TIRUPATI COLLEGE OF POLYTECHNIC AND PHARMACY, RATIA

D. PHARMACY FIRST YEAR

BIOCHEMISTRY AND CLINICAL PATHOLOGY

Section A **1 x 10 = 10**

FILL IN THE BLANKS.

1. Uric acid is produced by breakdown of **purine.**
2. The condition in which glucose is present in urine is **glucosuria.**
3. Vitamin B_3 deficiency causes **pellagra.**
4. **Cholesterol** is the main component of gall stones.
5. The condition in which excess of sodium is present in the body is **hypernatremia.**
6. Serum amylase values are increased in **acute pancreatitis.**
7. The sequence of amino acids in protein molecule is determined by **primary** structure.
8. The Ketone bodies present in urine are **ketonuria.**
9. Glucose and fructose can be distinguished by **functional group**.
10. Pregnancy can be detected by the presence of **human gonadotropin (HGT).**
11. The test used for the detection of aromatic amino acids is **millon's test.**
12. SGOT values are increased significantly in **myocardial infarction**.
13. The condition in which excess of cholersterol present in blood is called **hypercholesterolemia.**
14. The conversion of pyruvate to oxaloacetic acid is known as **Citric acid cycle.**
15. The lock and key theory of enzyme action was proposed by **Emil Fischer**.
16. The condition in which blood is present in urine is **hematuria.**
17. **Molish's test** is a preliminary test used to detect carbohydrates.
18. The sequence of amino acids in the protein molecule is determined by **Sanger's reagent.**
19. The deficiency of ascorbic acid causes **scurvy** disease.
20. Sodium deficiency disease is known as **hyponatremia**
21. **Ricket** is a disease in children due to calcium deficiency.
22. Cholesterol belongs to the class of **derived lipids**
23. The optimum temperature range for most of enzymes is **40 - 55 °C**
24. The water soluble vitamins are **B and C.**
25. Urea is converted into ammonia by **action of urease enzymes.**
26. SGPT stands for **serum glutamic pyruvic transaminase.**
27. **Heparin** is anticlotting factor.
28. **Starch** is most common polysaccharide present in plants.

29. Proteins are polymers of amino acid that are linked by **peptide bond.**
30. SGOT stands for **serum glutamic oxaloacetic transaminase.**
31. The preliminary test used to detect proteins in a sample is **ninhydrin test**
32. The formation of erythrocytes is known as **erythropoiesis.**
33. Serum ACP (Acid Phosphatase) activity increases in **prostatic cancer.**
34. Iodine is responsible for the synthesis of **thyroxine** and **triiodothyronine**
35. The synthesis of urea from ammonia is known as **urea cycle.**
36. Rancidity of fat is caused due to **ester hydrolysis.**
37. GTT is done in persons to diagnose **diabetes mellitus.**
38. The major function of iodine is **synthesis thyroid hormone.**
39. The process of blood clotting is initiated by **platelets**
40. **Saliwanoff"s** test is used to distinguish between aldoses and ketoses.
41. The condition in which proteins are present in urine is called **proteinuria.**
42. Vitamin B_{12} is also known as **cyanocobalamine**
43. The vitamin necessary for clothing of blood is **vitamin K**
44. The series of reactions by which glucose is converted to pyruvate is called **glycolysis**.
45. The steroid used to relieve rheumatoid arthritis is **corticosteroids.**
46. The pH of normal urine is **6.**
47. The primary structure of proteins refers to the **linear** sequence.
48. Vitamin **D** is required for proper absorption of dietary calcium.
49. Microcytic anemia occurs due to deficiency of **hemoglobin**
50. **Vitamin C** is an anti-scurvy factor.
51. Loss of water from body is called as **dehydration.**
52. Atherosclerosis is deposition of **saturated fatty acid** in the arteries.
53. **Artherosclerosis** is a condition characterised by thickening of internal layer of artery walls.
54. Sun bath produces vitamin **D** in skin.
55. **Lactose** is a disaccharide present in milk.
56. Presence of **ketone bodies** in urine **indicates starvation.**
57. Sucrose is composed of **fructose** and **glucose**.
58. Calcium and phosphorous are the chief constituents of **bones** and teeth.
59. **Fats** provide more than half of the energy requirements of body.
60. The normal value of renal threshold for glucose is **160-180 mg/dl.**
61. **Glycogen** is the most common polysaccharide present in animals.

62. Increased activity of **acidic phosphatase** enzyme is responsible for prostatic carcinoma.
63. **Kwashiorkar** is the most common protein deficiency disease in children.
64. The fat soluble vitamins are **A,D,E,K**
65. **Lecithin** is an example of phospholipid.
66. **Benedict's reagent** is used to detect presence of glucose in urine
67. **Starch** is the most common polysaachandes present in plants.
68. **Heparin** is anticlotting factor.
69. Cholesterol belongs to class of **derived lipids.**
70. **Rickets and osteoporosis** is most common disease in children due to deficiency of calcium.
71. Two protein deficiency diseases are **marasmus** and **kwashiorkor**.
72. One of the major functions of sodium is **acid base balance.**
73. **Hypoparathyrodism** like calcium reduces neuromuscular excitability.
74. Water logging of tissues is known as **Odema**
75. Vitamin D is an antirachitic factor.
76. Life span of erythocytes is **120 days**.
77. Serum ACP activity is significantly used in **prostatic carcinoma detection.**
78. Membranes are composed of a double layer of **phospholipids.**
79. Glycogenesis is the synthesis of **glycogen.**
80. Vitamin **B_{12} (cynocobalamine)** deficiency produces pernicious anemia.
81. **Glucosuria** is caused when level of glucose in blood crosses renal threshold.
82. **Artherosclerosis** is a condition characterized by thickening of artery walls.
83. Milky white colour of urine is due to presence of **fats.**
84. Histidine is **a heterocyclic** amino acid.
85. Night blindness is also called **nyctalpia.**
86. The optimum pH of erythrocytes is known as **7.4**
87. The major function of chloride is **regulate osmotic pressure**
88. The deficiency of ascorbic acid causes **scurvy**
89. Vitamin B_{12} is also known as **cyanocobalamine**
90. The ketone bodies present in the urine are mainly **acetoacetate**
91. **Cortocosteroid** is a steroid which relieves rheumatoid arthritis.
92. Serum ALP values increase in **rickett's and osteomalacia**

Section-B **3 x 5 = 15**

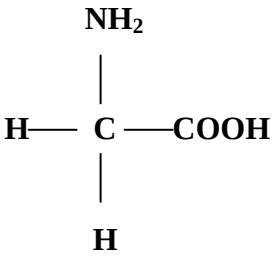
Attempt any five questions. Each question carry four mark

1) What are proteins? Give their classification and role.
2) Name and Explain the protein deficiency diseases.
3) Write a detailed note on mechanism of enzyme action.
4) Write a note on factors effecting enzyme action.
5) Write the functions of sodium and Potassium.
6) Name abnormal constituents of urine and their diagnostic importance.
7) What are amino acids? Classify them with examples.
8) Name any four trace elements and write their functions of each.
9) Define immunity? Explain its classification.

