



9. Proofs of re-test, assignments, posting end tests, answer sheets.

Division No.	Name of the Institute	Section	Place	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	No of days present	FEES		Date of Payment								
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55	Tulasi Nidagonda			P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P								
56	Vaishnavi Nhatkar			P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P						
57	Vidhata Nicas			P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P					
58	Vidya Rekha			P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P				
59	Zanya Fakhari			P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P			
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23	Mansita N	P	P	P	P	60	62	61	P	P	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	26			
24	Manoj Kumar B.S	P	P	P	P	65	62	66	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	26			
25	Manshan Arland	P	P	P	A	60	62	61	A	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	26			
26	Masera Jasheem	P	P	P	P	62	60	63	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	26			
27	Mohammed Rafi	P	P	P	P	64	64	65	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	26			
28	Monisha Rani M.	P	P	P	P	63	61	64	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	26			
29	Murgali Sai Sureshli	P	P	P	P	61	68	62	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	26			
30	Srejan Sinha	P	P	P	P	63	63	63	A	A	A	P	P	A	A	A	P	A	A	A	P	A	A	P	A	A	A	A	A	A	A	A	P	P	26		
31	Lika	P	P	P					P	P	A	P	A	A	A	A																					
32	Druka Reddy	A	P	P					A	A	A	A	A	A	A																						
33	Kabir Krishna	A	P	A					A	A	A	A	A	A	A																						
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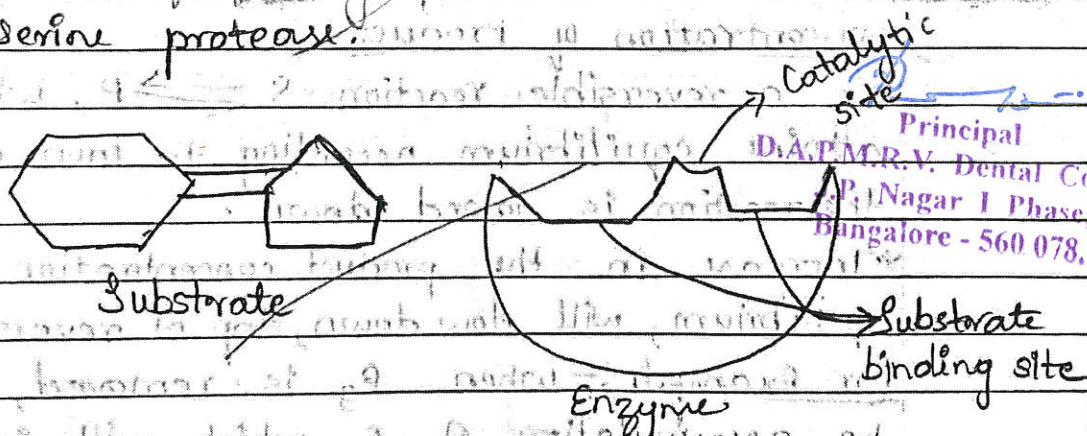
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23	Manisha N	P	P	P	P	60	62	61	P	A	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P				
24	Manoj kumar B-s	P	P	P	P	65	63	66	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P				
25	Manjara Avland	P	P	P	P	60	62	61	A	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P					
26	Mansi Taskin	P	P	P	P	62	60	63	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P					
27	Melewarad Kay	P	P	P	P	64	65	65	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P					
28	Manisha Rani M.	P	P	P	P	61	61	64	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P					
29	Munagai Sai Sreedathi	P	P	P	P	61	60	62	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P					
30	Snehan Soma	P	P	P	P	62	63	63	A	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P					
31	Lisbo	P	P	P	P				P	P	A	A	A	A																						
32	Dhruva Reddy	A	P	P					A	A	A	A	A	A																						
33	Sakshi Krishna	A	A	A					A	A	A	A	A	A																						
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- 1) Active site of enzyme
- 1) Active site of an enzyme occupies a small portion of the whole enzyme, where the substrate binds and participates in catalysis.
- 2) Active site of an enzyme is not rigid or pre-shaped but rather flexible to promote the binding of specific substrate.
- 3) Each enzyme has a specific function due to the presence of active site.
- 4) Active site has a site - substrate binding site and a catalytic binding site.
- 5) Catalytic binding site is for the catalysis of the particular reaction by the involvement of particular coenzymes or co-factors.
- 6) Substrate binding where a specific substrate combines with the enzyme to form enzyme-substrate complex.
- 7) Product is formed after the catalysis and enzyme is reused for another reaction.
- 8) The amino acids present in the active site are serine, cysteine, lysine, tyrosine, aspartate, glutamate, histidine, arginine etc.

9) The most frequently present amino acid is serine.  
Ex: - serine protease.



- Factors effecting the enzyme activity are:-
- 1) Enzyme concentration: Increase in the concentration of the enzyme will also increase the velocity of the reaction, where the substrate is unlimited.

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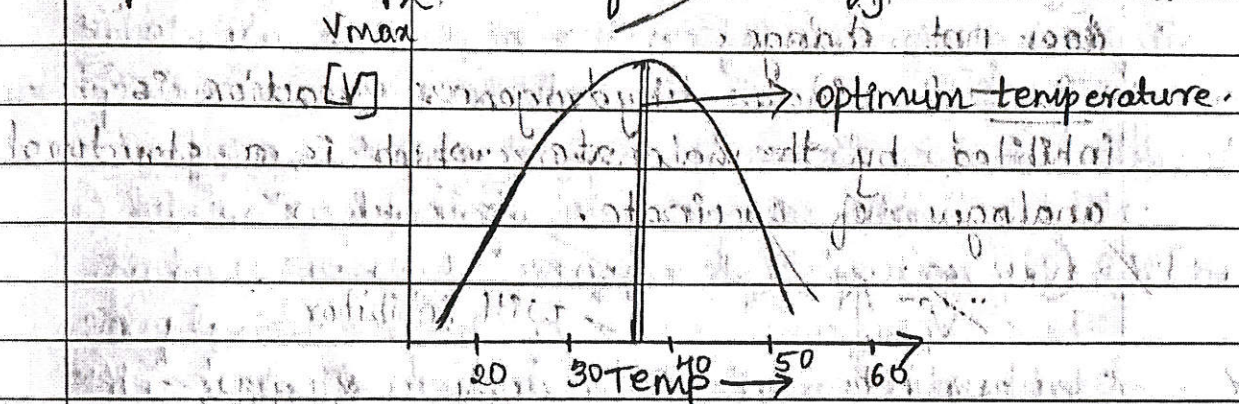


4) Effect of temperature:- Increase in ~~velocity~~ temperature will cause increase in the velocity of the reaction, then it reaches maximum and falls back, forming a bell-shaped curve.

