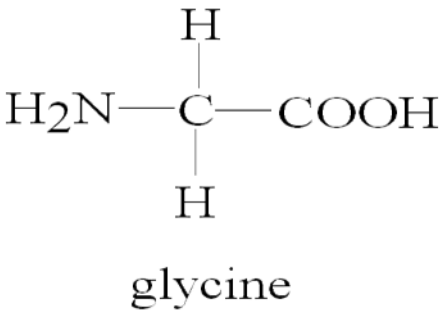
Important Instructions to examiners:

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		**Solve any four of the following:**	
	a)	**What is Biochemistry?** Biochemistry -The study dealing with the chemistry of living organism in its different phases of activity is called as biochemistry. It deals with the structure and function of cellular components such as proteins, carbohydrates, lipids, nucleic acids and other biomolecules	**2M**

	b)	**Define cell and give its functions**	**1M**
		Cell: It is defined as structural and functional unit of living organism and capable of carry on processes of life independently.	**1M**
		Cell membrane:	**any two functions**
		• It holds cell together.	
		• It serves as selective barrier to the outside.	
		• It secretes waste products.	
		• It keeps out toxic materials.	
	c)	**Distinguish between reducing and non-reducing sugar**	**2M**
		Reducing sugars — Non reducing sugars	
		Free carbonyl group — Free carbonyl group not present	
		Osazone test is positive — Osazone test is negative	
		Fehlings ,Benedicts And Tommers Test positive — Fehlings, Benedicts And Tommers test negative	
		Eg. Glucose, lactose — Eg, Sucrose	
	d)	**Give Structure of glycine.**	**2M**
		 glycine	

	e)	**Define anabolism and catabolism.** Anabolism: It's a biosynthetic phase, uses energy to construct components of cells such as proteins and nucleic acids. ii) Catabolism : It's a process of degradation of complex matter into simple form the generating energy & metabolites that provide metabolic fuel & building block for the cell.	**1M each**
	f)	**What are coenzymes** 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. e.g. Folic acid : Tetra hydrofolate (THF) Pyridoxin : Pyridoxal phosphate (PP) (any another suitable example can be considered)	**2M**
	g)	**Give symptoms due to deficiency of vitamin C** Deficiency of vitamin C causes scurvy. Symptoms weakness, pain in bones and joints , loosening of teeth, poor healing of wound, internal hemorrhage, swelling of long bone, Easy factorability of bones 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, osteoporosis**.**	**2M**

h) What is Osteoporosis — **2M**

Osteoporosis is a condition characterized by a decrease in the density of bone, decreasing its strength and resulting in fragile bones. Osteoporosis literally leads to abnormally porous bone that is compressible, like a sponge.

This disorder of the skeleton weakens the bone and results in frequent fractures (breaks) in the bones. Usually seen in adults

Symptoms – Pain of Spine, loss of height**,** fragile bones

Treatment: Vitamin D with Calcium

i) Distinguish between Fats and Oils — **2M**

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
Acts as food reservoir	Mostly protective in functions
e. g. bees wax.	e. g. castor oil

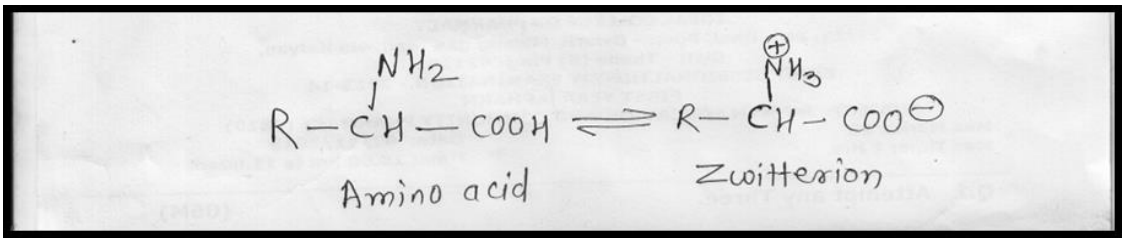
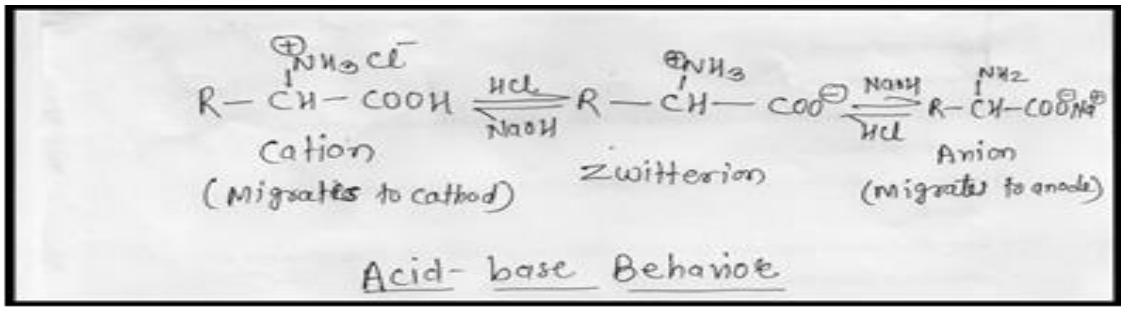
j) Define the term Holoenzyme and Apoenzyme — **2M**

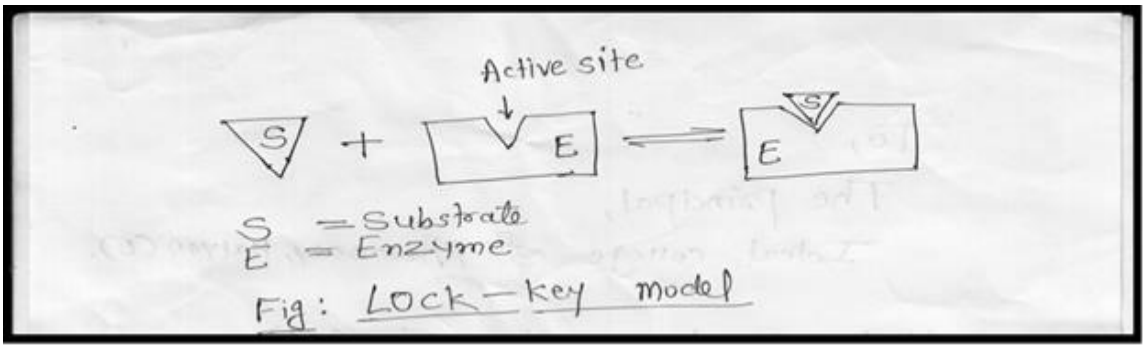
Holoenzymes : Apoenzymes in combination with its prosthetic group constitutes Holoenzymes.