Question No. 01. What are proteins? Give their classification and role.

Ans. **Proteins:** Proteins can be defined as high molecular weight polypeptides containing alpha amino acids joined together by peptide linkage (CO-NH).

At specific pH (Isoelectric pH) amino acids exists as a dipolar ion (Zwitterion**)**



(Glycine Amino Acid)

Role of proteins in human body:

1. They provide structural frame work for cells and tissues.
2. They act as enzymes and hormones.
3. Some transport proteins carry specific substances and store them e.g. – iron is stored as ferritin.
4. Proteins can be catabolised to release energy.
5. Proteins exert osmotic pressure which helps in maintaining electrolytes and water balance.
6. Receptor proteins bind with specific substances like vitamins, minerals & mediate their cellular actions.
7. Storage proteins bind with specific substances and store them e.g. - iron is stored as ferritin.

Classification of proteins: Proteins are commonly classified on the basis of physical properties like solubility and composition.

i) **Simple proteins**: On hydrolysis they give only α-amino acids. For example: - Globulin, Glutelin, Prolamines, Sclero Proteins, Histones and Protamines

ii) **Conjugated proteins**: These are simple proteins combined with a non-protein group called prosthetic group. On the basis of prosthetic group the conjugated proteins are classified as: Nucleo proteins, Phosphoproteins, Glycoproteins, Lipoproteins, Metalloproteins and Chromoproteins.

iii) **Derived proteins**: These are formed from simple and conjugated proteins by physical or chemical factors. Derived proteins are classified as:

a) Primary Derived Proteins and b) Secondary Derived Proteins

Question No. 02. Explain the protein deficiency diseases.

Answer : Dietery deficiency of proteins :

1. Kwashiorkar : Protein energy malnutrition (PEM) or diet low in protein.
    i) Retard growth, oedema, vomiting and diarrhoea.
    ii) Skin pigmentation, thickening, cracks and ulceration.
    iii) Hair thin and colour change.

    Supplement : Milk, egg and soyabean.
2. Marasmus : Occurs in second six month of child, diet low in protein.
    i) Muscles are severely wasted.
    ii) Head is large and limbs are thin like sticks.

    Supplement : Milk, egg, soyabean and diet rich in protein.

Proteins Metabolism Disorder: Some diseases are caused by abnormal metabolism of proteins, for Example: i) Phenylketonuria ii) Alkaptonuria iii) Albinism iv) Tyrosinosis

i) Phenylketonuria: It is a metabolic disorder of proteins which occurs due to the absence of the enzyme phenylalanine hydroxylase as a result phenylalanine cannot be converted into tyrosine. So this leads to increased excretion of phenylalanine and its catabolite like phenyl pyruvic acid and phenyl lactic acid. The manifestation of this disease is mental retardation and seizures. Also diminished pigmentation of hair and skin can occur. It can be treated by giving a diet with low levels of phenylalanine. Tyrosine constitutes an essential amino acid in these patients and it must be provided in the diet

ii) Alkaptonuria: It is a metabolic disorder associated with abnormal metabolism of tyrosine. It is caused by the absence of the enzyme homogentisate oxidase. So, homogentisic acid accumulates in the tissues and blood and also it appears in urine. Urine containing homogentisic acid turns black in color due to oxidation when exposed to air. Alkaptonuria does not produce any clinical manifestation.

iii) Albinism: Congenital non pathological partial or total absence of pigment in skin, hair and eyes.

iv) Tyrosinosis: It is a condition resulting from faulty metabolism of tyrosine, whereby its oxidation products appear in urine.

Question No. 18. Write a detailed note on mechanism of enzyme action.

Ans. Mechanism of enzyme action: Enzyme acts on a substrate and converts it into a product. The enzyme is regenerated at the end of the reaction. The sequence at which this occurs is as follows.

i) All enzymes have reactive sites on their surface. The substrate fits on the reactive site of the enzymes. This produces a complex called enzyme substrate complex. It is also called as Michaelis complex.

ii) This complex activates the substrate which has fit on the surface of enzyme. As a result an activated complex is formed.

iii) Activation of the substrate converts it into the products. Now, the enzyme is regenerated. So, the enzyme can act on another substrate molecule and the process is repeated.

The sequence of reactions can be written as follows:

Enzyme + Substrate ⟶ Enzyme substrate complex (Michaelis complex)

Enzyme substrate complex ⟶ Activated complex

Activated complex ⟶ Products + Enzyme

Question No .04. Write a note on factors effecting enzyme action.

Answer: 1. Temperature: the rate of enzyme reaction increase with increase in temperature. The temperature at which enzyme action is maximum is called optimum temperature.

2. pH: The rate of enzyme reaction increases with the increase in pH. The pH at which enzyme action is maximum is called optimum pH.

3. Concentration of enzyme: The rate of enzyme reaction increases with the increase in enzyme concentration. When all the substrate molecules are saturated with the enzyme, further increase in enzyme concentration has no effect.

4. Concentration of substrate: The rate of enzyme reaction with increase in concentration of substrate These aspects are explained by Michaelis curve and Lineweaver –Burk plot.

5. Radiation: X-Rays, UV, Beta and Gamma rays produce inactivation of enzyme.

Question No.05. Write the functions of sodium and Potassium.

Answer: Potassium is very important in the human body. Along with sodium, it regulates the water balance and the acid-base balance in the blood and tissues. Potassium enters the cell more readily than does sodium and instigates the brief sodium-potassium exchange across the cell membranes. In the nerve cells, this

sodium-potassium flux generates the electrical potential that aids the conduction of nerve impulses. When potassium leaves the cell, it changes the membrane potential and allows the nerve impulse to progress. This electrical potential gradient, created by the "sodium-potassium pump," helps generate muscle contractions and regulates the heartbeat. Another of the pump's most important functions is preventing the swelling of cells. If sodium is not pumped out, water accumulates within the cell causing it to swell and ultimately burst.

