

**BDS FIRST PROFESSIONAL EXAMINATION 2007
BIOCHEMISTRY (SEQs)
MODEL PAPER**

Time: 2 Hours.

Maximum Marks: 24

Q. No. 1:

A. A Patient has been presented with Severe Uncontrolled Diarrhoea. Elaborate The Mechanism of Onset & Management of Diarrhoea in this Case. 1½

Topic Specifications: Acid Base Balance:**Reading Material:** Any Standard Medical Text**Key:**

- Diarrhoea is Characterized by Intestinal Hurry.
- It could be due to bacterial /worm infestation /drug activity. 0.5 Marks

- Fluid is Lost from intestinal lumen resulting in fluid drag from blood supply.
- First the causative reason is blocked. 0.5 Marks

- Add fluid correction by I/V line.
- Add NaHCO₃. 0.5 Marks

B. If Diarrhoea is Uncontrolled which Acid Base Abnormality this Case is Likely To End Up with? 1½

Topic specifications: Acid Base Balance:**Reading Material:** Any Standard Medical Text**Key:**

- Fluid & Electrolytes are Lost in Large Proportion.
- NaHCO₃ is also lost in large Quantity. 0.5 Marks

- H⁺ ions are greatly conserved in Blood.
- H⁺ ion concentration with subsequent Na⁺ loss may lower pH below lowest permissible range of 7.35. 0.5 Marks
- Results in Metabolic Acidosis. 0.5 Marks

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Q. No. 2:

- A. Elaborate the Hierarchies Involved in Organization of Structure of Proteins. 1½**

Topic Specification: Structure of Proteins

Reading Material: Harpers Illustrated Biochemistry [27th Edition]

Key:

- Four Level of Protein Structure known as Hierarchies are known.
 - Three are essentially required at least. [0.5 Mark](#)

 - First is Primary Structure which is made up of amino acids genetically united in peptide bonds. Other possible bonds are disulphide & ionic bonds.
 - Second is Secondary Structure which is made up of hydrogen bonds expressed as a Helices or β Helices, Super Helices, β Turns, Random Coil or β Pleated Structures. [0.5 Marks](#)

 - Third is Tertiary Structure which is made up of Domains with Hydrophobic/ Hydrophilic Domains, van der Waal Domains or London Dispersion Forces.
- Fourth is Quaternary Structure drawn between Protein & Non Protein Part. [0.5 Marks](#)

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B. Illustrate the Role of Haldane's & Bohr's Effects in Oxygen Loading & Unloading in Human Body. 1½

Topic Specification: Oxygen Binding & Unbinding in Haemoproteins

Reading Material: Harpers Illustrated Biochemistry [27th Edition]

Key:

- Adult Haemoglobin was demonstrated to bind with Oxygen at alveolar level where pH is High, P_{O_2} is High, P_{CO_2} is Low & 2, 3 Bisphosphoglycerate is Absent.
- The HbA Molecule is relaxed & as a result cooperatively O_2 binds with HbA.
- This was elaborated by Haldane in 1916 known as Haldane's Effect. [0.5 Marks](#)
- As the HbA is driven away to peripheral region.
- In Peripheral Region there is low pH, P_{O_2} is Low, P_{CO_2} is High & 2, 3 Bisphosphoglycerate is Present. [0.5 Marks](#)

- The HbA Molecule is thus Taut & Unloads O_2 to ICF across cells.
- This was Demonstrated by Christian Bohr in 1908 & is known as Bohr's Effect. [0.5 Marks](#)

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Q. No. 3:

- A. Illustrate the Terms, Enzyme, Coenzyme, Apoenzyme, Holoenzyme, Lysozyme, & Isozyme. 1½**

Topic Specification: Enzymes

Reading Material: Harpers Illustrated Biochemistry [27th Edition]

Key:

- Enzymes are Genetically Expressed Protein Molecules which can initiate / modulate / transform or complete a biochemical reaction.
- Coenzyme is Non protein conjugated part of Enzyme through which enzyme exhibits its activity. [0.5 Marks](#)
- Apoenzyme is protein part of a Holoenzyme.
- Holoenzyme is conjugated part of Apoenzyme. [0.5 Marks](#)
- Lysozymes are enzymes manufactured and secreted by Lysosomes. They have large antibacterial activity.
- Isozyme is isomer of an enzyme. [0.5 Marks](#)