Apoenzyme: The protein part of conjugated enzyme is referred as apoenzymes.

	k)	**How sugar and blood detected in urine** Sugar: 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 OR Fehling's test: 2ml fehling's A+ 2ml fehlin'g B, boil for few minutes, add 2-3 ml of urine, boil again. Red/ yellow ppt obtained indicates presence of sugar ii)Blood: Benzidine test: Pinch of benzidine powder +1ml of glacial acetic acid, shake for 1 minute. Add 2ml urine + few drops of H_2O_2, Green / blue colour due to iron benzidine formation indicates presence of blood.	**2M**
2	**l)**	**Define Pyuria and Haematuria** Pyuria-It is the condition of urine containing white blood cells or pus. It may be due to bacterial infection Hematuria- It is the appearance of blood in urine. It may be due to tumor, renal stone.	**1M each**
		Solve any four of the following	
	a)	**Define following (any three)** i)Sap value: It is the number of milligrams of KOH required to saponify free or combined fatty acids present in 1 gram of fat or oil. ii) 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. iii) Polensky Number: It is the number of milliliter of 0.1 N KOH required to neutralize the insoluble fatty acids from 5gm of fat or oil	**3M any Three**

	b)	iv) Iodine number It is the number of grams of iodine required to saturate or absorbed by 100gms of fat or oil. **Define Carbohydrates and classify them with examples** Carbohydrates are defined as polyhydroxy aldehydes or ketones or compounds derived from their hydrolysis. Classification- 1) Sugars (saccharides) 2) Non sugars (poly saccharides) 1) Sugars (saccharides)- a) Monosaccharides (depending upon number of carbon atom, it is 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) i) Homopolysaccharides-e.g. starch, cellulose. ii) Heteropolysaccharides e. g. hyaluronic acid Schematic representation can also be considered	**1M def.,** **2M classification**

	c)	**What do you mean by Zwitterion .Explain acid base behavior of amino acid.**	
		Zwitter ion: At the intermediate pH or isoelectric pH , the amino acid carries equal number of positive and negative charge and net charge becomes zero, that ion is called Zwitter ion.	1M def.
			
		Acid-base behavior of amino acids:	
			2M explanation
		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. 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. viii. At the Isoelectric point, that amino acid becomes insoluble and precipitates out. Eg. Isoelectric pH of Aspartic acid 2.87 and alanine 6.02 (consider any example**)**	

	d)	**Explain lock and key model of enzyme action**  It is the first model proposed by" Emil Fisher" to explain enzyme action mechanism. It is like a Lock & Key. In this case the shape of active site of an enzyme and that of substrate is complementary to each other. The substrate molecule fits into the active site of enzyme just as key fits into a lock. Hence called Lock & Key model. The shape of active site is rigid and complementary to the shape of substrate complex.	1M dig. 2M explanation
	e)	**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 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	1.5M expl.

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- 100ml

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

1.5M table

f) **What is pathological urine .Name four abnormal constituents with their significance,**

Pathological urine: Urine that contains substances essential to the body or tissues (like sugar, bile salts, albumin etc.), in addition to normal organic & inorganic substances, is called as pathological or abnormal urine. 1M

Such urine indicates some disease or disorder or derailment in body physiology.

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

2M

		Albumin	Proteinuria- Pregnancy, severe exercise, high protein meal, Nephritis	
		Bile pigments / salts	Jaundice /Hepatitis	
		Blood	Haematuria- blood in urine	
		Pus	Pyuria- Inflammation of urinary bladder, urethra, kidney	

Solve any FOUR of the following:(4x3)

3

a) **Explain role of Vit-A in vision cycle**. 1.5M expl.

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.

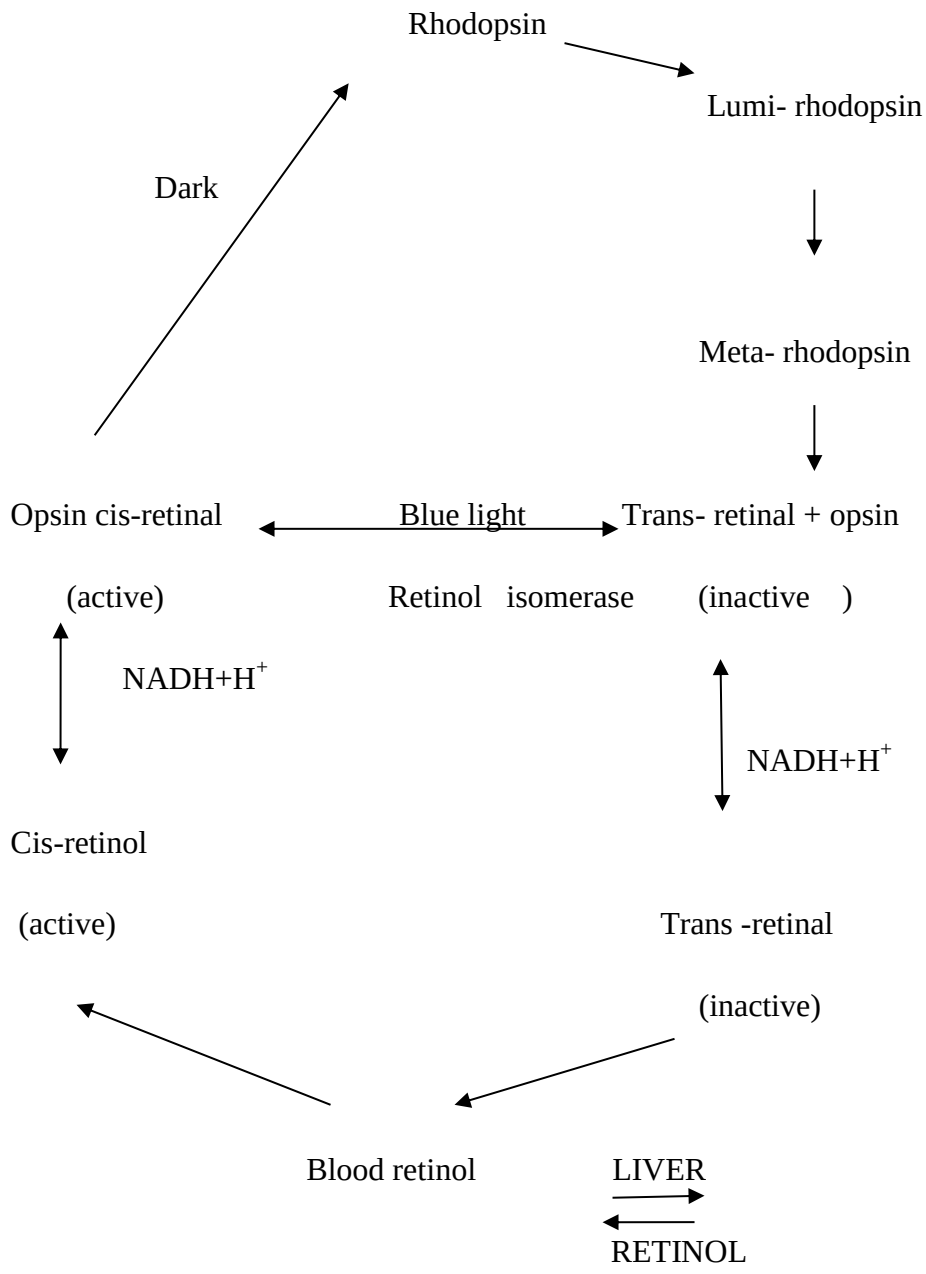
In retinal pigments, the rod cells contain rhodopsin. Under the influence of light, rhodopsin is converted to lumirhodopsin which is further converted into metarhodopsin. Then hydrolysed to protein opsin & trans retinal. Trans-Retinal (trans- retinene) is inactive in the synthesis of rhodopsin; it must 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.