\* Maximum temperature at which maximum substrate is converted into product in unit time is called as optimum temp.

\* Increase in the temperature more than  $50^{\circ}\text{C}$  will cause denaturation & loss of  $3^{\circ}$  proteins, which will reduce the enzyme activity.

\* Optimum temperature of human enzyme is around  $37^{\circ}\text{C}$ .

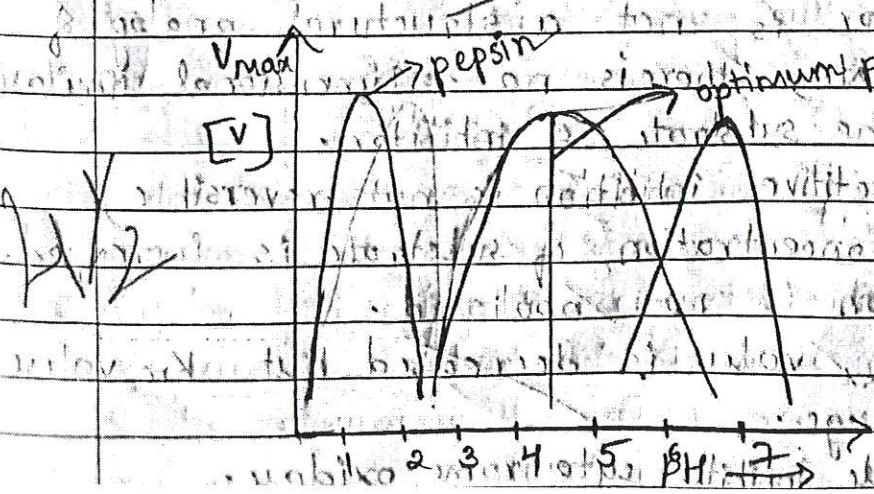


5) Effect of pH:- Each enzyme has an optimum pH, on either side of which the velocity decreases drastically, bell-shaped curve is formed.

The optimum pH of enzyme is 5-6.

Exceptions are:- pepsin  $\rightarrow$  1-2, alkaline phosphatase  $\rightarrow$  9-10, acid phosphatase  $\rightarrow$  4-5.

Above & below the optimum pH, the curve fall down.



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~~Alkaline~~ Alkaline  
4) ~~Alkaline~~ Alkaline phosphatase [ALP].

Normal value  $\rightarrow$  40-125 U/L.

Increase in alkaline phosphatase is also seen in liver disease like hepatic disease.

Decrease in bone mass - osteoporosis etc.

~~Alkaline~~ Acidic  
5) ~~Alkaline~~ Acidic phosphatase [ACP]

Normal value - 1-12 U/L.

Increase in ACP causes Prostate cancer.

It is a mark for tumor development.

3) Coenzyme - 2 types.

$\rightarrow$  Coenzyme is a low molecular weight substance without which an enzyme cannot carry out a reaction.

There are 2 groups of coenzymes -

1) First group of coenzymes -

These coenzymes are seen in reactions which takes place by oxidoreductase enzyme.

Ex:- Lactate is oxidised which causes reduction of coenzyme. The coenzyme used here is NAD<sup>+</sup>.

Other examples: NADP<sup>+</sup> - NADPH, FMN - FMNH<sub>2</sub>.

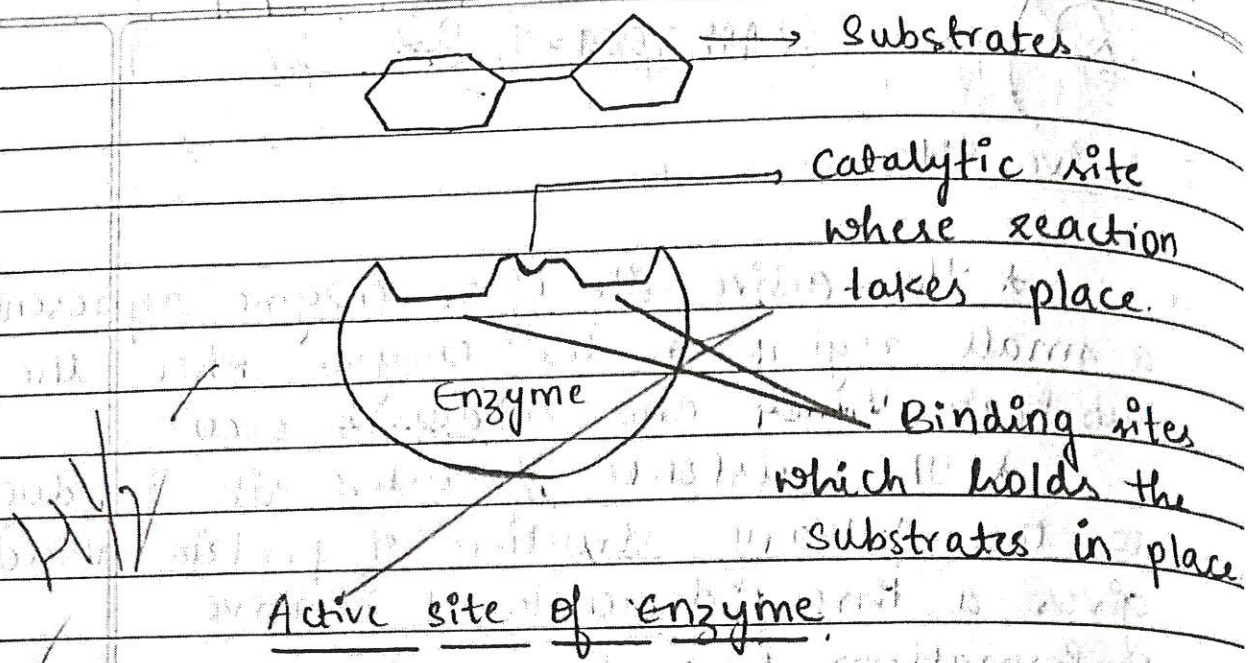
2) Second group of coenzymes -

These coenzymes are seen in reactions where transfer of groups other than hydrogen takes place.

Ex:- ATP (Adenosine Triphosphate).