- B. Draw & Elaborate the Graphic Representation of Enzyme Catalysed Reactions on the Basis of Michaelis Menten Plot & Lineweaver Burk Plot. 1½**

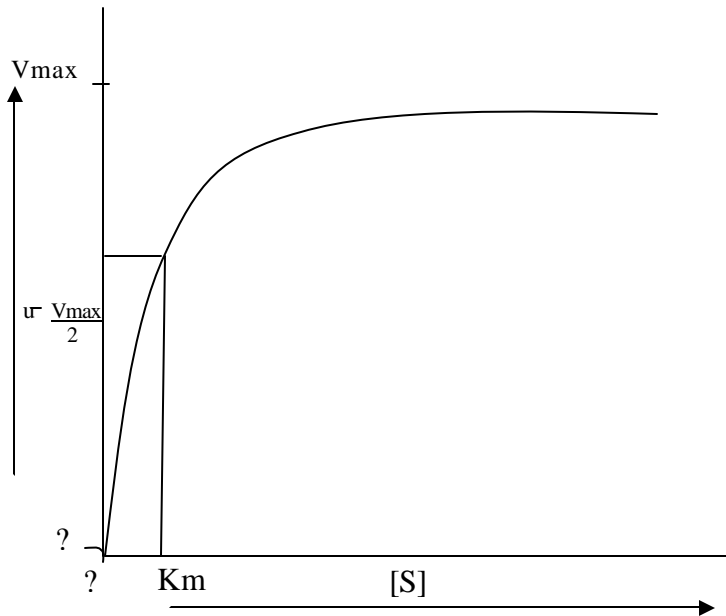
Topic Specification: Enzymes

Reading Material: Harpers Illustrated Biochemistry [27th Edition]

Key:

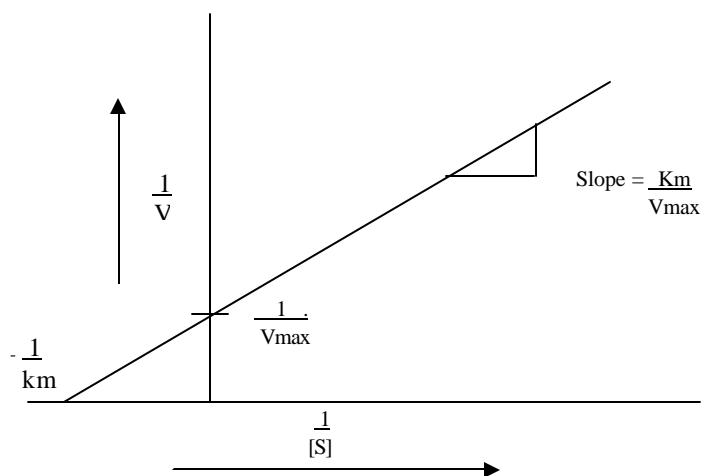
- Michaelis Menten Equation is Plotted as $v_i = V_{max} [S] / K_m + [S]$
- First the Velocity increase directly as the Enzyme is added to the substrate when Temperature / pH / Substrate Concentration. [0.5 Marks](#)
- The Velocity becomes straight line after a while.
- The Increase in Velocity slows down.
- Finally the Velocity is Constant. [0.5 Marks](#)

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**SUBSTRATE CONCENTRATION VERSUS VELOCITY
MICHALIS MENTEN GRAPH (PLOT)**

- This converted to a straight line equation as Lineweaver Burk Plot i.e., $Y = AX + B$.
- The Graph becomes very important as only two values of $1 / S$ versus $1 / V$ will be required to plot the graph. [0.5 Marks](#)



K_m = Michaelis Constt.

V_{max} = Maximal Velocity

S = Substrate Conc.