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.


Rhodopsin
Lumi- rhodopsin
Dark
Meta- rhodopsin
Opsin cis-retinal
Blue light
Trans- retinal + opsin
(active)
Retinol isomerase
(inactive)
NADH+H+
NADH+H+
Cis-retinol
(active)
Trans -retinal
(inactive)
Blood retinol
LIVER
RETINOL

1.5M dig

Q. No.	Sub Q.N.	Answer	Marking Scheme
	(b)	**Define enzymes: classify them 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 • 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**	(Defination 1 mark, Classification 3 marks)

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:

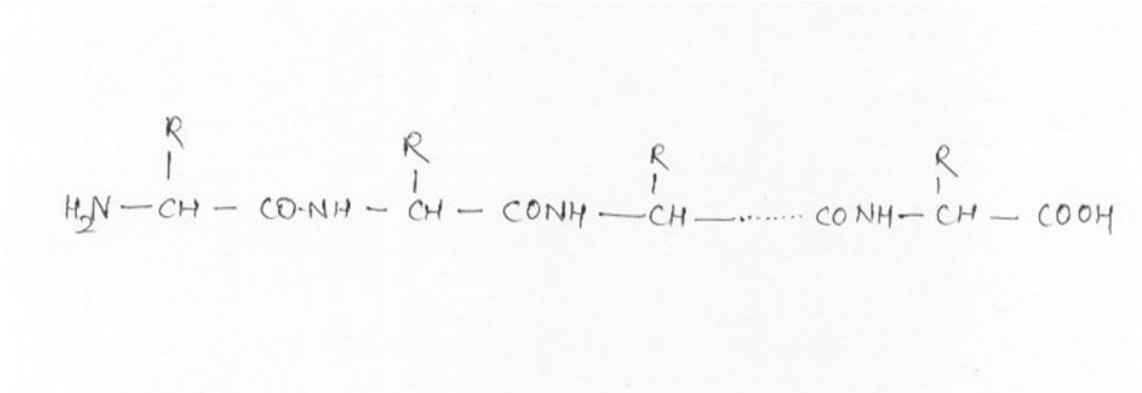
Catalyze interconversion of isomers. eg. Dextrose isomerase

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 .

(c)

Explain primary structure of protein 1.5M



Primary structure:

It's a straight chain structure.

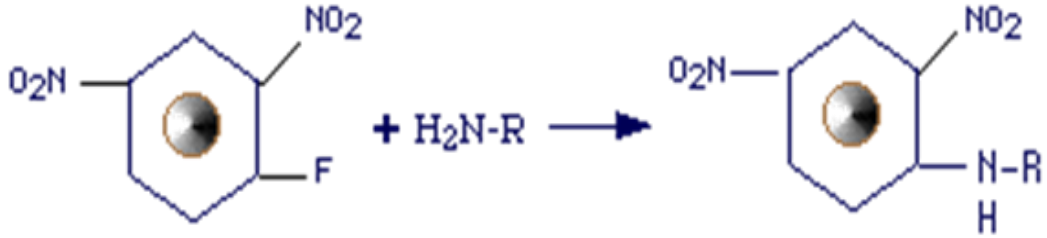
The 'N' terminal amino acid i.e. amino acid with free amino group is always on left end of polypeptide chain & the 'C' terminal amino acid i.e. amino acid with free –COOH group is at the right end of the chain. 1.5M

(d) Give reactions of following reagents with amino acids-

(i) F.D.N.B.

Reaction with Sanger's reagent(1-fluro,2-4 dinitro benzene or FDNB)

Reagent reacts with free amino group of amino acid or protein at room temperature & gives yellow coloured dinitro phenyl amino acid. 1.5M



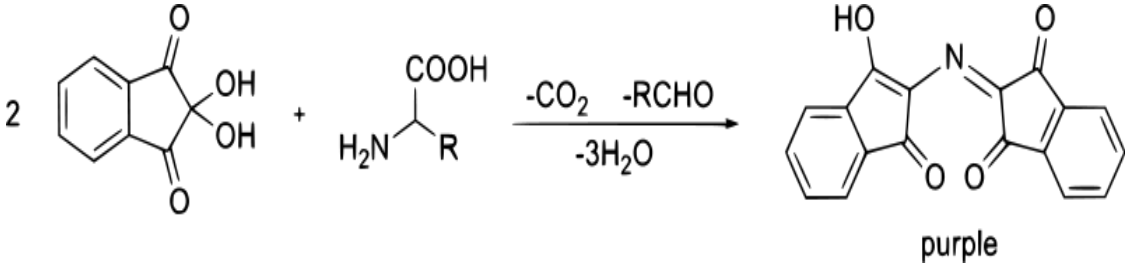
1-FLUORO-2,4-DINITROBENZENE YELLOW PRODUCT

R indicates rest of amino acid structure

(ii) Ninhydrin

In acidic condition amino acid reacts with ninhydrin to give blue to violet colour at 60-70^{0}C . (Reaction is optional)