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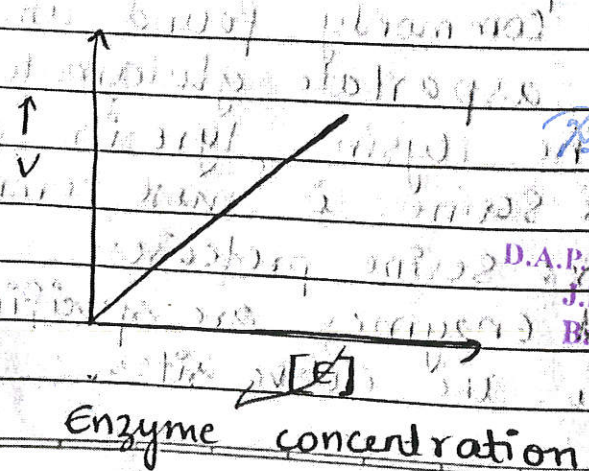


② Factors affecting Enzyme Activity.

⇒ The factors are

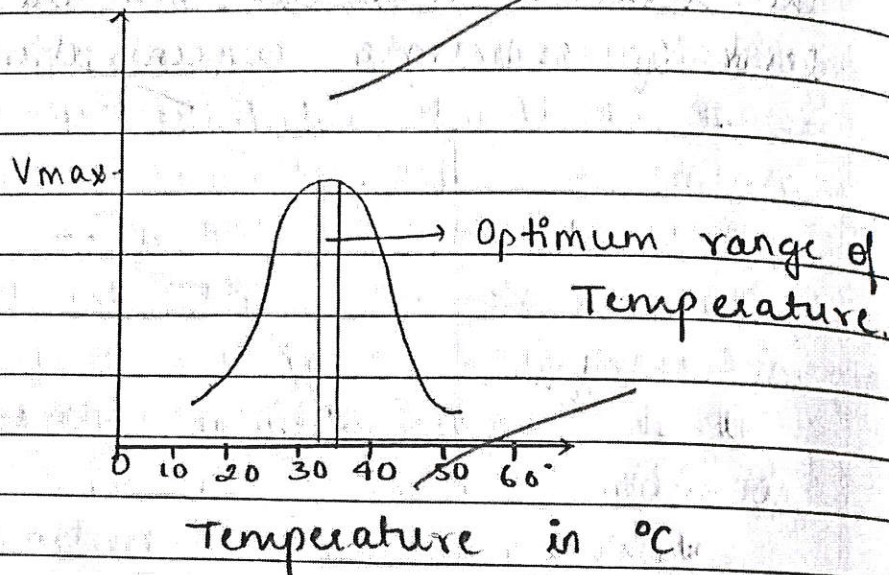
- a) Enzyme concentration
- b) Substrate concentration
- c) Effect of concentration of products
- d) Effect of Temperature
- e) Effect of pH.

a) Enzyme concentration: As the enzyme concentration is increased, the velocity of the reaction proportionately increases when the substrate concentration is unlimited.





In humans, optimum temperature is  $37^{\circ}\text{C}$ .



e) Effect of pH: Enzymes have an optimum pH at which their activity is fastest. It shows a bell shaped curve.

The optimum pH range of most of the enzymes is 6-8.

The exceptions are:

pepsin (1-2)

Alkaline phosphatase (9-10).

Vmax

Optimum pH

0

1

2

3

4

5

6

7

8

9

10

pH

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## Non-competitive inhibition:

\* Iodoacetate, lead, mercury and some oxidising agents act as irreversible non-competitive inhibitors.

\* The inhibitor binds to the different domain on the enzyme molecule and not to the active site of the enzyme.

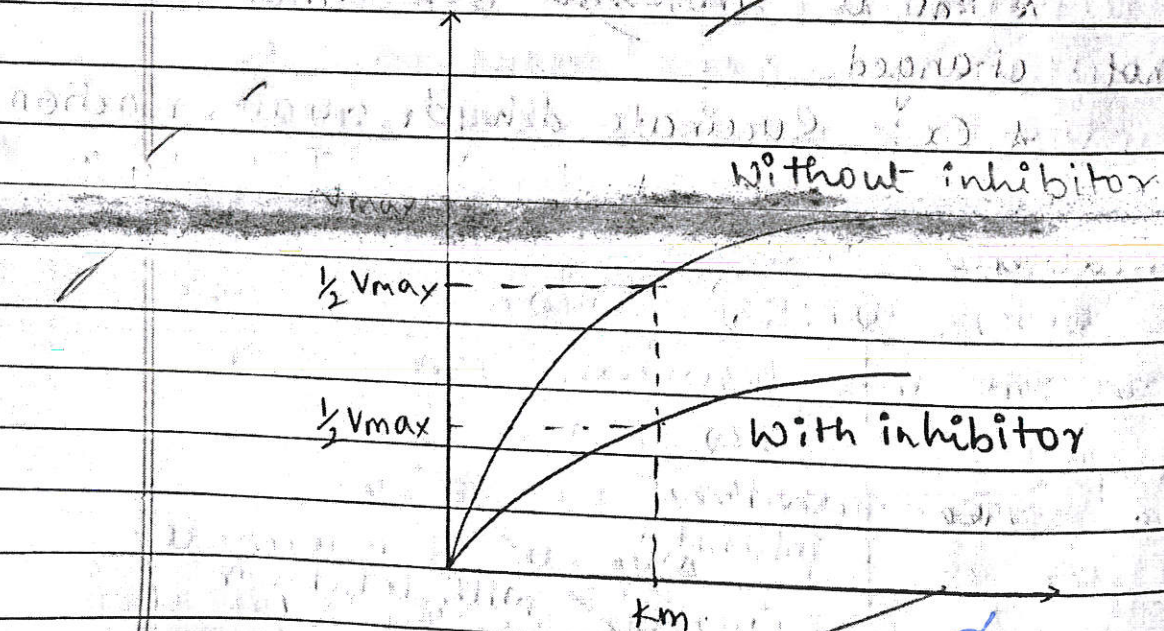
\* Inhibitor is not a structural analogue of substrate.

\* The inhibitor binds to the enzyme by non-covalent bonds and the reaction becomes irreversible.

\*  $V_{max}$  is reduced but the  $K_m$  is not changed.

\* Ex:- Cyanide inhibits cytochrome oxidase.

\* Fluoride inhibits enolase.



Non-competitive  
Inhibition



\* Aspartate Aminotransferase: (AST)

→ Normal serum levels is

8-20 U/L.

→ The levels of AST are increased in liver diseases.

\* Alkaline phosphatase: (ALP)

→ Normal serum levels are 40-125 U/L.

→ childrens have high level due to increased osteoblastic activity

→ Increase in levels of ALP is seen in alcoholic hepatitis, Rickets etc.

\* Acid phosphatase (ACP)

→ Normal serum level is 2.5-12 U/L.

→ Levels of ACP are increased in prostate cancer and malignancies

→ ACP is a tumor marker.