V = Velocity

DOUBLE RECIPROCAL LINE WEAVER BURK PLOT

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Q. No. 4:

- A. In an Acute Inflammatory Disease A Patient Presented with Severely Increased Levels of Blood Urea Nitrogen. Elaborate the Sequence of Urea Formation, its Normal & Abnormal Levels. 2**

Topic Specification: Metabolism of Proteomics [Krebs Henseleit's Urea Cycle]:

Reading Material: Harpers Illustrated Biochemistry [27th Edition]

Key:

- Urea is formed in Urea Cycle taking place in Mitochondria of Hepatocytes.
- Pathway is cyclic & begins from NH_4^+ contributed by Oxidation of Amino Acids along with HCO_3^- contributed from Blood.

[0.5 Mark](#)

- Carbamoyl Phosphate is formed & ATP is used. Enzyme is Carbamoyl Phosphate Synthase I.
- Ornithine combines with Carbamoyl Phosphate & Citrulline is formed. Transcarbamoylase is Enzyme.
- Citrulline & Aspartic Acid combine to synthesize Arginino Succinate. Enzyme is Arginino Succinate Synthase.
- Fumerate is lost while Arginine is formed. Enzyme is Arginino Succinate Lyase.
- Arginine is hydrolysed to Ornithine & Urea. Argininase is the Enzyme.

PATHWAY IS GIVEN BELOW

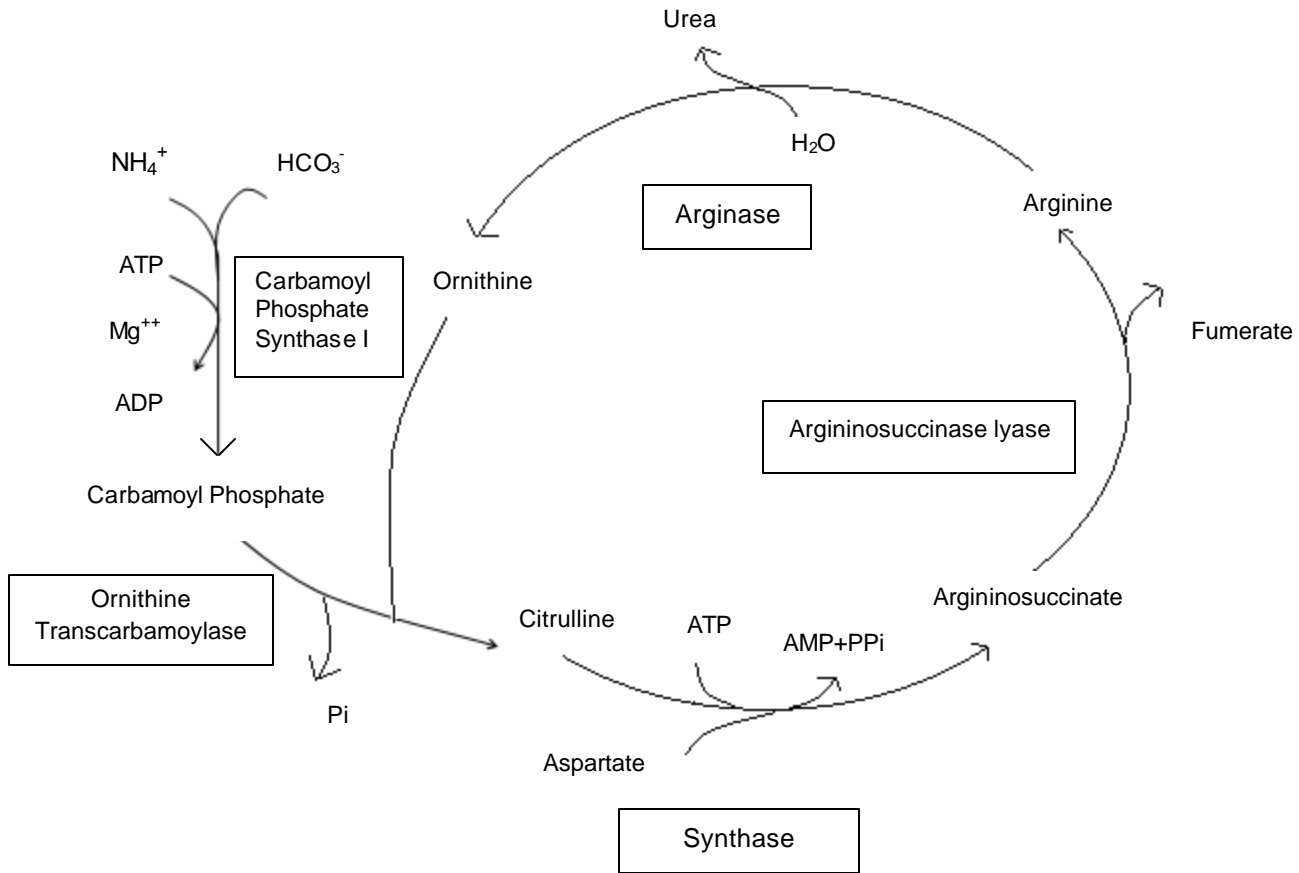
[1 Mark](#)