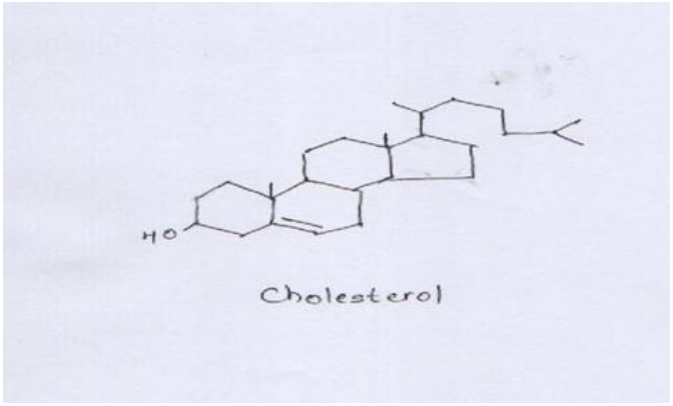
A deep blue or purple colour known as Ruhemann's purple is evolved. It's an identification test for amino acids .Ninhydrin is most commonly used to detect fingerprints. 1.5M



purple

	(e)	**Write short account of -**	
	(i)	**Beri-Beri** The deficiency of vitamin B1 causes Beri-Beri. Beri-Beri may be classified as dry and wet type I] Dry beriberi is associated with nervous system disorder. Ii] In wet beriberi there is polyneuritis along with edema. Symptoms of dry beriberi: Weak & wasted muscles, Difficulty in walking Symptoms of wet beriberi Edema in the legs, Fast pulse, weak heart, Feeling of weakness Treatment of beriberi: By giving thiamine intramuscularly.	1.5M
	(ii)	**Pellagra** It is a vitamin deficiency disease caused by dietary lack of niacin (B3) and protein, especially proteins containing the essential amino acid tryptophan. Because tryptophan can be converted into niacin, foods with tryptophan but without niacin, such as milk, prevent pellagra. **The symptoms of pellagra include:** • High sensitivity to sunlight • Dermatitis, alopecia, oedema • Red skin lesions • Mental confusion • Diarrhoea • Eventually dementia	1.5M

	f)	The main results of pellagra can easily be remembered as "the four D's": diarrhea, dermatitis, dementia, and death. Pellagra can be treated with niacin (usually as niacinamide). The frequency and amount of niacinamide administered depends on the degree to which the condition has progressed. **What are lymphocytes? Give their role in health and disease.** Lymphocytes are among agranulocytes (leucocytes/ WBCs). These have spherical nucleus and are non phagocytic. These constitute to about 23% of total leucocytes. Types: B –cells :These possess the capability to specifically recognize each antigen & produce antibodies (immunoglobulin) against it. T-cells : These can identify viruses and microorganisms from the antigens .They are responsible for cell mediated immunity. **OR** Large lymphocytes are about 12 micron in diameter, the nucleus may be round or kidney shaped. They are younger forms of lymphocytes. Small lymphocytes are slightly larger than R.B.C.s, about 7.5 micron in diameter. Nucleus is relatively large & occupies major part of the cell. 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 pertusis.	1.5M 1.5M

4.		**Solve any FOUR of the following: (4x3)**	
	a)	**Explain 'Mutarotation' of D-glucose**. 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. 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. $(+112^0)$ $(+52.5^0)$ $(+19^0)$	3M
	b)	**Give structure and colour reactions 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	1M

		□ Salkowaski test: 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 . □ Formaldehyde-H2SO4 Test: To a solution of cholesterol in chloroform in dry test tube If 2ml of formaldehyde-sulphuric acid solution is added, cherry colour develops.	2M any 2 reactions
	(c)	**Explain following :**	
	i)	**Essential fatty acids with 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	1.5M
	ii)	**Rancidification of Fats and Oils.** 1. When fats and oils are exposed to light, air, heat, moisture for a longer time, develops disagreeable and objectionable odour. Such oil or fat is said to be rancid, and the phenomenon is called as rancidification. 2. The bad and objectionable odour is because of liberation of volatile fatty acids like butyric acid, caproic acid, caprylic acid. 3. The rancid oils or fats shows acidic reaction due to decomposition of glyceride resulting into more amount of free acid. 4. Rancid oil shows high acid values. 5. Rancidification can be prevented by antioxidants Vitamin E, BHT.	1.5M

	d)	**Name the vitamins, deficiency of which leads to** i) Egg White injury Vitamin H (Biotin). (ii) Pernicious anaemia Vitamin B12 (Cyanocobalamine). (iii) Scurvy Vitamin C (Ascorbic acid) (iv) Night blindness Vitamin A (Retinol) (v) Rickets Vitamin D (Calciferol) (vi) Blood clotting disorder Vitamin K	0.5M each
	e)	**What is dehydration ? Give symptoms and treatment of dehydration.** It is a condition characterized by water depletion in the body It may be due to loss of water alone or due to deprivation of water & electrolytes. Causes : Diarrhea, vomiting, Excessive sweating , Fluid loss in burns, Adrenocortical dysfunction, Kidney diseases, Cholera Symptoms.: Increased pulse rate, low blood pressure, sunken eyeballs, decreased skin elasticity, lethargy, confusion & ultimately coma. Treatment: Intake of plenty of water If a person can't take orally water be given I.V.ly in an isotonic solution (5%glucose) If dehydration is due to loss of electrolytes, then electrolytes can be given orally or intravenously.	1M 1M 1M

	f)	**Explain the term Phenylketoneuria and Maple syrup urine disease**. Phenylketouria: This is a genetic disorder related to phenyalanine metabolism. Phenyalanine is precursor for biosynthsis of tyrosine. In the catabolism of phenyl alanine the first enzyme phenylalanine hydroxylase convert phenylalanine to tyrosine. The inherited deficiency of this enzyme results in accumulation of phenyl alanine, and is excreted as phenyl pyruvate. This condition is called phenyl ketouria.	1.5M
		Maple syrup urine disease: It's a metabolic disorder of branched amino acid. Deficiency of alpha keto dehydrogenase results in accumulation of branched alpha keto acid & are excreted through urine.	1.5M
5		**Solve any four of the following**	
	a)	**Mention factors affecting rate of enzyme catalyzed reaction. Discuss effect of temperature & pH on enzyme catalyzed reaction** 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

Effect of temperature:

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

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

• Above the optimum temperature, rate decreases.