Potassium is very important in cellular biochemical reactions and energy metabolism; it participates in the synthesis of protein from amino acids in the cell. Potassium also functions in carbohydrate metabolism; it is active in glycogen and glucose metabolism, converting glucose to glycogen that can be stored in the liver for future energy. Potassium is important for normal growth and for building muscle.

Though sodium is readily conserved by the body, there is no effective method for potassium conservation. Even when a potassium shortage exists, the kidneys continue to excrete it. Because the human body relies on potassium balance for a regularly contracting heart and a healthy nervous system, it is essential to strive for this electrolyte's balance.

Question No.06. Name abnormal constituents of urine and their diagnostic importance.

Answer: Substances like proteins, albumin, sugars, ketone bodies, and blood not excreted in urine. They are excreted in urine in some pathological conditions. So they are called as abnormal constituents of urine.

The presence of abnormal constituents in urine helps in the diagnosis of various systemic and renal diseases.

Abnormal constituent	**Disease**
Proteins	proteinuria
Glucose	Glucosuria
Pentoses	Pentosuria
Ketone bodies	Ketosis
Bile salts & Bile pigments	Jaundice
Blood	Heamaturia
Pus	pyuria

1) Proteinurea:

It means the presence of protein in the urine. Normal urine in all animal species contains little or small amount of protein from desquamation of epithelial cells and other sources, but the amount is insufficient to produce a positive reaction to the standard test. Also, urine of equines has an increased protein level, and consequently their urine appears turbid.

Proteinuria is usually associated the following disease conditions:

- Hemoglobinuria, myoglobinuria, hematuria.
- Glomerulonephritis, renal infarction, nephrosis, amyloidosis, congestive heart failure.

2. Hematuria:

It is the presence of intact blood cells in the urine. It may appear as gross blood clots passed at the beginning, during, or at the end of urination or as more uniformed discoloration of the urine throughout the urination without clots. It large clots are present, obstruction of U.T. may occur, resulting in stranguria and dysuria.

3. Hemoglobinuria:

It is defined as presence of hemoglobin in the urine. False hemoglobinuria occurs with cases of hematuria when the R.B.Cs is destroyed and liberate their contents of hemoglobin into urine. Meanwhile, true hemoglobinuria is manifested by deep red discoloration of the urine caused by lysis of R.B.Cs due to many diseases such as:

- Bacillary hemoglobinuria.
- Babesiasis.

4. Glucosuria and Ketonuria:

Glucosuria is not common in large animals but occurs usually in pet animals such as in diabetes mellitus. Glucosuria in large animals is usually associated with the following disease conditions:

- Enterotoxaemia is caused by clostridium peferinges type D.
- Meanwhile, ketonuria is more common in cattle and sheep as in cases of starvation, pregnancy toxemia and acetonemia in cattle.

Question No. 07. What are amino acids? Classify them with examples.

Answer: Amino acids: Amino acids are the simplest units of proteins .All amino acids consists of 1) free NH2 group 2) a free COOH group. ALL amino acids of proteins have the NH2 group attached to carbon atom which is next to COOH group.

Classification:- Based on properties

1. Neutral Amino Acid : Glycine, Alanine, Serine, threonine, Valine, Leucine, Isolucine
2. Acidic Amino Acid : Aspartic Acid, Glutamic Acid.
3. Basic Amino Acid : Arginine, Lysine.
4. Sulfur Containing Amino Acids : Cysteine, Cystine, Methionine.
5. Aromatic Amino Acid : Phenylalanine, Tyrosine, Tryptophan.
6. Heterocyclic Amino Acid : Proline, Hydroxyproline, Histidine.

Question No.08. Name any four trace elements and write their functions of each.

Answer: A **trace element** is a chemical element such as iron or zinc that occurs in very small amounts in living things and is necessary for normal growth and development.

Function:

1) **Iron**: Iron is present in all body cells. As a component of hemoglobin and myoglobin, it functions as a carrier of oxygen in the blood and muscles. Because of iron losses during menstruation, women in their reproductive years require higher iron intakes than men.
2) **Zinc:** Zinc, a constituent of more than 200 enzymes, plays an important role in nucleic acid metabolism, cell replication, tissue repair, and growth through its function in nucleic acid polymerases. These zinc-dependent enzymes include the potentially rate-limiting enzymes involved in DNA synthesis. Zinc also has many recognized and biologically important interactions with hormones and plays a role in production.
3) **Iodine:** Iodine is an essential micronutrient and an integral component of thyroid hormones. In food and water, iodine occurs largely as inorganic iodide and is absorbed from all levels of the gastrointestinal tract.
4) **Chromium**: Chromium is an essential trace element needed for normal carbohydrate metabolism. The biologic function of chromium is closely associated with that of insulin. Most chromium-stimulated reactions are also insulin dependent. For example, chromium functions in carbohydrate and lipid metabolism as a potentiator of insulin action.

Question No.09. Define immunity? Explain its classification.

Answer: Immunity is defined as the resistance against an infecting organism. The immune mechanism of the body is capable of recognising, destroying and eliminating infectious micro organism. The immune mechanism is due to antibodies produced in the body.

Classification of Immunity: Immunity can be classified into:

(1) Natural Immunity (2) Artificial Immunity

Natural Immunity-This type of immunity is inherited from birth itself. This type of immunity provides natural resistant against disease. For example, Man is naturally resistant to a virus which produces a disease called rinderpest in cattle.

Artificial Immunity-It produced by the administration of vaccines or suitable substances. Artificial Immunity is classified into 1.Active immunity 2.Passive immunity

1. Active immunity-It involves the stimulation of the body to produce its own antibodies. The stimulation of antibody production is achieved by the administration of vaccines, toxoids etc. Active immunity takes some time to develop, but it is of long duration.

2. Passive Immunity- It involves the administration of an antibody produced in one body to another i.e. readymade antibodies are administered. Passive immunity develops rapidly, but it is of short duration.

Section-C **5 x 5 = 25**

Attempt any five questions. Each question carry five mark

1) Write short note on GTT and its importance.
2) Define reducing sugar and non-reducing sugar. Enumerate the tests for reducing sugar.
3) Write a short note on coenzymes.
4) Write a note on enzymes of diagnostic importance.
5) Enlist the various parameters used to study oils and fats.
6) How is albumin detected in urine?
7) What is anemia? Explain various types of anemia.
8) What are lymphocytes and mention their role?
9) Give the platelets in blood clothing process.
10) Write a note on diabetes mellitus and its diagnoses.
11) Write a note on water balance in human body.
12) Explain role of calcium in life processes.