- The process continues till all NH_4^+ Provided by the oxidation of amino acids is disposed off.
- In Inflammatory phase T_3 / T_4 & Cortisol are responsible for the increased urea formation.
- Normal Blood Urea Level = 20 – 40 mg / dl while under abnormal circumstances Blood Urea Level may be raised to over 50 mg / dl.

[0.5 Marks](#)

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UREA CYCLE



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B. Enlist Five Most Presentable Clinical Conditions with Increased Urea Levels. 1

Topic Specification: Metabolism of Proteomics [Krebs Henseleit's Urea Cycle]:

Reading Material: Harpers Illustrated Biochemistry [27th Edition]

Key:

- Inflammation: When Tissue damage produces increased free amino acids pool hence most of these are diverted toward liver for removal as Urea.
- Protracted Infection: When Phagocytotic assembly is hyperactive & surplus amino acids are eliminated as Urea. [0.5 Marks](#)
- Tissue Injury: When damaged proteins are eliminated by Urea formation.
- Protracted High Grade Pyrexia: When due to fluid loss excessive tissue damage ensues increased Urea formation.
- Diabetes Mellitus: There is increased tissue damage & increased Urea formation. [0.5 Marks](#)

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Q. No. 5:

A. A Patient has Presented with Elevated Blood Glucose Levels during Fed Condition. Give Metabolic Management of Glucose in Post Absorptive Stage. 1½

Topic Specification: Metabolism of Glycomics [Maintenance of Blood Glucose Levels]

Reading Material: Harpers Illustrated Biochemistry [27th Edition]

Key:

- After Absorption in fed condition the blood glucose rises normally up to 140 mg / dl of blood.
- If it is beyond normal value up to 150 mg /dl it is impaired blood glucose level and the patient is threatened to become diabetic.
- If the level is above 180 mg / dl and there is history of glucosuria the patient is diabetic. [0.5 Marks](#)

- In Post Absorptive Phase when glucose level rises in blood Insulin is secreted which drives glucose to peripheral tissues.
- Glucose is thereby converted mostly to Glycogen in Liver & Extrahepatic Tissues by process of Glycogenesis. [0.5 Marks](#)

- In Fasting Condition when blood glucose level is running down Liver Glycogen is Glycogenolysed through Glycogenolysis to provide glucose to blood.
- The process is activated by Thyroid Hormones, Glucagon & Cortisol. [0.5 Marks](#)

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B. How would You Design A Diagnostic Protocol in a Suspected Patient of Diabetes Mellitus? 1½

Topic Specification: Metabolism of Glycomics[Persistent Hyperglycaemia]:

Reading Material: Harpers Illustrated Biochemistry [27th Edition]

Key:

- The Test Protocol is Called as Glucose Tolerance Test.
- The Patient is asked to have a Carbohydrate Rich diet for a week.
- The Patient is asked to come for test with an overnight fast. [0.5 Marks](#)

- A Fasting Blood Sample is drawn along with a urine sample.
- The Patient is given either equivalent to 1G / Kg Body Weight Glucose in water to drink or the patient may be asked to take his normal breakfast.
- Exactly after Half Hour another blood sample is drawn.
- Subsequently 1, 1½, 2, 2½, 3 & 3½ Hour Samples are Drawn & Labelled. [0.5 Marks](#)
- Glucose is estimated in Urine sample by Benedict's Method.
- Enzyme True Oxidase Method is used to estimate glucose in blood.
- Normal / Impaired / Diabetic Curves are drawn and patient is Compared.
- If Patient is Diabetic his Fasting / Random Glucose Levels will be above 110 mg /dl & 140 mg / dl respectively. [0.5 Marks](#)