1M

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

• Most of the enzymes get denatured above 60oC.

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

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

Effect of pH:

• 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.

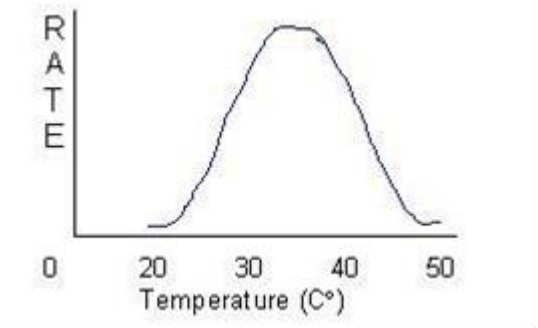
1M

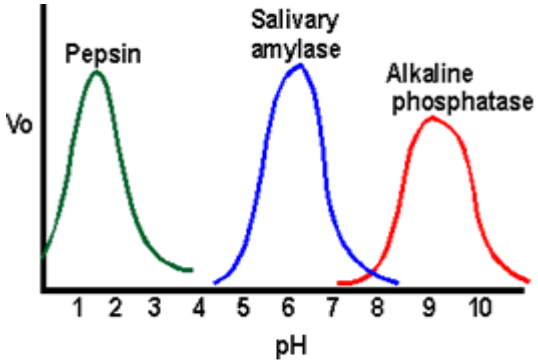
• Buffers are used to keep enzyme at an optimum or at least a favorable H ion concentration.

• 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

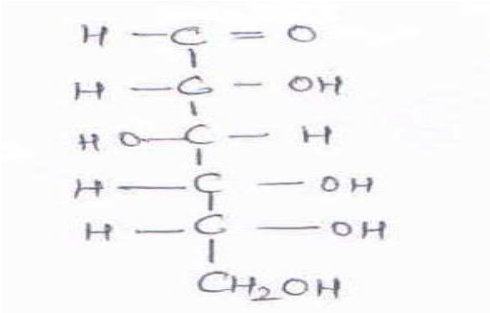
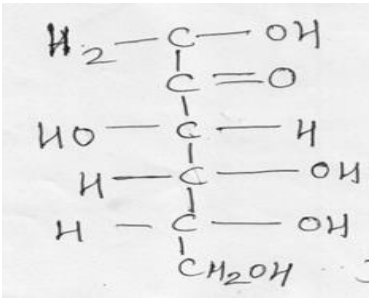
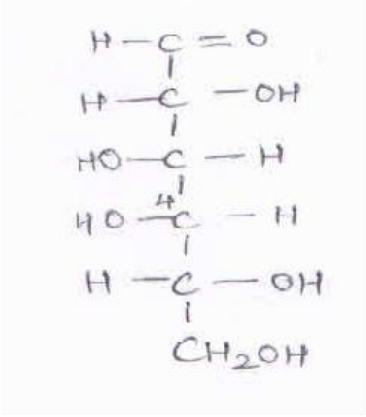




b) Write physiological functions of minerals.

- Maintenance of osmotic pressure of cell
- Oxygen transportation
- Growth and maintenance of tissues and bones
- Proper working of nervous system
- Muscular contraction
- Maintenance of electrolyte balance
- Maintenance of acid- base balance
- Activation of enzymes.

