Kiccha kishor III B.Sc CB2 025

Biochemistry Notes.

"kishor publications"

20-03-2020 : Friday.

My own Notes.

- M.R. Kuj

"DO not feel lonely, the entire universe is inside of you"

- Kiccha kishor [M.R. Kuj]

contents.

Biochemistry completed

Introduction To Biochemistry

Contributions:-

Lavoisier:- 1780 - 89.
* Respiration in oxidation.

Louis pasteur:- 1854 - 64
* fermentation.

Emil fischer:- 1899
* Specifity of enzymes.

Krebs. 1935
* citric acid cycle

pauling :- 1950
* Structure of proteins

watson - crick 1953
* DNA structure.

Kornberg 1956
* Discovery of DNA polymerase

Kendrew & perutz 1960
* Str. of myoglobin & Haemoglobin.

Khorona & Holley 1965
* Eclucidation of the genetic code.

Jeffrey's 1985
* Genetic finger printing.

chargaff: 1953
* Base equivalence in DNA.

meischer 1869
* discovery of DNA

Edward Jenner 1796
* vaccination against Small pox

wohler 1826
* prepare urea from inorganic compound

muller. 1830
* discovery of proteins.

michaelix & menten 1913
* developed a kinetic theory of enzyme nature.

Banting & Best 1921
* first isolated insluin from pancreas.

fleming 1928
* discovered pencillin

Snages. 1956
* determined the amino acid sequence of Insulin

Element Composition of living organisms

Organic Biomolecules:
- carbon - C
- Hydrogen - H
- oxygen - O
- Nitrogen - N
- phosphorous - P
- Sulphur - S

Elements occuring as ions
- Sodium - Na^+
- Potassium - K^+
- magnesium - Mg^{2+}
- calcium - Ca^{2+}
- Chlorine - Cl^-

Trace elements
- Iron - Fe
- Copper - Cu
- Zinc - Zn
- manganese - Mn
- Cobalt - Co

Biochemical composition of living organisms
- protein
- Lipid
- Nucleic acids
- Carbohydrates
- Inorganic & miscellanious molecules

Role of water in Biochemical system

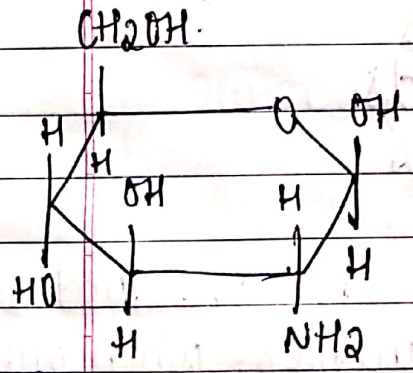
* water serves as the medium in which all cellular reactions occur & essential to life.
* water is used to transport nutrients & waste products into & out of the cells.
* water itself participates in several reactions either as reactant (or) products.
* Due to surface tension of H_2O. it moves from roots of plant to the tips through capillary action.
* water has maximum density at 4°c due to this, water freezes from top to bottom enabling aquatic animals survive in liquid water.
* water acts as lubricant in the body to prevent frictions in joints & some parts of the body.

Carbohydrates

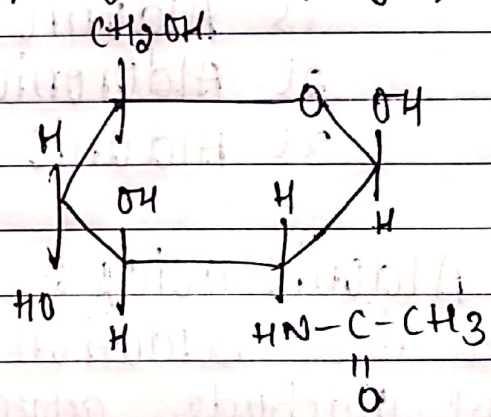
Carbohydrates are the class of organic compound of only carbon, hydrogen & oxygen. they are defined as polyhydroxy aldehydes (or) ketones which yeild these compounds on hydrolysis.
They are classified into mono, oligo & polysaccharides.

a) Amino sugars :- These are sugars in which a hydroxyl groups of the sugar is replaced by an amino groups.
Ex :- D-Glucosamine & D-galactosamine.