(5) Coenzymes. (2)

⇒ → It is a low molecular weight organic substance without which the enzyme cannot exhibit any reaction.

→ It is heat stable.

→ Most of the coenzymes are derivatives of vitamin B complex.

There are 2 groups:

a) first group: Any change in reaction is counter balanced by coenzyme oxidation.

Ex:- Nicotinamide adenine Dinucleotide (NAD)

b) Second group: Reactions transferring groups other than hydrogen.

Ex: Adenosine Triphosphate (ATP)



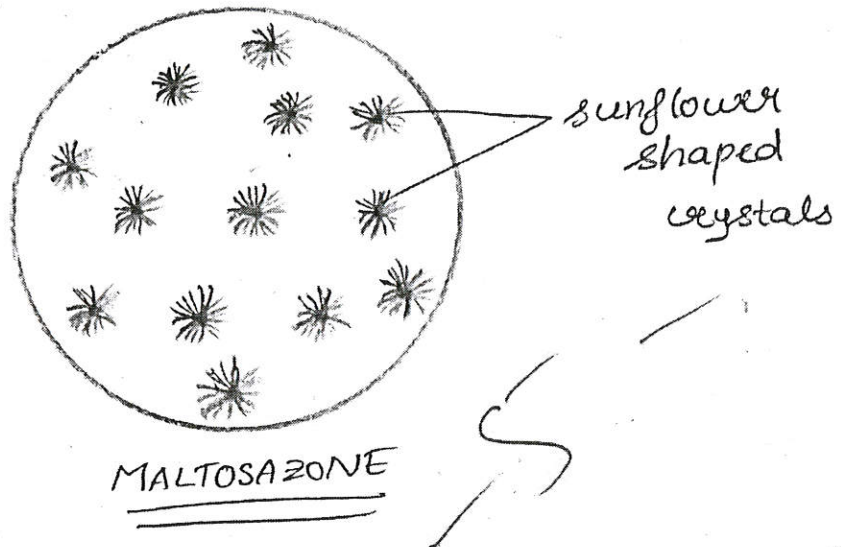
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<u>Procedure</u>	<u>Observation</u>	<u>Inference</u>
<p>i) <u>Biuret test</u>: 3ml of unknown solution + 1ml 10% NaOH + 2-3 drops of <math>CuSO_4</math>.</p>	<p>Violet colour is observed.</p>	<p>The solution is a protein.</p>
<p>ii) <u>Isoelectric pH</u>: 3ml of the solution + 2-3 drops of bromo-cresol<sup>blue</sup> + few drops of 1% acetic acid.</p>	<p>Green/blue curdy ppt is observed.</p>	<p>The solution maybe casein.</p>
<p>iii) <u>Phosphorous test</u>: (confirmatory test) 5ml of casein solution + 5 drops of 10% NaOH. Mix well. Heat &amp; cool. Add 5 drops of conc. <math>HNO_3</math>. Filter. Add a pinch of sodium molybdenum &amp; warm gently.</p>	<p>Canary yellow solution is observed.</p>	<p>The solution is casein which is a milk protein.</p>

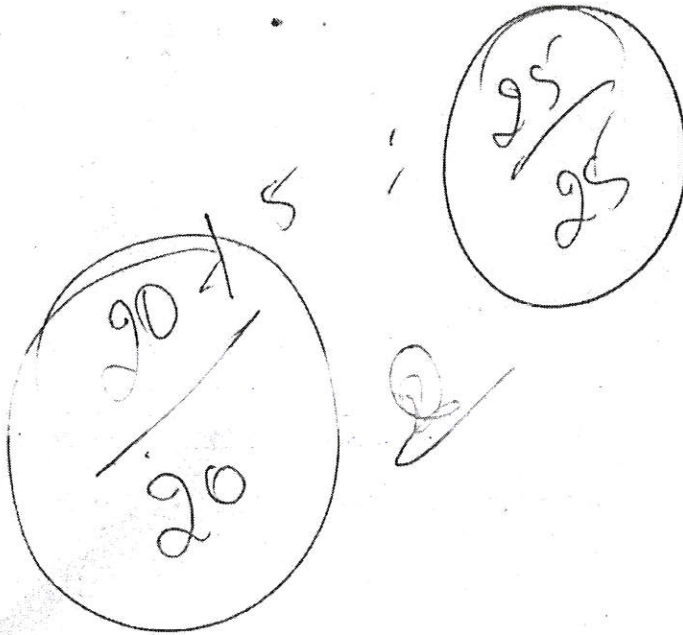
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Diagram:-



Results The carbohydrate observed under microscope is maltosazone.



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2) Oral glucose tolerance test was performed with a 48 year old person and the results are given below. What is your opinion?

Time (hours)	Blood glucose (mg%) (Folin-Wu method)	Urine sugar Benedict's test.
0 (fasting)	80	Blue
0.5	120	Blue
1.0	150	Blue
1.5	130	Blue
2.0	82	Blue

→ Normal report.

*[Handwritten signature]*

9-

*[Handwritten signature]*  
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$$\frac{28}{30} + 5 = \frac{33}{35}$$

*[Handwritten signature]*



⑤ Acid Hydrolysis Test

10 ml of unknown solution, add 8-10 drops of conc. HCl. Mix well and keep it in boiling bath for 10 minutes. Neutralize the solution by using 40% NaOH until the Red litmus turns blue.

⑥ Benedict's Test

5 ml of Benedict's reagent + 1 ml of hydrolysed solution, Heat for 2 mins.

Red ppt is observed.

Starch on hydrolysis Reduces.

RESULT:

The unknown solution is STARCH

14 + 5 = 19  
-----  
20

15



- Calcium ions is required in many metabolic reactions as cofactor.  
Eg. Glycolysis, glycogen dehydrogenase etc.
- Calcium is also involved in the phosphate metabolism.

RDA: Pregnant and lactating women - 1200 mg  
900 - 1200 mg in adults. Increased in children.

### Absorption:

- The calcium absorption is affected by the vitamin D, parathyroid hormone and calcitonin.
- The parathyroid and vitamin D increases the calcium absorption.
- Protein rich food increases the calcium absorption.
- Oxalate inhibits the ~~increase~~ <sup>absorption</sup> of calcium.
- Fat - rich diet inhibits calcium absorption.
- Calcitonin hormone also inhibits the calcium absorption.
- Phosphorous rich diet also inhibits the calcium absorption.
- Calcium absorption is inhibited by these because calcium forms salts with phosphorus and insoluble fat soaps with fatty diet.



called tetany.