Question No. 01. Write short note on GTT and its importance.

Answer: GLUCOSE TOLERANCE TEST (GTT)

The diagnosis of diabetes can be made on the basis of individual's response to the oral glucose load, commonly referred to as oral glucose tolerance test (OGGT). The person should have been taking carbohydrate-rich diet for at least 3 days prior to the test. All drugs known to influence carbohydrate metabolism should be discontinued (for at least 2 days). The subject should avoid strenuous exercise on the previous day of the test. He/she should be in an overnight (at least 10 hr) fasting state. During the course of GTT, the person should be comfortably seated and should refrain from smoking and exercise.

Question No. 02. Define reducing sugars and non-reducing sugars. Enumerate the tests for reducing sugar.

Answer: Reducing sugars: These are those sugars molecule which reduce Benedict's reagent and Fehling's solution due to free aldehydes or ketones group e.g. all Monosaccharide and disaccharides except Sucrose and Trehalose.

Non Reducing sugars: These are those sugar molecule which don't reduce the Benedict's reagent and Fehling's solution e.g., Sucrose, Trehalose and all polysaccharides**.**

Qualitative tests for Carbohydrates (Reducing Sugars):

i) Fehling's test: One ml of the test solution and 2 ml of Fehling's solutions are boiled in a test tube for 2 minutes. A brick red precipitate indicates the presence of reducing sugar.

ii) Benedict's test: One ml of an aqueous solution of the test substance and 2 ml of Benedict's reagent are boiled in a test tube for 2 minutes. A brick red precipitate indicates the presence of reducing sugars.

iii) Barfoed's test: 10 ml of the test solution is taken in a test tube. To this, 1 ml of Barfoed's reagent (copper acetate and acetic acid) is added. The contents are heated in water bath for 5 minutes. A brick red precipitates indicates the presence of monosaccharides.

iv) Seliwanoff's test: One ml of an aqueous solution of the test substance is taken in a test tube. To this, add 2 ml of Seliwanoff's reagent (resorcinol and HCl). A cherry red color is formed on boiling. It indicates the presence of fructose.

Question No. 03. Write a short note on coenzymes.

Answer: Co-enzyme: The non-protein, organic, low molecular weight and dialysable substance associated with enzyme function are known as coenzyme. It is attached to the enzymes which is a protein substance. When the attachment is weak the non-protein part is called as coenzyme. If the attachment is firm, the non-protein part is called as prosthetic group. They differ from enzymes in the following aspects.

1. They are non-protein in nature.
2. They have a low molecular weight.
3. They are heat stable.
4. They can be separated by dialysis.
5. They are generally derived from vitamins.

Apo enzyme is the protein part of the enzyme to which the coenzymes is attached.

Halo enzyme is complete enzyme which consists of apoenzyme and coenzyme.

Classification of coenzymes: They can be broadly classified as:

i) Group transferring coenzyme: TPP, Biotin and Coenzyme A.

ii) Hydrogen transferring coenzymes: NAD, NADP, FAD, FMN.

Question No. 04. Write a short note on enzymes of diagnostic importance.

Answer: Medicinal uses of enzymes:

1). **Drugs acting through enzymes**: A number of drugs act by inhibiting enzymes. Enzymes act on drugs and convert them into inactive metabolites. So the duration of action of drug is increased. In presence of compound which inhibits the enzyme, the formation of inactive metabolite is prevented. So the drug remains in active form. So the duration of drug is prolonged e.g. acetylcholine is inactivated by the enzyme acetyl cholinesterase.

2) Therapeutic uses of enzymes: Enzymes are used for the treatment of number of diseases. The following are a few examples:

a) **Enzymes for improving digestion**: Enzymes like pepsin, papain, and amylase are administered for improving digestion.

b) **Enzymes for diffusion of drugs:** The enzymes HYALURONIDASE is used for diffusion of no. of drugs.

c) **Enzyme for dissolving blood clot**: The enzymes streptokinase and urokinase are used for dissolving blood clot

d) In treatment of cataract: The enzyme trypsin is used for liquefying the lens. So it is used in the treatment of cataract

e) In treatment of cancer: The enzyme asparaginase is used for the treatment of cancer.

Question No. 05. Enlist the various parameters used to study oils and fats.

Answer: Characterization of fats and oils: Fats and oils form essential constituents of diet. Edible oils and fats like butter and ghee are usually adulterated, so it is necessary to identify the fat and assess its purity. This can be done by physical methods like specific gravity and solidification point. Various parameters are used to study oils and fats. Following are the chemical methods by which fat can be identified:

i) Saponification Number: It is the number of mg of KOH required to saponify 1g of fat or oil.

ii) **Acid Number:** It is the number of mg of KOH required to neutralize the fatty acids in 1g of fat.

iii) Acetyl Number: It is the number of milligram of KOH required to neutralize the acetic acid obtained by the saponification of 1gram of acetylated fat.

iv) Polenske Number: It is the number of ml of 0.1N KOH required to neutralize the insoluble fatty acids from 5g of fat.

v) Reichert-Meissel Number: It is the number of milliliters of 0.1N KOH required to neutralize the soluble volatile fatty acids distilled from 5grams of fat.

vi) Iodine Number: It is number of grams of iodine absorbed by 100 grams of fat.

Question No. 06. How is albumin detected in urine?

Answer: Normal urine virtually has no protein. The protein that is excreted in urine is very insignificant. But proteins may be excreted in urine in some diseases. The proteins, albumin is readily excreted because of its smaller size. So urinary excretion of protein is referred as abluminuria.

Causes for Proteinuria may be :

1. Violent exercise
2. Pregnancy
3. High Fever
4. Renal diseases like nephritis and nephrosis.
5. Ascites and abdominal tumours.

Test for albumin detected in urine:

a) **Heat test**: Urine is taken 2/3 full in a test tube. Holding the bottom of the test tube, top portion of urine is heated. Then, 1or 2 drops of acetic acid is added. Turbidity or precipitate in the heated portion indicates the presence of albumin.

b) **Sulphosalicylic acid test:** 2 ml of urine is taken in a test tube. In this, a few drops of 25% Sulphosalicylic acid is added. A white precipitate indicates the presence of albumin.

c) **Heller's Nitric acid test**: To 3 ml of nitric acid taken in test tube, 2 ml of urine is added carefully on the sides. A white ring at the junction of the two liquids indicates the presence of albumin.