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Q. No. 6:

- A. A Child was Diagnosed to be Ricketic. The Paediatrician Prescribed the Desired Vitamin. However the Patient Did Not Respond well. Comment on What was Prescribed & Why the Response was Not Upto the Mark? 2**

Topic Specification: Human Nutrition [Vitamin D]:

Reading Material: Harpers Illustrated Biochemistry [27th Edition]

Key:

- Vitamin D, i.e., 1,25 Dihydroxy Cholecalciferol is synthesized in Kidney Tubules & is responsible for Hypercalcaemia. It increases Osteoclastic Activity in Bone.
- The process stimulates Calcitonin secretion from Parafollicular Cells of Thyroid Gland which activates Osteoblastic Activity in Bone.
- Thus normal bone tissue requires stimulation of Vitamin D which would conversely stimulate Calcitonin & Bone Development & Repair.
- The Child had Vitamin D deficiency hence he developed Rickets. [0.5 Marks](#)

- As the Paediatrician prescribed Vitamin D the Patient should have responded to improvement in symptoms.
- He did not respond because he would have had additional Calcium provided.
- In the absence of dietary or therapeutic Calcium support Rickets would NOT Improve.
- Milk is an important dietary component which should be supplementing Calcium. [1 Marks](#)

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B. Comment on the Metabolic Role of Vitamin C. 1½

Topic Specification: Human Nutrition [Vitamin C]

Reading Material: Harpers Illustrated Biochemistry [27th Edition]

Key:

- Vitamin C, i.e., Ascorbic Acid is synthesized in Plants & Bacteria.
- Vitamin C is required to Absorb Fe^{++} from human intestine. It is present here as Fe^{+++} which can not be absorbed.
- Vitamin C oxidises Fe^{+++} to Fe^{++} and then stimulated Apoferritin Synthesis in Intestinal Mucosal Cells.
- Transferring is responsible for Fe^{++} transport in blood & in Liver Fe^{++} is stored as Ferritin. Vitamin C Assists both Proteins Synthesis.
- Also in Haeme Synthesis Vitamin C plays a key role in insertion of Fe^{++} by Ferrochelatase. [0.5 Marks](#)

- Vitamin C is also responsible for Synthesis of Collagen where it serves as coenzyme of Lysyl Oxidase & Prolyl Oxidase.

- The deficiency of Vitamin c will result in Scurvy. [0.5 Marks](#)

- Vitamin C is also responsible for cholesterol synthesis where it serves as coenzyme with synthetic oxidases / dehydrogenases.
- It is also responsible for synthesis of Bile Salts from Cholesterol.
- It is also responsible for Steroid Hormone Synthesis. [0.5 Marks](#)

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Q. No. 7:**A. Carefully Select Dietary Lipomics & Elaborate Their Sequential Digestion & Absorption Within Human Body.****1½****Topic Specification:** Digestion & Absorption of Lipomics**Reading Material:** Harpers Illustrated Biochemistry [27th Edition]**Key:**

- Fats, i.e., Triacylglycerols & Esterified Cholesterol are Major Dietary Lipomics.
- After ingestion they are mixed with Saliva where pH is 6.9 – 7.1 & pushed to Stomach through opening of Cardiac Sphincter.
- Normal pH is 2.5 – 3.5. Gastric Juice is secreted which contains an Enzyme Gastric Lipase. However, the Enzyme is inactive at this pH. Longer time is spent in stomach while significant lipids are present. Mixing causes formation of Micelles. [0.5 Marks](#)
- After opening Pyloric Sphincter the Micelles get into Duodenum.
- In Duodenum pH is elevated between 7 – 7.5 due to Biliary & Pancreatic NaHCO₃.
- Mixed Micelles are formed by mixing Micelle with Bile Salts.
- Colipase combines with Mixed Micelle & Then Pancreatic Lipase Hydrolysis Triacylglycerols to Monoacylglycerols & Fatty Acids.
- Esterified Cholesterol is Hydrolysed by Cholesterol Esterase to free cholesterol & fatty acids.
- Phospholipids are Hydrolysed by Phospholipase A & Phospholipase B to Phosphoric Acid / Monoacylglycerols / Fatty Acids. [0.5 Marks](#)
- In Intestinal Lumen Triacylglycerols are Reesterified by Enzymes.
- Cholesterol is also Reesterified.
- Phospholipids & Apoprotein is formed.
- Chylomicra are formed containing absorbed Lipomics.
- This is enrooted through lymph to blood & to liver. [0.5 Marks](#)