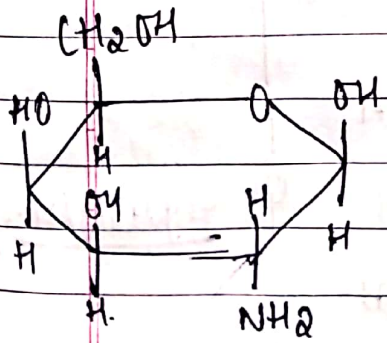
Haworth structures of Aminosugars.



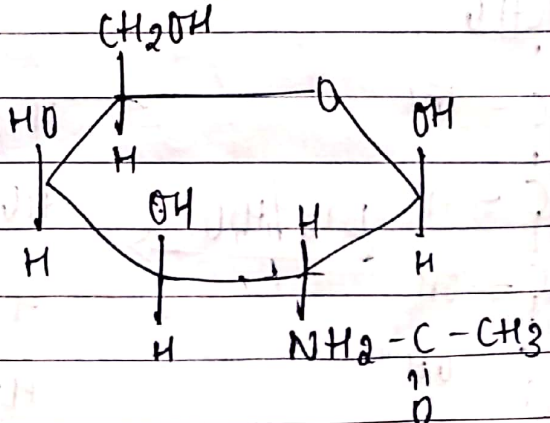
(β-D-Glucosamine)



(N-acetyl β-D Glucosamine)



(β-D-galactosamine)



(N-acetyl β-galactosamine)

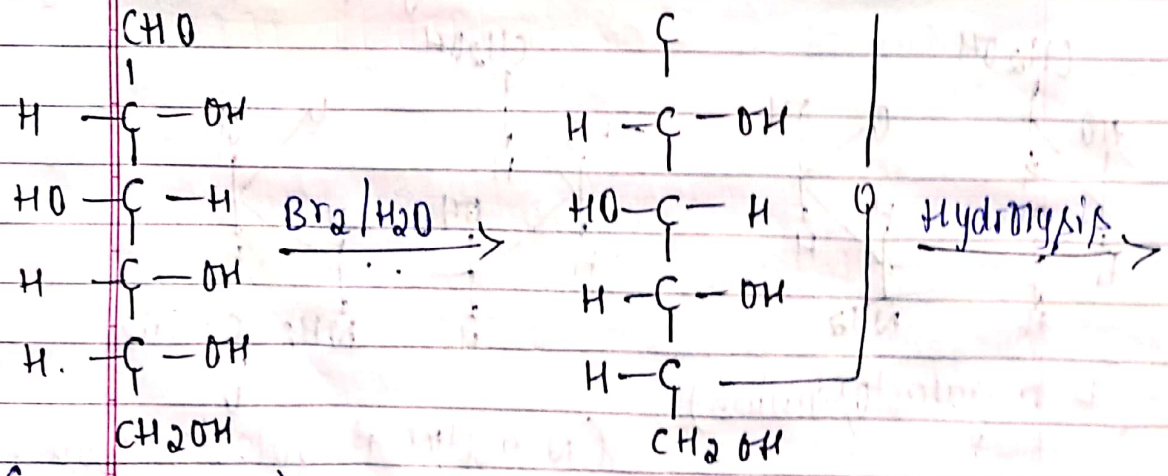
Biological Importance

* N-acetylglucosamine is a component of the polysaccharide present in bacteria cell walls
* Chitin is a structural polysaccharide in the shells of shellfishes & crabs.
* N-acetylgalactosamine is a component of Chondroitin protein found in cartilage
* Some amino sugars are present in antibiotic like streptomycin & erythromycin.