→ It is painful muscle spasm as the neurotransmitters are affected by the lack of  $Ca^{2+}$ .

• Osteoporosis:

→ When the calcium levels are low in blood the parathormone causes resorption of bone.

→ This results in the excess loss of bone.

→ The bones become weak and fragile with porosity.

→ It is common in women of 60 yrs and above due to low estrogen levels.

## Short Essays

2. Basal metabolic rate is the energy required by an individual at awake for physical, emotional and digestive activities at rest.

It is the energy required by an individual to carry out vital, visceral activities like, beating of heart, circulation, digestion, respiration etc.

• The basal metabolic rate is measured by the oxygen consumed, caloric value and heat produced.

• The caloric value of oxygen is 4.8 which means 1g of oxygen produces 4.8 kcal.







4. Vitamin C is also called the ascorbic acid.  
Sources:

- It is found in fruits, vegetables.
- Rich source are citrus fruits like oranges, lemons etc.

Functions:

- It helps in collagen fibre synthesis. It provides the required amino acids and cofactors for the formation of collagen.
- It hydroxylates proline and lysine to form hydroxyproline and hydroxylysine.
- It forms cross-links of collagen.
- It acts as an anti-oxidant in the body and binds with the free radicals to prevent them to oxidize.
- It prevents cancer.
- It also plays important role in immunity.
- It prevents viral infections.
- It also acts with  $\beta$ -carotene.
- It also is required in formation of Apo B-48 ~~in the~~ chylomicrons.

Recommended daily allowance: 65 - 85 mg/day

Deficiency:

Scurvy!!

- The gums bleed in the scurvy.



$U$  = creatinine in urine

$V$  = volume of urine

$P$  = creatinine in plasma

7. The calorific value of a nutrient is the amount of energy yield per gram of the nutrient in given time. It is also called energy density.

The respiratory quotient is the ratio between the volume of  $\text{CO}_2$  and the volume of  $\text{O}_2$  consumed.

8. Phenylketonuria is a condition due to deficiency of the phenylalanine hydroxylase.

- The level of phenylalanine in blood increases.

- This is because it cannot be converted to tyrosine.

- Mental retardation, agitation, contractions, tetany etc is seen.

- Phenylalanine interferes with neurotransmitter metabolism.

- Phenylpyruvate, phenyllactose, phenylacetate is seen in the urine. These are phenylketon bodies.



# Biochemistry Internal Assessment Theory and Practicals.

1. Carbohydrates are polyhydroxy aldehyde or ketone or compounds that liberate them on hydrolysis. Carbohydrates are classified as follows:

i) Monosaccharides.

- They are the simplest sugars.
  - They can not be further hydrolysed.
  - The general formula is  $C_nH_{2n}O_n$ .
- Eg: Glucose, Fructose.

They are further classified:

→ Based on their functional group:

a) Aldoses: Monosaccharides with functional group as aldehyde.

Eg. Glyceraldehyde, Glucose.

b) Ketoses: Monosaccharides with functional group as ketone.

Eg. Dihydroxyacetone, Fructose, Ribulose.

→ Based on number of carbon atom:

No. of C	Name	General formula	Aldose	Ketose
3	trioses	$C_3H_6O_3$	Glyceraldehyde	Dihydroxyacetone
4	tetroses	$C_4H_8O_4$	Erythrose	Erythrulose
5	pentoses	$C_5H_{10}O_5$	Ribose	Ribulose
6	hexoses	$C_6H_{12}O_6$	Glucose	Fructose
7	heptoses	$C_7H_{14}O_7$	Glucoheptose	Sedoheptulose



Eg. Starch, glycogen, cellulose.

b) Heteropolysaccharides:

They are polymers of different kind of monosaccharide units.

Eg. Mucopolysaccharide, Agar.

Q2. Heparin:

- It is a type of anticoagulant found in blood.
- It is a mucopolysaccharide.

Due to its anticoagulant properties, it is also used in clinical applications.

- It is a chain of alternating N-sulpho-D-glucosamine-6-sulphate and D-glycarronate-2-sulphate.

Chondroitin sulphate:

- It is found in the matrix of many mammalian tissue.

- It is one of the glycosaminoglycans.

- It is very similar to hyaluronic acid in structure.

- It is composed of N-acetyl-D-glucosamine-4-sulphate and D-galactosamine-6-sulphate.

Hyaluronic acid:

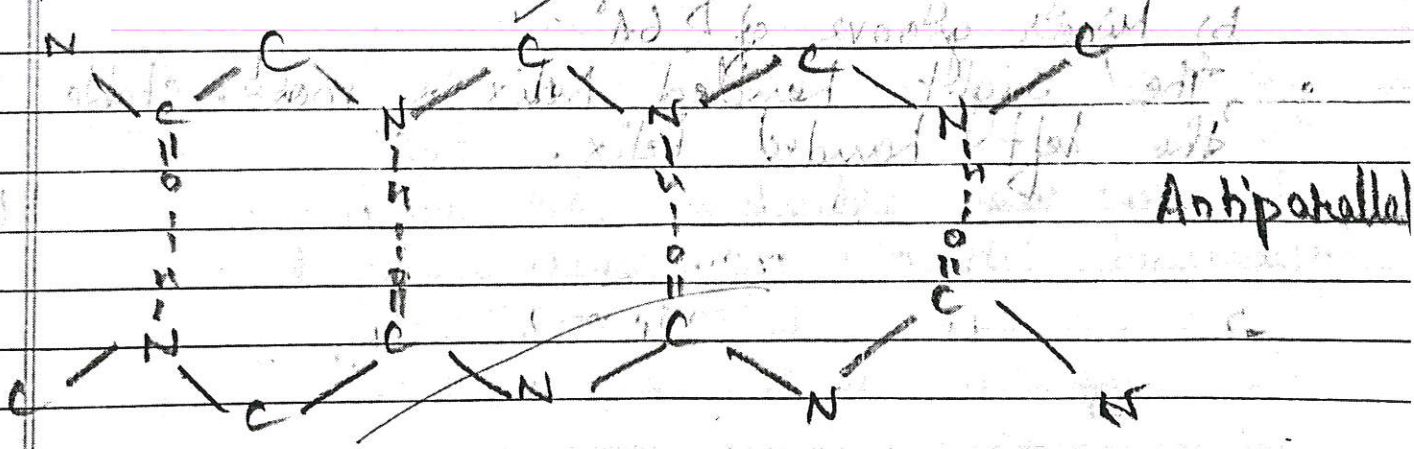
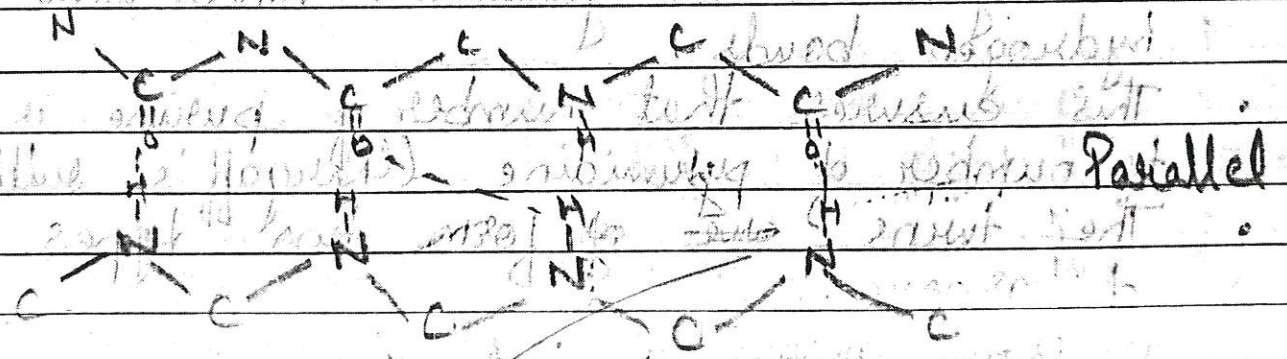
- It is found in the synovial fluid of synovial joint.
- It is in the humor vitreous of eye and covers the cornea.