Question No. 07. What is anemia? Explain various types of anemia's.

Answer: Anemia: It is the disease which occurs due to deficiency in the number of red blood cells or deficiency of hemoglobin. Because of any one of these deficiencies, there is decrease in oxygen carrying capacity of blood. The symptoms of anemia are in the form of breathlessness, tiredness, loss of appetite and pallor of skin. The important types of anemia are:

i) Iron deficiency anemia ii) Megaloblastic anemia

iii) Hemolytic anemia iv) Aplastic anemia

i) Iron deficiency anemia: This type of anemia occurs due to deficiency of iron in low dietary intake or decreased absorption. Due to lack of oxygen and iron, sufficient hemoglobin is not formed.

ii) Megaloblastic anemia: This type of anemia occurs due to deficiency of either vitamin B_{12} **(**also known as **pernicious anemia)** or folic acid. Both are required for the maturation of red blood cells. So immature large sized red blood cells called magaloblasts are released in circulation.

iii) Hemolytic anemia: It occurs due to increased destruction of red blood cells. It occurs due to hereditary disorder, mechanical injury to red blood cells and infections like malaria.

iv) Aplastic anemia: It occurs due to suppression of bone marrow function. It can be caused by drugs, chemicals, irradiation or malignant disease.

Question No. 08. What are lymphocytes and mention their role?

Answer: Lymphocytes: They are non-granular leucocytes. They are small round cells. They are present not only in blood but also lymph, lymphoid organs and many other tissues. Lymphocytes constitute 20-25% of leucocytes. These are of two types i.e. small and large. Small are 25% of total WBC's and large are 3-5% only. In small lymphocytes nucleus almost occupies the whole cell, leaving a thin rim of cytoplasm. Large lymphocytes contain more amount of cytoplasm.

Classification of lymphocytes:

1. Based on morphological characters 2. Based on Life span 3. Immunological characters

1. Morphological classification:

Small Lymphocytes: They are 9-12 µm diameters. They contain a small, spherical nucleus and a thin rim of cytoplasm. They show a slow movement. During movement, the nucleus is in the front and cytoplasm is behind just at tail. This looks like a hand mirror

Large Lymphocytes: They are 12-16 µm diameters. They are round in outline. The nucleus is round. Cytoplasm is abundant, stains pale-blue and is non-granular.

2. Classification based on life span:

Shirt- lived Lymphocytes: They are a life span of two weeks.

Long-lived Lymphocytes: They are a life span of 3 years or more or even for life.

3. Immunological Classification:

Lymphocytes are involved in immunological reactions. Based on this function, lymphocytes are classified as T cells and B cells.

Question No. 09. Write a note on diabetes mellitus and its diagnoses.

Answer: Diabetes Mellitus: The normal blood glucose level is 80-120 mg/dl. Due to the deficiency of insulin, there is derangement in carbohydrate metabolism. This leads to an increase in blood glucose level. This condition is called as diabetes mellitus. Diabetes mellitus is a serious pathological disorder due to lack/deficiency/inactivation of the hormone insulin, secreted from ß-cells of pancreas and characterized by polyuria, polydypsia, polyphagia, glycosuria.

i) Hyperglycemia i.e. increase in glucose level in blood

ii) Glycosuria i.e. presence of sugar in urine

The symptoms of diabetes mellitus are:

Polyphagia – increased appetite

Polydypsia – Increased thirst

Polyuria – increased urine output.

The causes for increased blood sugar level in diabetes mellitus are:

a) Increased absorption of glucose from intestine.

b) Decreased entry and oxidation of glucose in muscles and other tissues.

c) Decreased glycogen formation in the liver.

d) Increased glycogen breakdown in the liver.

All these occur due to the deficiency of insulin which regulates carbohydrate metabolism. The complications of diabetes mellitus are Neuropathy, Cataract and retinopathy and Nephropathy.

Question No. 10. Write a note on water balance in human body.

Answer: Role of water in life processes: Water content of the body is about 60 to 70% of body weight. Water present in the body may be classified as:

i) Intracellular Water (50% of body weight)

ii) Extracellular Water (Plasma-7.5%, Interstitial fluid-20%, Connective tissue-15%, CSF, endolymph-5%)

Functions of body water:

i) It acts as a solvent.

ii) It is a regulator of body temperature.

iii) It lubricates joints and membranes.

iv) It is a carrier for nutrition and waste products.

v) It regulates electrolytes balance and osmotic pressure.

Body is said to maintain water balance when water gain is equal to water loss.

Water balance: In heath, a balance is maintained between intake and output of water. The regulatory mechanism prevents accumulation of water which leads to edema and loss of water which leads to dehydration. The regulatory mechanism is further influenced by hormones like ADH and aldosterone.

Question No. 11. Explain role of calcium in life processes.

Answer: This mineral is essential for a number of metabolic processes like blood coagulation, muscle contraction and enzyme action.

Classification of mineral elements:

i) Macro-minerals: For e.g. Calcium, Magnesium, sodium, potassium, phosphorus, sulphur & chlorine.

ii) Micro-minerals (Trace elements): For e.g. Iron, Iodine, Zinc, Copper, Cobalt, Fluorine & vanadium

Role of calcium in life processes: It's present in large amounts in the body. It constituents 2% of body weight. A normal adult has 1200 grams of calcium in the body.

Sources: Milk, Cheese and Vegetables.

Physiological functions:

a) It is necessary for the formation and growth of bones and teeth.

b) It is essential for coagulation of blood.

c) It is essential for transmission of nerve impulses.

d) It is also necessary for muscle contraction.

e) It helps in maintaining acid balance and water.

f) It activates a number of enzymes.