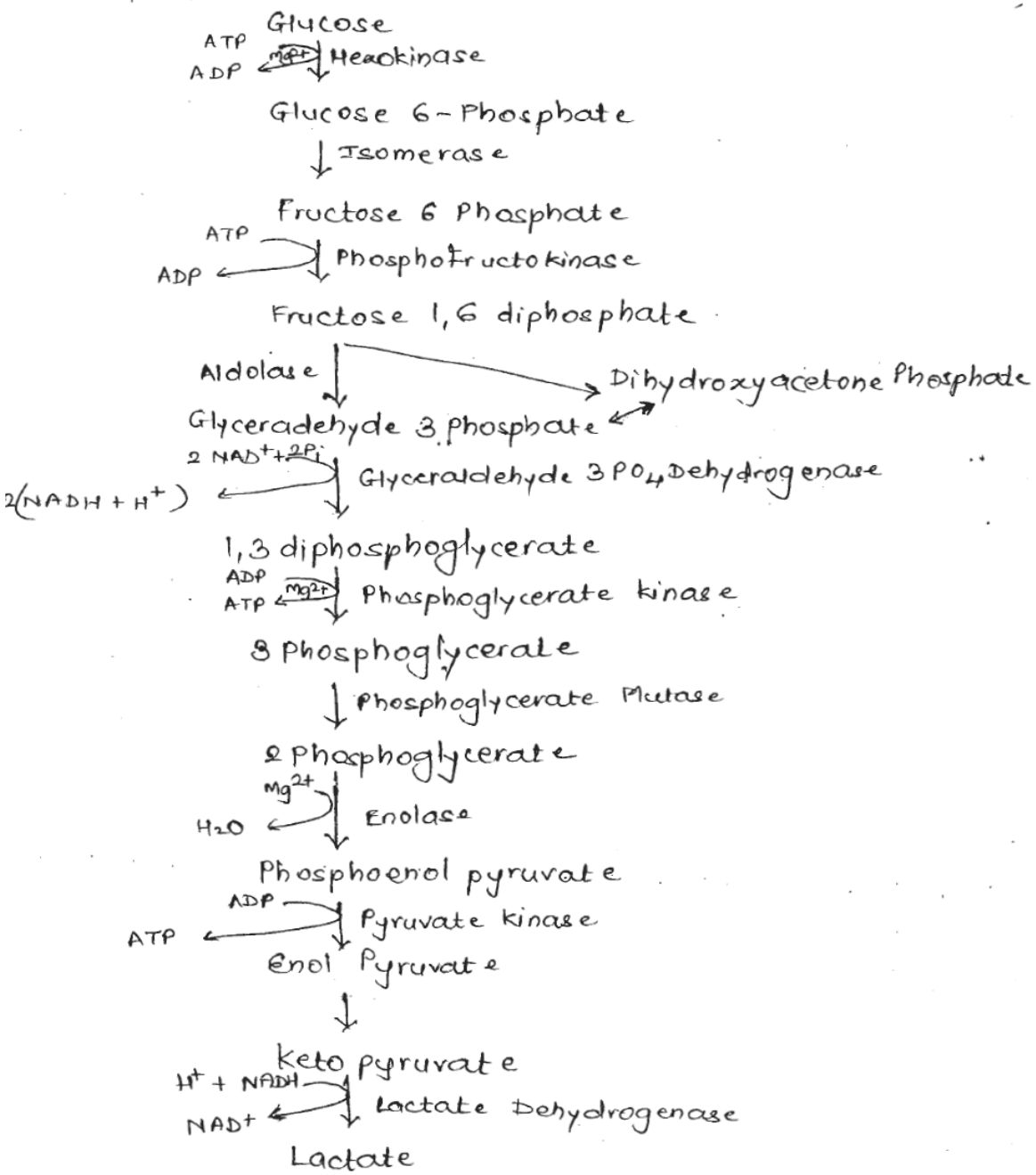
3M for any six

	c)	**Give the structure of D-glucose, D-fructose, D-galactose** **D-Glucose**  **D-fructose**  **D-galactose** 	1M each

	d)	**Define(Any 3)** **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. **iii) Constitutive enzyme:** Produced in absence of substrate. Eg.: Enzymes of glycolytic series **iv)Zymogen** Proenzyme or zymogen is the inactive form of enzyme. It is activated and converted into the active enzyme form such as:	1M each
	e)	**Explain the biochemical role of following co-enzyme** i)NAD It is involved in variety of oxidation-reduction reactions. It is involved in carbohydrate ,lipid, protein metabolism ii) FAD It participates in many redox reactions responsible for energy production It is involved in carbohydrate, lipid, protein & purine metabolism. iii) TPP Plays imp role in transmission of nerve impulse It is intimately connected with energy releasing reactions in carbohydrate metabolism	1M each any 1 function

	f)	**What are Vitamins? Classify with examples** 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. Their absorption requires presence of bile salts and fats. Vitamin A, Vitamin D, Vitamin E and Vitamin K • **Water soluble vitamins:** These are soluble in water and are not stored in body. Water soluble vitamin includes B-complex group and vitamin C. **Non B- complex:** Vitamin C (Ascorbic acid) **B complex** **a)** Vitamin B_1- Thiamine **b)** Vitamin B_2- Riboflavin **c)** Vitamin B_3- Niacin **d)** Vitamin B_5- Pantothenic acid **e)** Vitamin B_6- Pyridoxine **f)** Vitamin B_7- Biotin **g)** Vitamin B_9- Folic acid **h)** Vitamin B_{12}- Cyanocobalamin	1M 2M

6		**Solve any Four of the following**	
	a)	Give steps involved in glycolysis with examples	4M



Glycolysis: (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 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

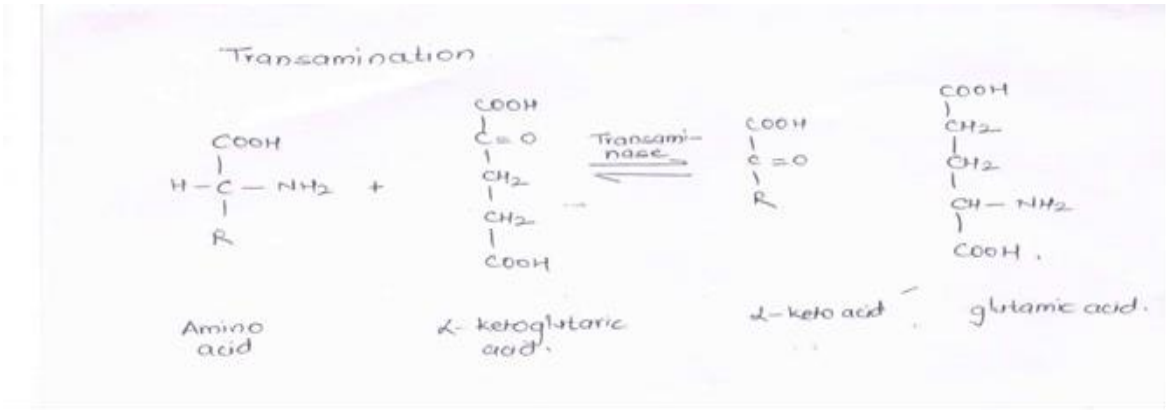
Net reaction for glycolysis is:

Glucose + 2NAD+ + 2 ADP + 2 Pi → 2 Pyruvate + 2 ATP + 2 NADH + 2 H2O

b) **Discuss following reactions with importance**

i) Transamination

In transamination, the NH2 group on one molecule is exchanged with the C =O group on the other molecule. The amino acid becomes a keto acid, and the keto acid becomes an amino acid



In this example alpha keto glutaric acid becomes glutamic acid, amino acid becomes keto acid.

This reaction is reversible.

Importance: It is important for redistribution of amino group and production of non-essential amino acid as per the required of the cell.

It diverts excess amino acids towards energy generation

1M for Explanation or Reaction

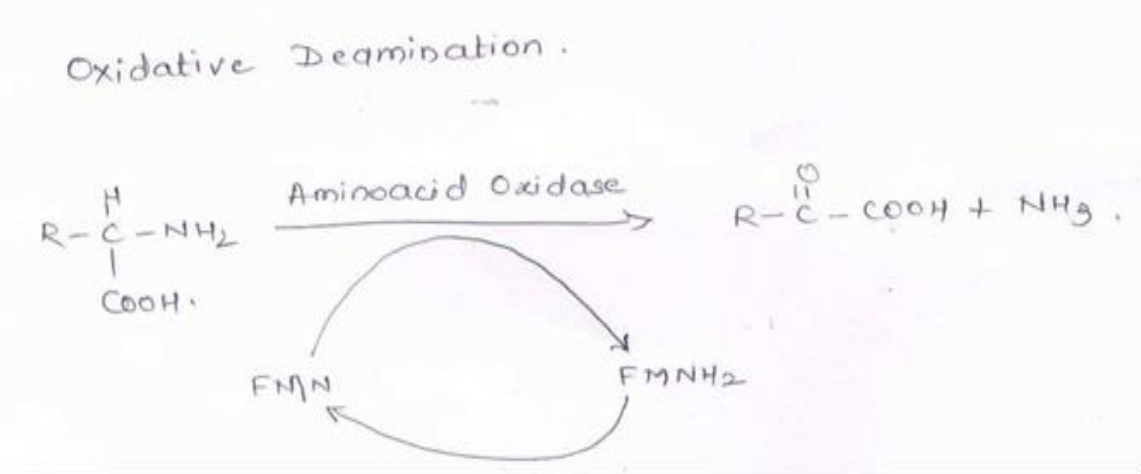
1M Importance

Oxidative deamination:

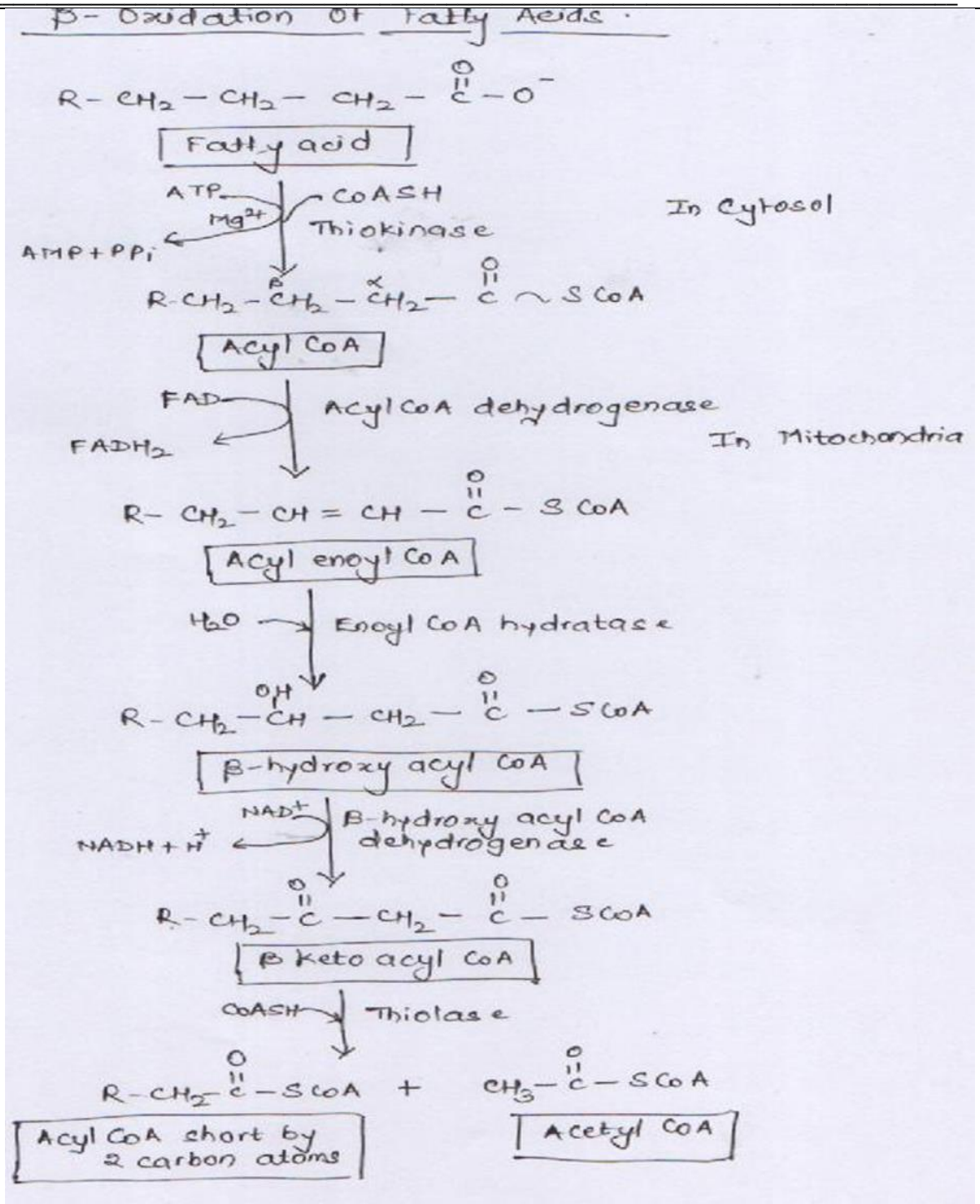
An amino acid is converted into the corresponding keto acid by the removal of the amine functional group as ammonia and the amine functional group is replaced by the ketone group. The ammonia eventually goes into the urea cycle. The main sites for this reaction are liver and kidney. The reaction is catalyzed by amino acid oxidase enzymes.

Importance: It provides ammonia for urea synthesis and alpha keto acid for variety of reactions including energy generation.

Reaction:



	c)	**Discuss in brief the reactions involved in Beta oxidation of fatty acids** (Detailed diagramatic 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+
CoASH
Thiokinase
In Cytosol
AMP + PPi
R-CH2 - β CH2 - α CH2 - C(=O) ~ SCoA
Acyl CoA
FAD
Acyl CoA dehydrogenase
In Mitochondria
FADH2
R- CH2 - CH = CH - C(=O) - SCoA
Acyl enoyl CoA
H2O
Enoyl CoA hydratase
R- CH2 - CH(OH) - CH2 - C(=O) - SCoA
β-hydroxy acyl CoA
NAD+
β-hydroxy acyl CoA dehydrogenase
NADH + H+
R- CH2 - C(=O) - CH2 - C(=O) - SCoA
β Keto acyl CoA
CoASH
Thiolase
R-CH2 - C(=O) - SCoA + CH3 - C(=O) - SCoA
Acyl CoA short by 2 carbon atoms
Acetyl CoA

d) Discuss energetics of TCA cycle — 4M

Energetics of TCA cycle

During the process of oxidation of acetyl CoA via Citric acid cycle or TCA cycle,4 reducing equivalents (3 as NADH & one as $FADH_2$) are produced.

Oxidation of 3 NADH by electron transport chain coupled with oxidative phosphorylation results in synthesis of 9ATP, whereas $FADH_2$ leads to formation of 2 ATP.