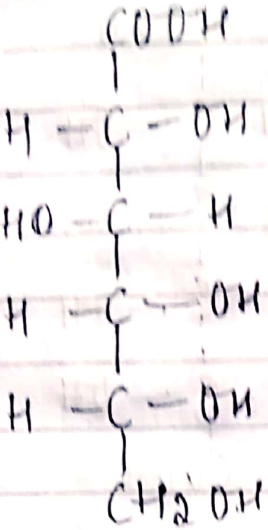
b) Sugar acids :- Sugar contains aldehyde group undergo oxidation with different oxidising agents to give sugars acids. The three types of sugar acids are:

1) Aldonic acids
2) Alduronic acids
3) Aldanic acids

1) Aldonic acids :- These are obtained by the mild oxidation of aldoses when only the aldehyde group is oxidised.

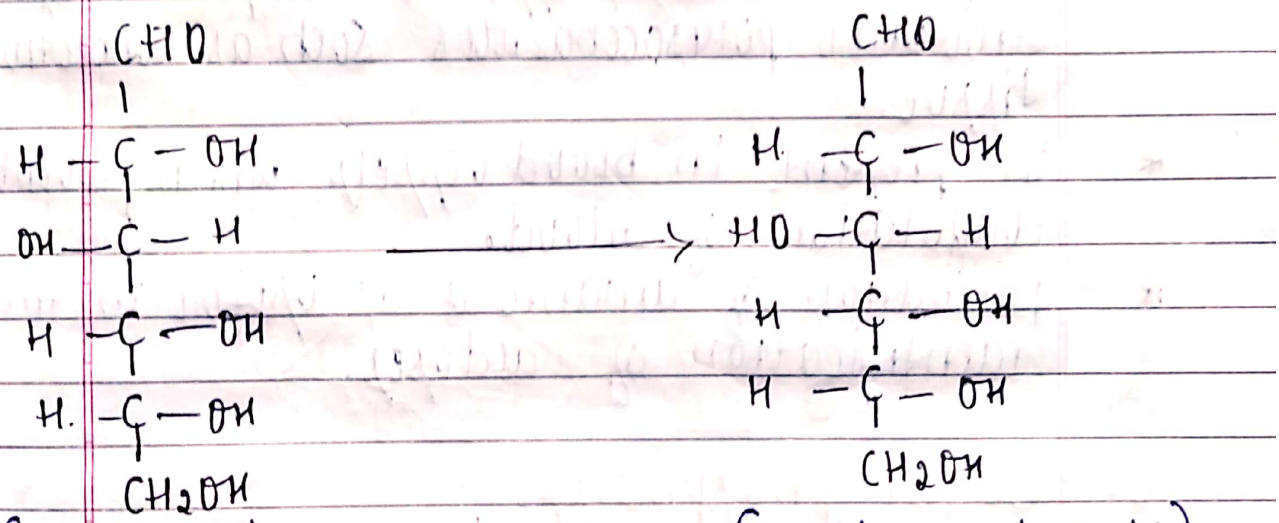


(D-Glucose)