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- B. Certain Lipoproteins are Enlisted as Cardio Protective while Others as Cardio Destructive. Elaborate the Role of such Lipoproteins. 1½**

Topic Specification: Metabolism of Lipomics [Lipoproteins]

Reading Material: Harpers Illustrated Biochemistry [27th Edition]

Key:

- The Lipoproteins are Chylomicra / VLDL / LDL / HDL / FFA.
- High Density Lipoproteins are formed in Liver & are left in Circulation where they are responsible for uptake of Free Cholesterol Esterified by LCAT enzyme & taken up by HDL. They are brought back to Liver. Where cholesterol is recycled & used by Human Body. [0.5 Marks](#)
- Low Density Lipoproteins are formed in Liver & are responsible for the transport of cholesterol to Extrahepatic Tissues. LDL-Receptors are located in Extrahepatic Tissues which internalise LDL & reesterify cholesterol for local use. [0.5 Marks](#)
- If LDL is not internalised because of receptor down regulation the LDL will be oxidised by Phagocytotic Cells & Cholesterol will become Cholestadiene. This substance is deposited in intima of blood vessels causing plaque formation. This is the mechanism of atherosclerosis. If HDL is also low in quantity this increases the process. There must be good LDL : HDL ratio which is 3:1. [0.5 Marks](#)

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Q. No. 8:

A. Comment on Clinical Use of Blood Gas Analyzer. 1½

Topic Specification: Biochemical Techniques [Blood Gas Analyzer]

Reading Material: Harpers Illustrated Biochemistry [27th Edition]

Key:

- Blood Gas Analyzer is an instrument designed to estimate Blood Gases, i.e., Partial Pressure of O_2 [P_{O_2}], Partial Pressure of CO_2 [P_{CO_2}] & calculate $NaHCO_3$ as well to find the Base Access.
- pH of the Sample is also directly measured by pH Electrode.
- Arterial Blood is drawn and injected into the port of Analyzer.

0.5 Marks

- By chemical reaction O_2 is dissolved and Estimated and Presented as P_{O_2} .
- By another chemical reaction CO_2 is also estimated and Presented as P_{CO_2} .
- $NaHCO_3$ is also calculated.

The pH, P_{O_2} , P_{CO_2} & $NaHCO_3$ values are inserted in Henderson Hasselbalch's Equation and the desired status of pH in blood is known.

0.5 Marks

- During Clinical / Surgical Management of Patients the Instrument is Extensively used.
- During Acid Base Abnormalities the Blood Gas Analyzer is used to rectify & monitor the pH of Blood.

0.5 Marks

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B. Elaborate the Role of Electrophoresis in Plasma Protein Determination. **1½**

Topic Specification: Biochemical Techniques [Electrophoresis]

Reading Material: Harpers Illustrated Biochemistry [27th Edition]

Key:

- Electrophoresis is a Technique used for separation, isolation, identification & quantification of Proteins.
- Polyacrylamide Gel Electrophoresis is used for this purpose.
- The Blood is drawn in heparinized tubes from a vein.
- Plasma is separated by centrifugation. 0.5 Marks
- Plasma is applied by applicator in a well.
- Adequate buffer system is loaded & Electrophoretic Tank is attached to electric supply with micro voltage.
- After a given time the plasma proteins are separated as albumins & globulins. 0.5 Marks
- The separated bands of proteins are treated with Coomassie Blue to Stain them in blue colour.
- Their respective concentration is also calculated which should be 2:1 in Normal Range. 0.5 Marks