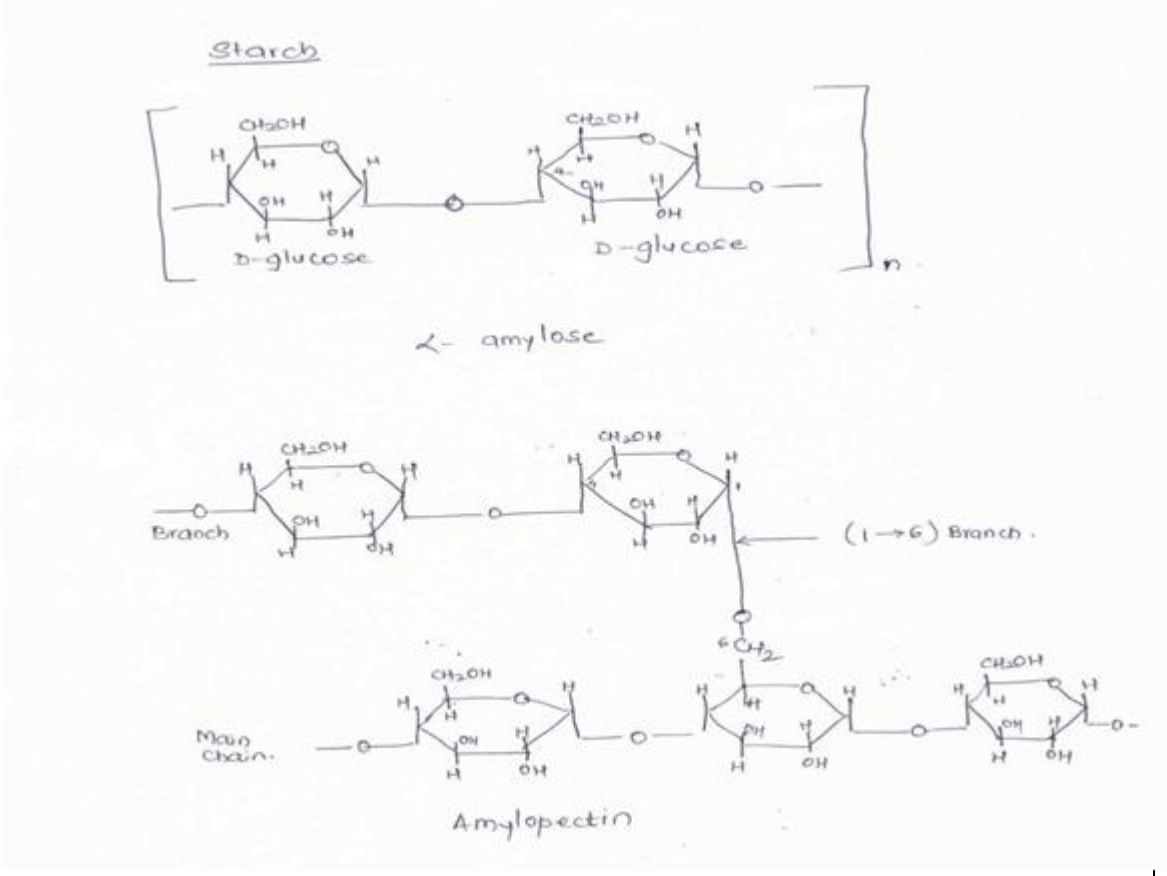
Besides there is one substrate level phosphorylation.

Thus a total of 12 ATP are produced from one acety lCoA

Reaction	ATP molecule formed
1) Isocitrate to oxalosuccinate	3
2) Alpha keto glutarate to succinyl Co-A	3
3) Succinyl Co-A **to** Succinate	1
4) Succinate to Fumarate	2
5) Malate to oxaloacetate	3
Total	12

e) Explain the structure of starch — 2M

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 insoluble.



2M

f)

Give biological functions of phospholipids &write structure of any phospholipid

Functions:

Phospholipids form structural components of membrane& regulate membrane permeability.

Phospholipids are responsible for maintaining conformation of electron transport chain components & so cellular respiration

Phospholipids participate in absorption of fat from intestine & also transport of lipids

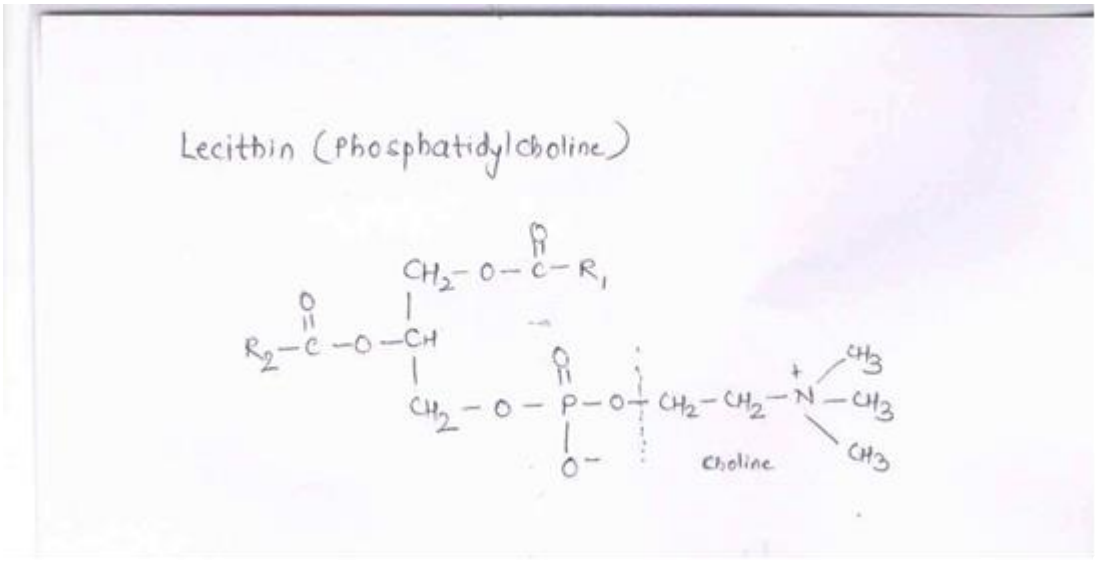
Phospholipids act as surfactants

3M

They are involved in signal transmission across membranes.

Cephalins participate in blood clotting.

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



1M