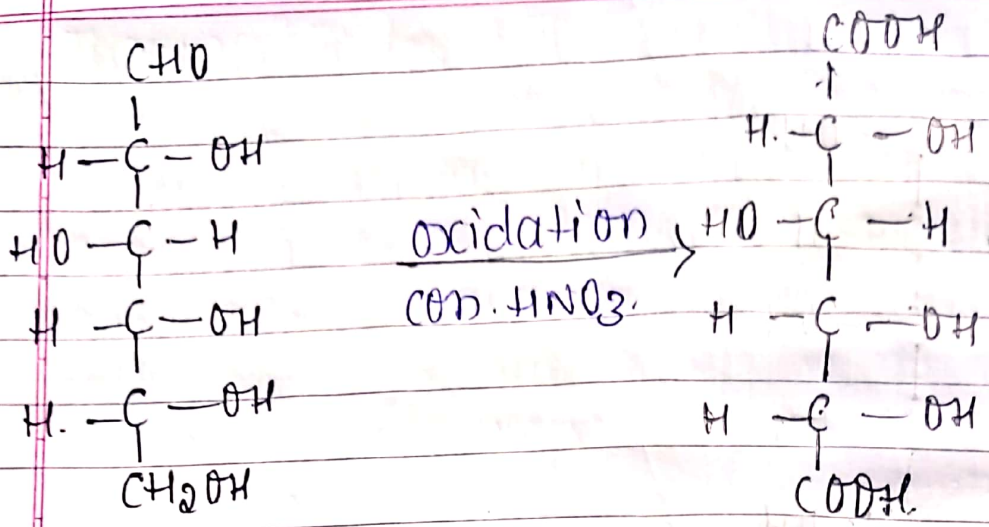
(D-Gluconic acid).

2) Alduronic ā: These are sugars in which terminal 1° alcohol group (-CH_2OH) of sugar is oxidised to carboxyl group leaving aldehyde group



(D-Glucose) (D-Glucuronic acid)

3) Aldanic ā: These are dicarboxylic ā obtained by the oxd^n of aldoses of strong oxidising agent COOH ā. During oxidation the aldehyde group as well as the 1° alcohol groups are oxidised.



D-Glucose D-Glucasic ā

Biological imp of Sugar acids.

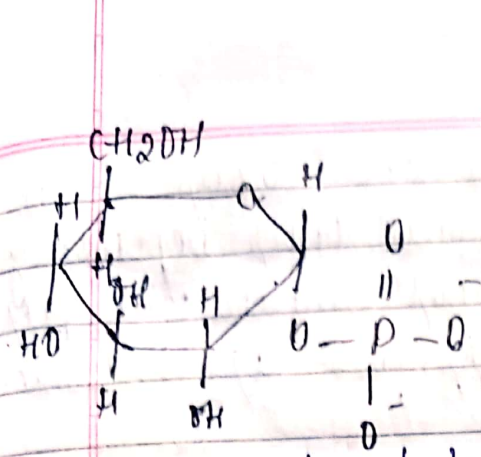
* Gluconic ā is readily metalised in the body of calcium gluconate it increases calcium level in blood.
* D-Glucuronic ā is essential component of structural polysaccharides such as connective tissue.
* It present in blood vessels which prevents coagulation of blood.
* formation of aldanic ā is useful in the identification of aldoses.

C. Sugar phosphates.

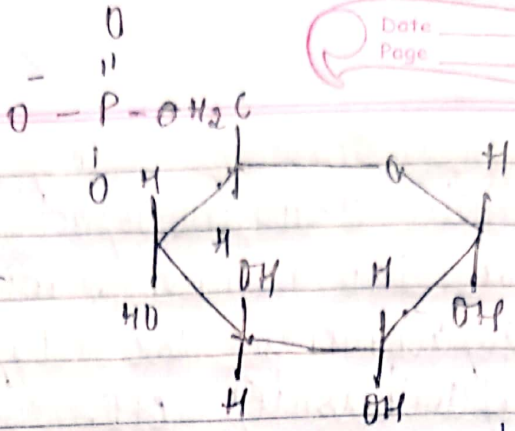
Condensation of phosphoric ā with one of the hydroxyl group of a sugar results in phosphate ester.

Eg:- α-D-glucose-1-phosphate.
α-D-Glucose-6-phosphate.