Blood calcium: In blood, calcium is present only in the plasma. The plasma concentration of calcium is 9 to 11 mg%. Plasma calcium exists in three forms: Ionized or diffusible form, Unionized or non- diffusible form and unionized complex with citrate

Section-D **10 x 3 = 30**

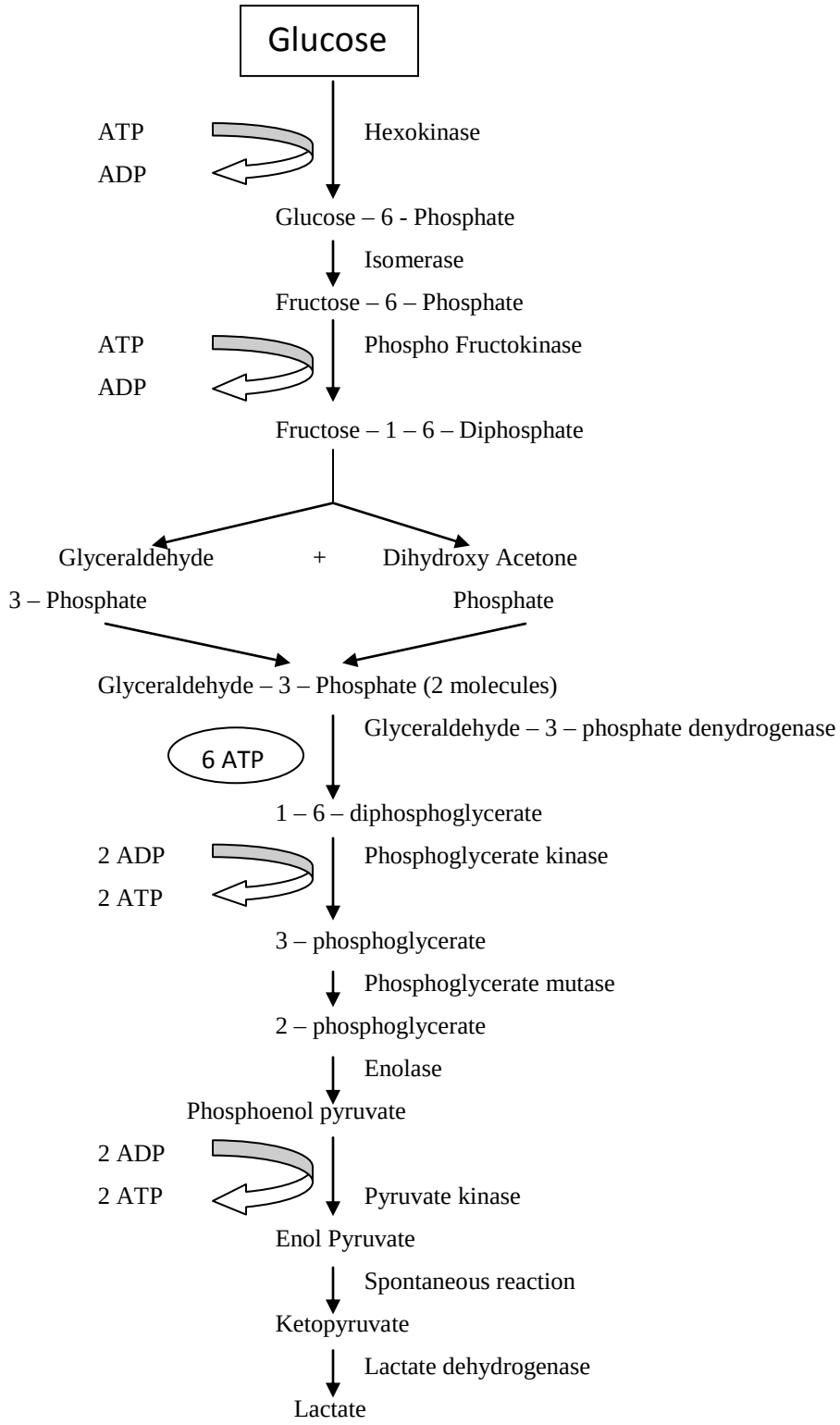
Attempt any three questions. Each question carry ten marks

1) Give the schematic representation of Glycolysis.
2) What are lipids? Give their classification and explain the role of lipids in the body. Enlist the diseases due to disorder of lipid metabolism. What is β- oxidation of fatty acids?
3) What is urea cycle? Explain the steps involved in urea cycle.
4) What are enzymes? Given their classification and explain the factors affecting.
5) What are proteins? Give their classification and role. Explain the protein deficiency diseases.
6) Define vitamins? Give the classification of vitamins and discuss fat soluble vitamin in detail.
7) Write a detailed note on mechanism of enzyme action.
8) What is TCA cycle? Explain the reactions involved in TCA cycle.
9) List the important constituents of urine. How is their detection important?

Question No. 01. Give the schematic representation of Glycolysis.

Ans. Glycolysis is defined as the sequence of reaction converting glucose to pyruvate or lactate, with the production of ATP. Glycolysis is an anaerobic phase of carbohydrate metabolism. All the enzymes of Glycolysis are found in the extra mitochondrial soluble fraction of the cell. The net numbers of ATP synthesized are eight in Glycolysis cycle.

The reactions of glycolysis can be schematically represented as follows:



Significance of glycolysis:

1. Tissue that functions under hypoxic circumstances will produce lactic acid from glucose oxidation, producing local acidosis.

2. If vigorously contracting skeletal muscle will produce lactic acid.

3. Whether oxygen is present or not, Glycolysis in erythrocytes always terminates in pyruvate and lactate.

4. When there is relative anaerobiosis, glycolysis will stop as cells will exhaust NAD^+.

5. Inhibition of lactate dehydrogenase (LDH) is oxamate. It competitively inhibits LDH and prevents the reoxidation of NADH.

Question No. 02. What are lipids? Give their classification and explain the role of lipids in the body. Enlist the diseases due to disorder of lipid metabolism. What is β- oxidation of fatty acids?

Ans. Lipids are a group of compounds related to fatty acids and are insoluble in water but soluble in organic solvents.

Lipids can be classified as follows: -

1) Simple lipids: - Simple lipids are the esters of fatty acids with alcohols. They are subdivided as:

a) Fats: Esters of fatty acids with glycerol.

b) Waxes: Esters of fatty acids with higher alcohol.

2) Compound lipids: - They are esters of fatty acids with alcohol, which contain additional group i.e., carbohydrates, phosphate, protein etc. They can be subdivided into the following groups:

a) Phospholipids (b) Glycolipids (c) Sulfolipids (d) Lipoproteins

3) Derived Lipids: Derived lipids are the substances which are derived from the above groups by hydrolysis. They Include:

(a) Fatty Acids (b) Alcohols (c) Sterols and steroids (d) Polyisoprenoids

Biochemical role of lipids:

1) Lipids are important constituents of diet.
2) Lipids act as a fuel and yield energy.
3) Lipids act as insulation and protect vital organs.
4) Lipids provide building blocks for high molecular weight substances. For example acetic acid is used for the synthesis of cholesterol and some hormones.
5) They supply essential fatty acids, which are not synthesized in the body.
6) They act as carriers for fat-soluble vitamins.
7) They are important structural component of cell membrane.