- It provides nutrition and acts as a shock absorber.

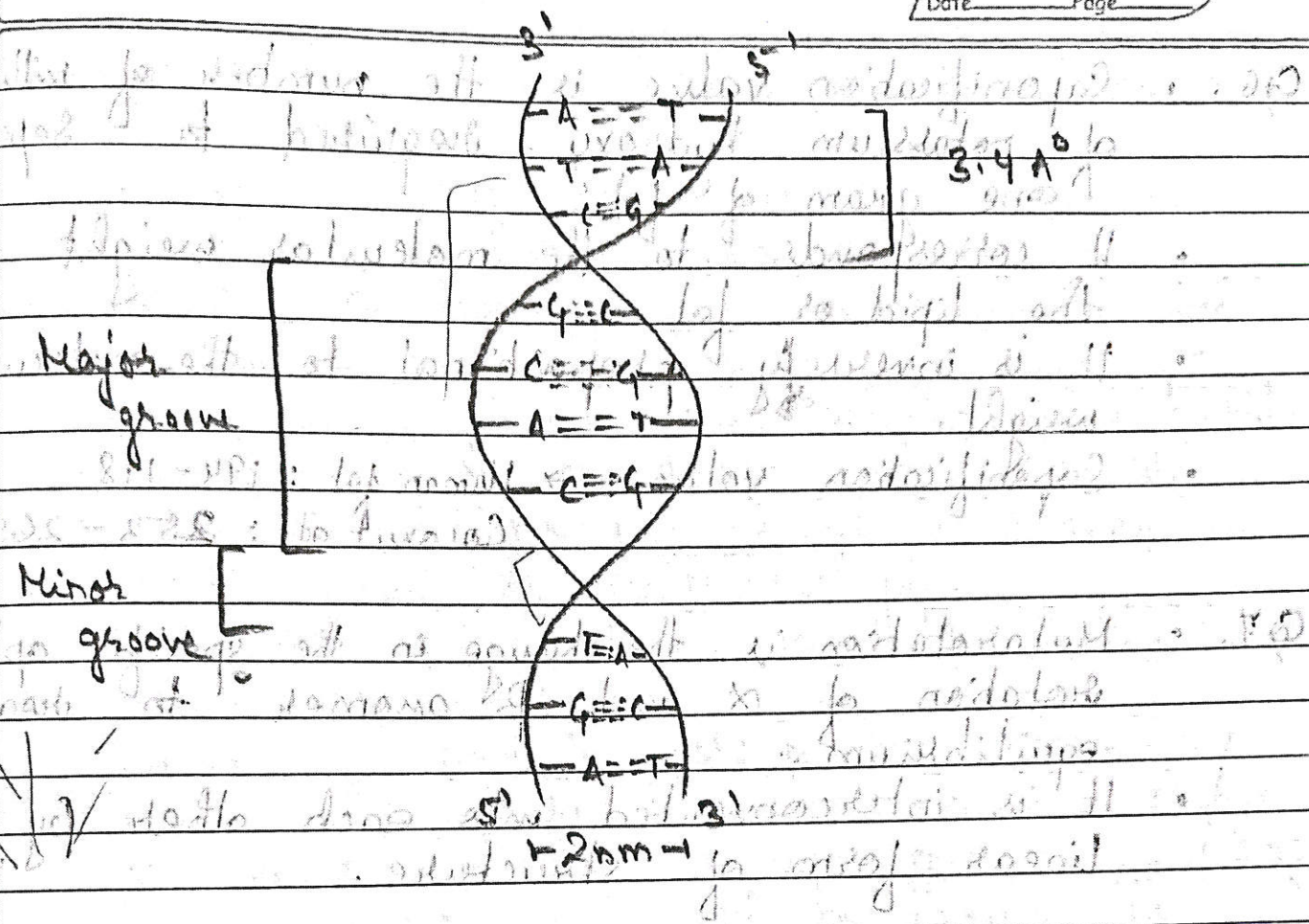


amino acid and carboxyl (C=O) group of another amino acid.

- The  $\beta$ -pleated sheet was the second structure suggested by Pauling and Corey.
- They are made of fully segmented polypeptide chains.
- The hydrogen bond in this case is formed between the adjacent amino acids.
- The direction of the segments can be parallel or antiparallel.
- The  $\beta$ -pleated sheet maybe formed by two polypeptide chain or by one chain that overlaps on itself.







Q5. Rancidity is the property of lipid.

- It is characterized by the foul odour and taste of fat oil.
- Rancidity is of two types:
  - Reducing:** when the fats and oils are reduced to alcohol.
  - Oxidative:** Oxidation of fats, oil and lipid may lead to rancidity.

Some oils and fats have natural antioxidants to prevent rancidity for some time.



Q8. Amino acid may be present as ampholytes or zwitter ions.

