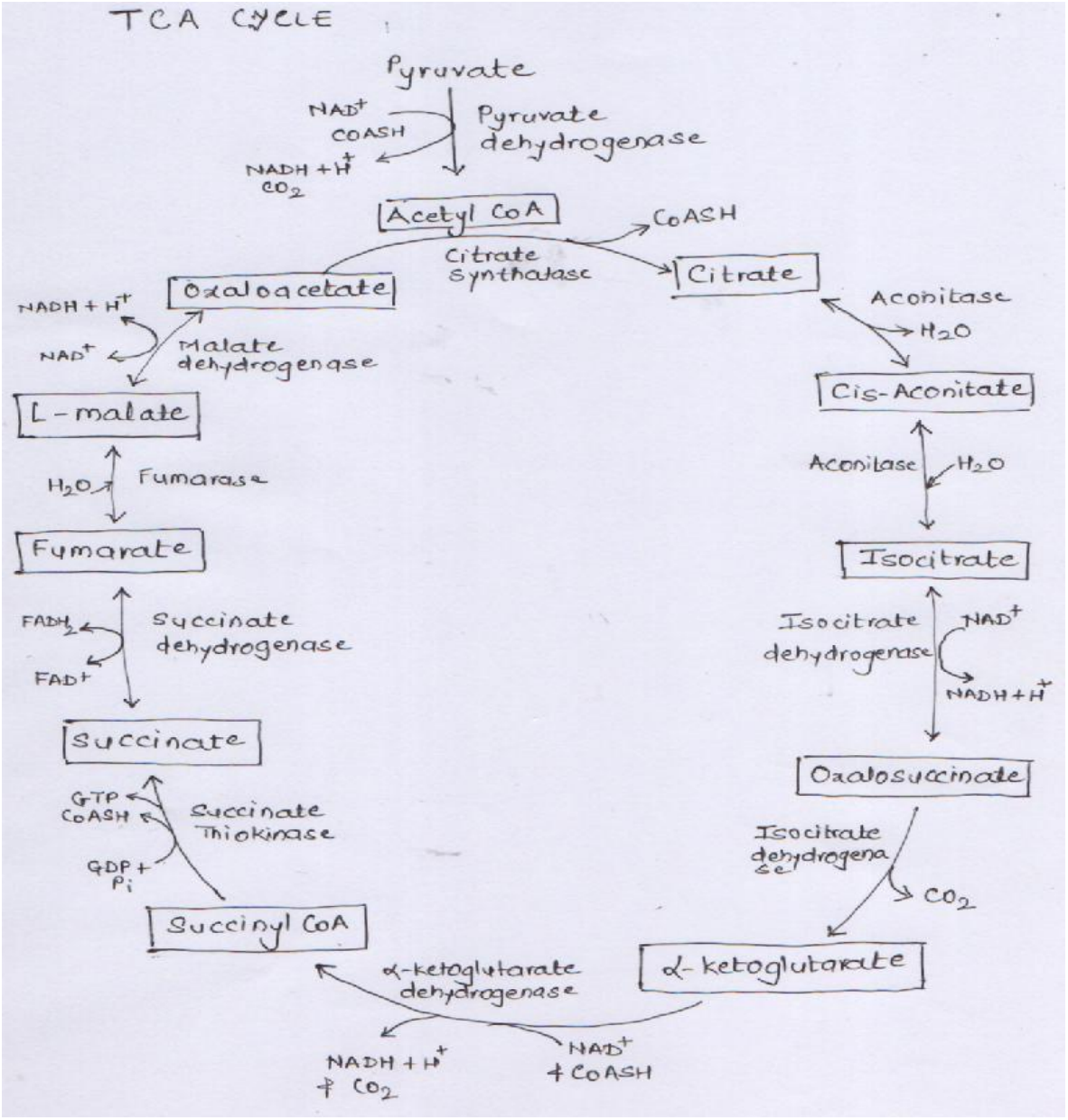
		phosphoenol pyruvic acid in presence of enolase 9. Loss of phosphate from phosphoenol pyruvic acid results into formation of Enol pyruvic acid in presence of pyruvate kinase, Mg & ADP 10. Enol pyruvic acid gets converted to keto form of pyruvic acid in presence of pyruvate kinase 11. Keto pyruvic acid 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	


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 3 PO4 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

6	**d)**	**Explain beta-oxidation of fatty acid in detail.** **(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.	**4M**


β- Oxidation of fatty Acids.
R- CH2 - CH2 - CH2 - C(=O) - O⁻
Fatty acid
ATP
Mg2+
AMP + PPi
CoASH
Thiokinase
In Cytosol
R-CH2 - β CH2 - α CH2 - C(=O) ~ S CoA
Acyl CoA
FAD
FADH2
Acyl CoA dehydrogenase
In Mitochondria
R- CH2 - CH = CH - C(=O) - S CoA
Acyl enoyl CoA
H2O
Enoyl CoA hydratase
R- CH2 - CH(OH) - CH2 - C(=O) - S CoA
β-hydroxy acyl CoA
NAD+
NADH + H+
β-hydroxy acyl CoA dehydrogenase
R- CH2 - C(=O) - CH2 - C(=O) - S CoA
β keto acyl CoA
CoASH
Thiolase
R- CH2 - C(=O) - S CoA + CH3 - C(=O) - S CoA
Acyl CoA short by 2 carbon atoms
Acetyl CoA

6	**e)**	**Explain kreb cycle in detail.**	**4M**



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	
6	**f)**	**Enlist different leucocyte disorders; explain any two disorders in detail.** Disorders of white blood cells: 1.Proliferative disorders: Lekocytosis: Increase in number of leukocytes • Neutrophilic Leukocytosis: Increase in number of neutrophils It may be due to acute bacterial infections, tissue damage as in burns, Intoxication, In corticosteroid therapy • Eosinophilic leukocytosis : Increase in number of eosinophils It may be due to allergic reaction, Parasitic infestation • Basophilic leucocytosis: Increase in number of basophils • Monocytosis: Increase in number of monocytes It may be due to certain bacterial infections or viral infections • Lymphocytosis: Increase in number of lymphocytes It may be due to certain acute infections like Pertussis, certain chronic infections like TB, other conditions like Thyrotoxicosis • Leukemia: Bone marrow cancer	**Enlist 2 M** **Expln 2M**

		2. Leukopenia: Decrease in number of leukocytes • Neutropenia: Decrease in number of neutrophils It may be due to infectious diseases(typhoid ,influenza, measles) Septicaemia; Anaphylaxis; Chronic infection as in TB • Eosinopenia: Decrease in number of eosinophils It may be due to adrenal steroids • Lymphopenia : Decrease in number of lymphocytes **Disorders involving Lymphocytes & Neutrophils are most common** **Disorders of monocytes & eosinophils are less common** **Disorders of basophils are rare**	