ß Oxidation: - Oxidation takes place at ß-carbon of the fatty acid. This type of oxidation takes place in fatty acids containing even and odd number of carbon atoms and also in unsaturated fatty acids.

Mechanism:

i) Activation ii) Desaturation iii) Oxidation iv) Thiolytic Cleavage

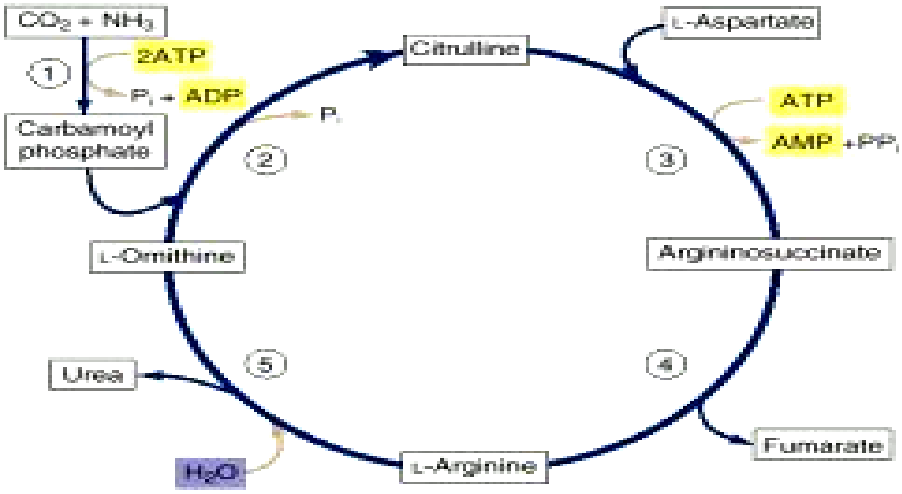
Fatty acid undergo various mechanism shown above and it is converted into ß - keto fatty acyl CoA. Finally and given reaction throw thiolytic cleavage process and carbon dioxide and water is produced. This process is repeat until entire fatty acid chain is converted in to acetyl CoA. ß -Oxidation pathway is most important pathway in fatty acid metabolism with generation of high energy (Five Molecules of ATP are produced in each round of ß-oxidation)

Question No. 03. What is urea cycle? Explain the steps involved in urea cycle.

Ans. Urea Cycle: (Kreb's Henseleit cycle): Urea is the end product of protein metabolism. The nitrogen of amino acid converted to ammonia. Ammonia is highly toxic. It is converted to urea and detoxified. Urea is synthesized in liver and transported to kidneys for excretion in urine.

Steps of Urea cycle:

1) Formation of carbamoyl phosphate
2) Formation of citrullin
3) Synthesis of arginosuccinate
4) Conversion of arginosuccinate to arginine
5) Arginine to urea



KEY TO ENZYMES (Circled Numbers)
1. Carbamoyl-phosphate synthase (ammonia)
2. Ornithine carbamoyltransferase
3. Argininosuccinate synthase
4. Argininosuccinate lyase
5. Arginase

Figure: Urea cycle

Significance of urea cycle:

i) Detoxification of Ammonia: Major biological role of this pathway is the detoxification of ammonia. Toxic ammonia is converted into a non toxic substance urea and excreted in urine.

ii) Biosynthesis of Arginine: The urea cycle also serves for the biosynthesis of arginine from ornithine in liver, kidney & intestinal mucosa. Kidney & mucosa probably contribute most of the body arginine because they possess all the urea cycle enzymes except **ARGINASE.** Hence they can from up to arginine & cannot from urea. The arginine is used for protein synthesis.

Question No. 04. What are enzymes? Given their classification and explain the factors affecting.

Ans. Enzymes: Enzymes are biocatalyst. These are substance that increases the velocity or rate of a chemical reaction without itself undergoing any change in overall process.

Classification of enzymes: - Enzyme is biological catalysts required in small amounts to catalyze biochemical reactions.

Classification of enzymes:

1) Oxidoreductases (alcohol. Dehydrogenase, lactate dehydrogenase)
2) Transferases (Transaminase, transacylase)
3) Hydrolases (Proteases, esterases)
4) Lyases (aldolase, enolase)
5) Isomerases (racemase, epimerase)
6) Ligases (succinyl CoA ligase, DNA ligase)

There are following factors which affect the enzyme activity:-

1) Substrate concentration: An increase in substrate concentration increases the enzyme activity till a maximum velocity is reached (V_{max}). A further increase in substrate does not increase the rate of reaction. After maximum velocity the reaction rate is come slowly because the all enzyme is saturated with the substrate.

Note: - The substrate concentration at which the velocity is half of the maximum velocity is Michaels constant or K_m value.

2) Enzyme concentration: Speed of enzyme reaction is directly proportional to enzyme concentration.

3) Concentration of Reaction Products: The reaction products in a reaction system retard the rate of enzyme action. The products form a lose complex with enzyme which makes the active centers less available. Sometimes a reverse reaction may take place.

1) **Effect of Temperature:** Rate of reaction increase as the temperature increase up to about 50^o C. Above this temperature heat inactivation of the enzyme takes place

2) Effects of pH: Each enzyme has an optimum pH at which it can react at maximum speed. Very slight changes towards either side of the optimum pH result in profound alterations of reaction rates.

3) Presence of Activators: Many ions and molecules have the capacity to activate some enzymes e.g. Pepsinogen is activated by H^+ ions to pepsin (active)

4) Presence of Inhibitors: There are four types of enzyme inhibitors which stop the reactions from occurring further so that no products are formed.

(a) Competitive inhibition (b) Non-competitive inhibition (c) Partially competitive inhibition

(d) Un-competitive inhibition.

Question No. 06. Write a detailed note on mechanism of enzyme action.

Ans. Mechanism of enzyme action: Enzyme acts on a substrate and converts it into a product. The enzyme is regenerated at the end of the reaction. The sequence at which this occurs is as follows.

i) All enzymes have reactive sites on their surface. The substrate fits on the reactive site of the enzymes. This produces a complex called enzyme substrate complex. It is also called as Michaelis complex.

ii) This complex activates the substrate which has fit on the surface of enzyme. As a result an activated complex is formed.

iii) Activation of the substrate converts it into the products. Now, the enzyme is regenerated. So, the enzyme can act on another substrate molecule and the process is repeated.

The sequence of reactions can be written as follow:

Enzyme + Substrate ⟶ Enzyme substrate complex (Michael's complex)

Enzyme substrate complex ⟶ Activated complex

Activated complex ⟶ Products + Enzyme.