- They can both accept or donate a proton, therefore are called ampholytes.
- In zwitter ion both positive and negative ion is present.
- Zwitter is a german word which means hybrid.
- The pH at which an amino acid exists as zwitter ion with no net charge is known as isoelectric point or isoelectric pH.
- There is no mobility of ion in electric field.
- Solubility also decreases.
- In acidic pH, there is more positive charge.
- In basic pH, there is more negative charge.
- Every amino acid has its own specific isoelectric pH. It can be calculated by taking the average pKa value of ionisable groups.
- The isoelectric pH of ~~Alanine~~ Leucine is 6.

$$\frac{3\frac{1}{2}}{35}$$

J. G. and

$$\frac{32}{35}$$

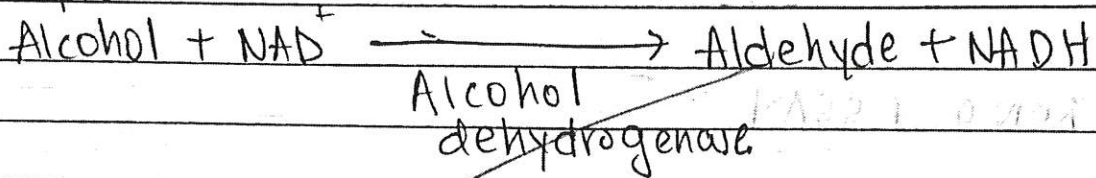
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Representation:



Example:



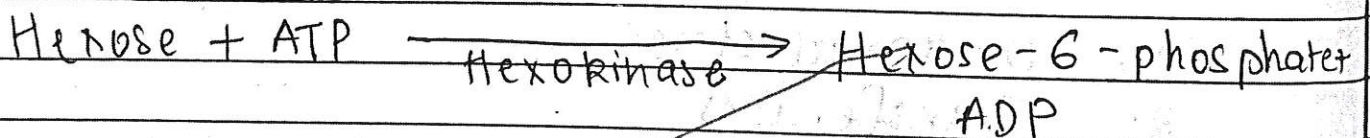
2. Transferases:

Help in transfer of group from one substrate to another

Representation:



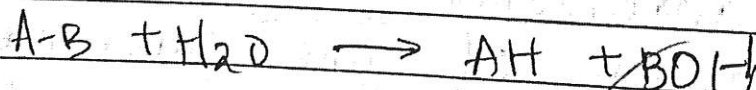
Example -



3. Hydrolases:

Aid in the breaking of bonds (peptide, ester, ether etc) by addition of water.

Representation:



Example -



Dihydroxy  
acetone  
phosphate

~~Triose isomerase  
phosphate~~

Glyceraldehyde  
3-phosphate

6. ligases:

Helps to combine 2 substrates together usually ~~with~~ the accompanied by the hydrolysis of ATP.

Example :-

Acetyl CoA + CoA  
+ ATP

~~Acetyl CoA  
carboxylase~~

Malonyl CoA +  
ADP + Pi

• Holo ENZYMES :-

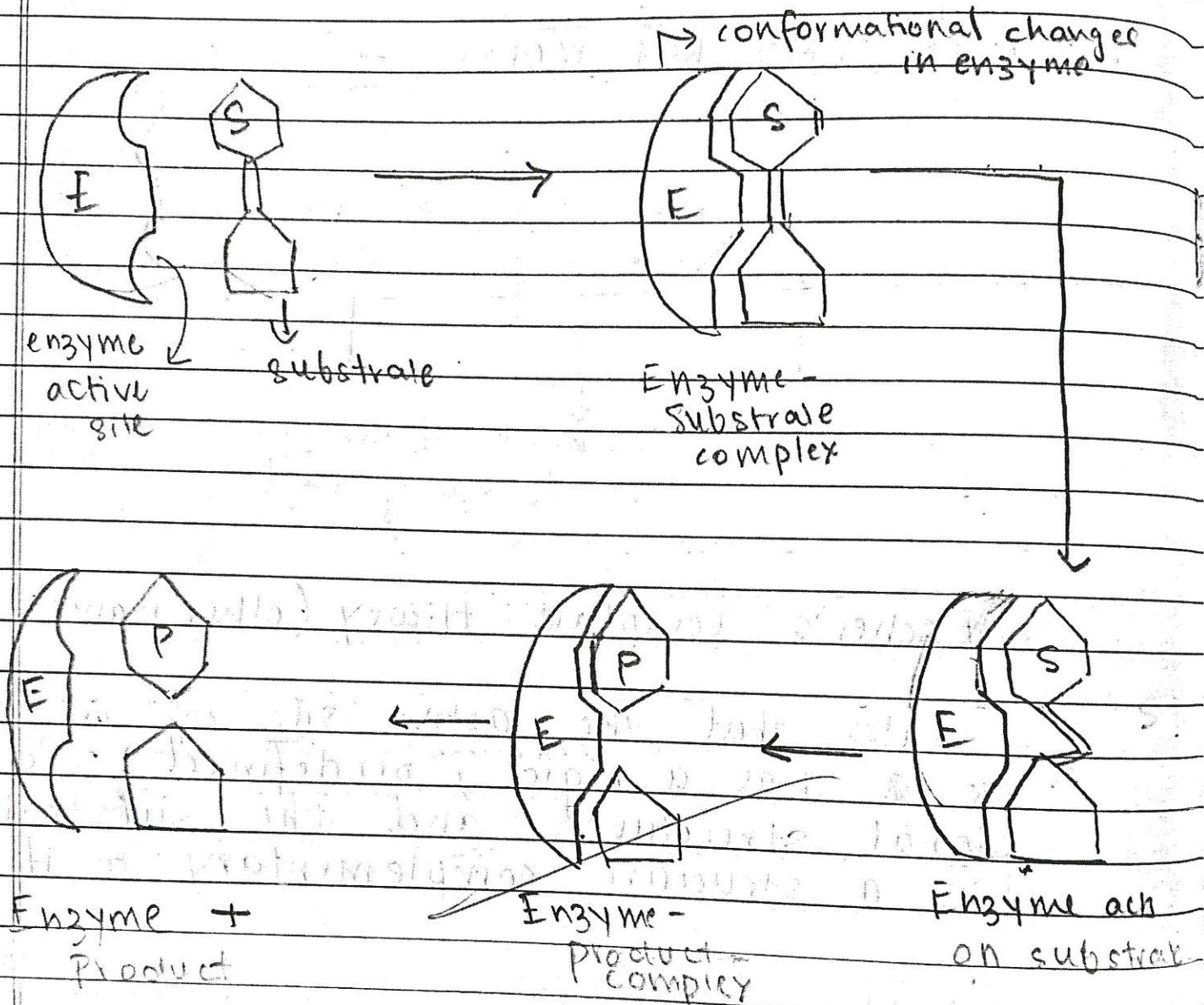
Holoenzymes are the ~~functional~~ part of the enzyme.

They consist of Apoprotein (protein part) and Coenzyme (non-protein part) of enzyme.

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## KOSHLAND'S INDUCED FIT THEORY



↳ Koshland's induced fit theory states that the active site of the enzyme is a flexible 3-dimensional structure.

• When substrate comes close to it, it undergoes unique conformational changes.



caused due to lack of action of Insulin enzyme (Target cells get resistant to the enzyme)

### • SYMPTOMS . e. →

↳ ~~Diabetes Mellitus is also due to lack of insulin.~~  
So insulin

↳ Hyperglycemia : Due to lack of insulin or its action, glucose present in the body cannot be utilised by the cells and thus result in Hyperglycemia.

↳ Glucosuria : Excess glucose begins to be secreted in the urine.

↳ Polyuria : Glucosuria causes excessive urination.

↳ Dehydration and Electrolyte imbalance : Polyuria leads to excess loss of water from body.

↳ Polydipsia : Thirst centers are activated and person drinks more water.

↳ Muscle wasting : Since glucose cannot be utilized for energy production, muscle proteins are broken down.



4. Blood Glucose levels can be estimated by Glucose oxidase method (more accurate) as it measures only glucose level.
2. Urine glucose level can be estimated by Benedict's test qualitative test.

## M. KETOSIS :-

When Acetyl CoA is produced in excess, excess of Ketone bodies are [acetone, aceto-acetate and  $\beta$ -hydroxy-butyrate] are formed; [while usually the ketone bodies <sup>bodies</sup> These leads to ~~low~~ levels are low in the body - less than 1 mg/dL].

Therefore this leads to ~~ketonemia~~ <sup>Ketoneimia</sup> (ketone bodies in blood), ~~ketonuria~~ (ketone bodies in urine) and Smell of acetone while breathing. These 3 symptoms together are known as KETOSIS -

## • Causes :-

1. Diabetes Mellitus :



are excreted from urine in the form of sodium salts.

#### 4. Coma :

Mainly dehydration and Keto Metabolic Ketacidosis can lead to coma.

#### • Diagnosis @ —

Diagnosis is done by ROTHERA'S TEST.

In case of Diabetes Mellitus ketacidosis ketosis both Rothera's and Benedict's test are answered while in starvation condition only Rothera's test (as glucose levels are depleted in body)

#### SHORT ANSWERS

5. Lactose intolerance : Body cannot utilise the lactose obtained from milk and milk products, due to deficiency of lactase enzyme. It is of 2 types : congenital and aquired. Bacteria act on the accumulated Lactose to convert to lactic acid. This leads to gastrointestinal problems, diarrhoea and dehydration.

6. HDL or high density lipoprotein helps to transport cholesterol from peripheral tissue to liver (only organ from where cholesterol can be



CK3 - MM → present in muscles

## 9. Fatty liver :

Fatty liver is defined as the deposition of fatty acids in the liver (hepatic cells).

Caused due to excess calorie intake, toxic damage to liver, like in case of Hepatitis B virus infection, Alcoholism etc.

- Lipoprotic factors : Deficiency of them can lead to fatty liver.

Examples : -

1. Choline : shown to reverse fatty liver in animals.

2. lecithin and Methionine : lecithin helps to produce choline.

3. Omega-3-fatty acids : Present in fish and helps to prevent fatty liver.

4. Vitamin E : Useful due to its anti-oxidant properties.



CLASS TEST.

- 1) Atlantooccipital Joint (5m)
- 2) Atlantoaxial Joint (5m)
- 3) Boundaries and contents of Occipital Triangle (2m)

ANSWERS

1) Atlantooccipital Joint

Type: It is a synovial joint of <sup>ellipsoid</sup> condylar variety. It is an 'YES' joint.

Articular Surfaces:

Above: The convex occipital condyles.  
Below: The superior articular facets of the atlas vertebra. These are concave.

Ligaments:

\* The fibrous capsule (capsular ligament) surrounds the joint. It is thick posterolaterally and thin anteromedially.

\* The anterior atlanto-occipital membrane extends from the anterior margin of foramen magnum above, and upper border of anterior arch of the atlas below. Laterally, it is continuous with the anterior part of capsular ligament. Anteriorly, it is strengthened by the cord-like anterior longitudinal ligament.

\* The posterior atlanto-occipital membrane extends from the posterior margin of the foramen magnum above, to the upper border of posterior arch of atlas below. Inferolaterally, it has a free margin which arches over the vertebral artery and the first cervical nerve. Laterally, it is continuous with the posterior part of capsular ligament.

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## Arterial and Nerve Supply.

The joint is supplied by the vertebral artery and by the first cervical Nerve.

## Movements

It permits movements around 2 axes.

- ① Flexion is by the longus capiti and rectus capitis anterior.
- ② Extension is by rectus capitis posterior major and minor, the obliquus capitis superior, splenius capitis.
- ③ Lateral bending is by rectus capitis lateralis, semispinalis capitis, splenius capitis.

## 2) Atlantoaxial Joints.

It is a 'NO' Joint.

### Types and Articular Surfaces:

- A pair of lateral atlantoaxial joints between the inferior facets of atlas and the superior facets of the axis. These are plane joints.
- A median atlantoaxial joint between the dens and the anterior arch and between the dens and transverse ligament of the atlas. It is a pivot joint.

Ligaments: The lateral atlantoaxial joints in support.

- a) A capsular ligament all around.
- b) The lateral part of the anterior longitudinal ligament.
- c) The ligamentum flavum.

  
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The medial atlantoaxial joints is supported by:

- a) The anterior smaller part of the joint between the anterior arch of atlas and the dens is surrounded by a dense capsular ligament.
- b) The posterior large part of the joint between the dens and transverse ligament is often continuous with one of the atlantooccipital joints. Its main support is the transverse ligament which forms a part of the cruciform ligament of atlas.

### Movements

Movements at all the 3 joints are rotatory and takes place around a vertical axis. The dens forms a pivot around which the atlas rotates. The movement is limited by the alar ligaments. Some rotatory movements also take place.

### ③ Boundaries

Superomedially: Rectus capitis posterior major muscle supplemented by the rectus capitis posterior minor.

Sublaterally: Superior oblique capitis muscle.

Inferiorly: Inferior oblique capitis muscle.

Roof: Medially: Dense fibrous tissue covered by the semispinalis capitis.

Laterally: Longissimus capitis.

Door: ① Posterior arch of atlas  
② Posterior atlanto-occipital membrane.

### Contents

- 1) Third part of vertebral artery.
- 2) Dorsal ramus of nerve C1 - Suboccipital Nerve
- 3) Suboccipital plexus of veins.



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