A few Theories have been put forth to explain mechanism of enzyme-substrate complex formation.

1) Lock and Key Theory.
2) Induced Fit Theory.
3) Substrate Strain Theory

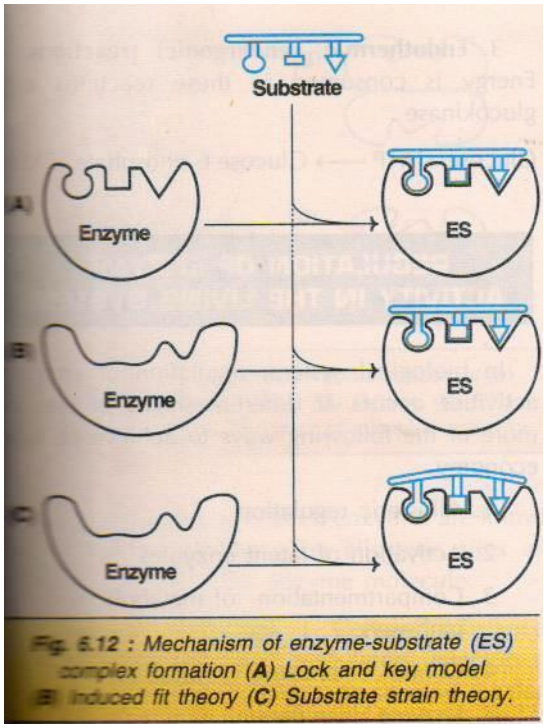


*Fig. 6.12 : Mechanism of enzyme-substrate (ES) complex formation (**A**) Lock and key model (**B**) Induced fit theory (**C**) Substrate strain theory.*

Question No. 07. Define vitamins. Give the classification of vitamins and discuss fat soluble vitamin in detail.

Ans. Vitamins: Vitamins may be regarded as organic compounds required in the diet in small amounts to perform specific biological functions for normal maintenance of optimum growth and health of the organism.

Classification:

1) Fat soluble vitamins - Vitamins A, D, E, and K

2) Water soluble vitamins - Vitamin B complex, Vitamin C

{Vitamin B complex i.e., Thiamine (B_1), Riboflavin (B_2), Pantothenic acid (B_3), Niacin (B_4), Pyridoxine (B_6), Biotin, Folic acid, Lipoic acid, Cyanocobalamine (B_{12})}.

Vitamin A: Retinol, Retinal and Retinoic acid are regarded as vitamins of vitamin A

1) Retinol: It is a primary alcohol containing β – ionone ring. The side chain has two isopreniod units four double bond and one hydroxyl group.

2) Retinal: It is obtained by the oxidation of Retinol. Retinal and retinol is interconvertable.

3) Retinoic acid: This is produced by oxidation of Retinal.

Role of Vitamin A:

1) Retinol and Retinoic acid function almost like steroid hormones they regulate protein synthesis.
2) Vitamin A is essential to maintain healthy epithelial tissue.
3) Retinol and Retinoic acid involved in the synthesis of transferrin.

4) Vitamin A is considered to be essential for the maintenance of proper immune system.
5) Cholesterol synthesis require vitamin A.
6) Vitamin A helps in vision.

Vitamin A Deficiency Disease: (a) Night blindness – Individual have difficulty to see in dim light prolonged due to deficiency of visual cells.

b) Xeropthalmia: Characterized by dryness of conjunctiva and cornea. In corneal area Bitot spot are seen.

c) Keratomalacia: If xerophthalmia is for prolonged time and not cured. Corneal ulceration occur causing total blindness.

d) Hyper vitaminosis A: Excessive consumption leads to toxicity which produced dryness of skin, enlargement of liver, long bones, loss of weight, loss of hair, joint pain etc.

Vitamin C:

Vitamin C is hexose derivative and closely resembles monosaccharide's in structure. Acidic property of vitamin C is due to enolic hydroxyl groups it is strong reducing agent. Oxidation of vitamin C is rapid in the presence of copper. It undergoes oxidation to form dehydroascorbic acid.

Role of Vitamin C

1) Bone formation: Bone tissue possesses organic matrix (collagen) and the inorganic elements (calcium, phosphate). It is required for bone formation.
2) Iron and hemoglobin metabolism: Vitamin C enhances iron absorption by keeping it in the ferrous form.
3) Vitamin C reduces the risk of cataract formation.
4) Vitamin C essential for hydroxylation of tryptophan to hydroxytryptophan in synthesis of serotonin.
5) Tyrosine metabolism: Vitamin C is required for oxidation of p-hydroxy Phenylpyruvate to homogenitisic acid.
6) Immunological function: Vitamin C enhances the synthesis of immunoglobins and increase immunity.
7) As an Antioxidant it reduces the risk of cancer.

Vitamin C Deficiency Disease: Scurvy: Vitamin C deficiency produces the symptoms are: - sore gums, Loose teeth, Anemia, Swollen joints, Delayed wound healing and Fragile blood vessels.

Question No. 08. What is TCA cycle? Explain the reactions involved in TCA cycle.

Ans. Citric Acid Cycle: (TCA cycle, Tricarboxylic acid cycle, Kreb's cycle): In the anaerobic pathway of glycolysis, glucose is oxidized to pyruvate. Later pyruvate is metabolized to Acetyl CoA. Further metabolism of acetyl CoA to carbondioxide and water occurs in Citric acid cycle. It is an aerobic pathway. The reactions of citric acid cycle occur in mitochondria. The total numbers of ATP formed in TCA cycle are 30.

Steps involved in kreb's cycle:

i) Acetyl CoA to citrate

ii) Citrate to isocitrate

iii) Isocitrate to oxalosuccinate

iv) Oxalosuccinate to α- ketoglutarate

v) α- ketoglutarate to succinyl CoA

vi) Succinyl CoA to Succinate

vii) Succinate to fumarate

viii) Fumarate to Malate

ix) Malate to oxaloacetate

Significance of Citric acid cycle:

1) TCA is a common metabolic pathway for the oxidation of carbohydrates, lipids and proteins. All these substances are metabolized to acetyl CoA. Later acetyl CoA enters into TCA cycle and oxidized to carbon dioxide and water.
2) During the oxidation of acetyl CoA, reducing equivalents are generated. This is due to the action of specific dehydrogenase.
3) The enzymes of TCA are located in the inner surface of mitochondrial membrane. They facilitate the transfer of reducing equivalents to the adjacent enzymes of respiratory chains.
4) Citric acid cycle is an aerobic process requiring oxygen.