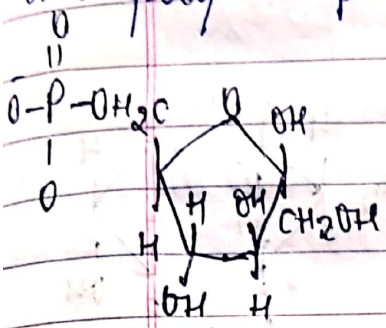
Haworth structures of sugar phosphates



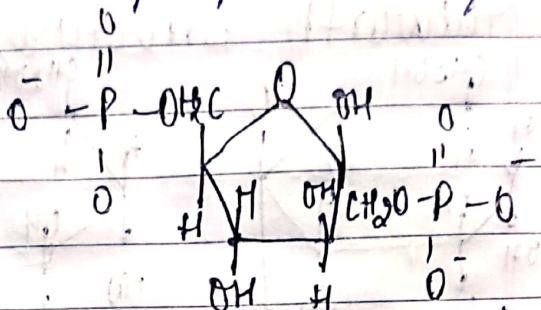
α-D-Glucose-1-phosphate,



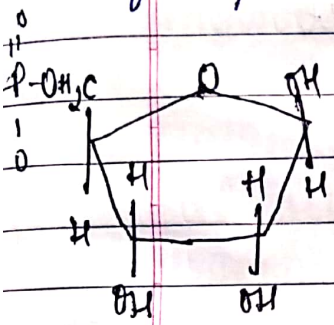
α-D-Glucose-6-phosphate.



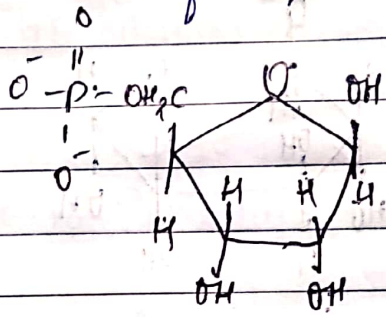
β-D-fructose-6-phosphate,



β-D-fructose-1,6 diphosphate



β-D-ribose-5-phosphate



β-D-2-deoxyribose-5-phosphate

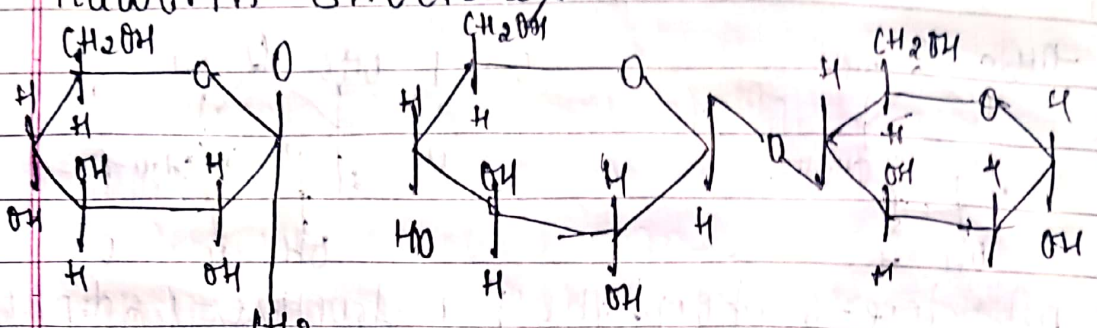
Biological importance of Sugar phosphates

* These are intermediates in the metabolism of carbohydrates. phosphorylation of sugars prevents their diffusion out of the cell & also activates sugars for subsequent chemical transformation.

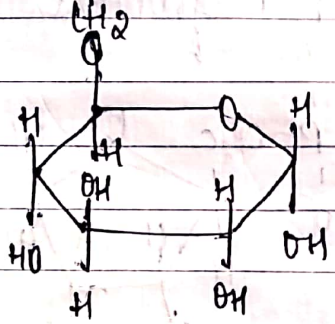
* phosphate esters of ribose & deoxyribose are constituents of nucleic acids & some co-enzymes.

Oligosacchirides:- These are sugars which contain 2-10 monosacchiride units depending upon the numbel of monosacchiride with present oligosacchiride are classified as disacchiride, trisacchasides etc.

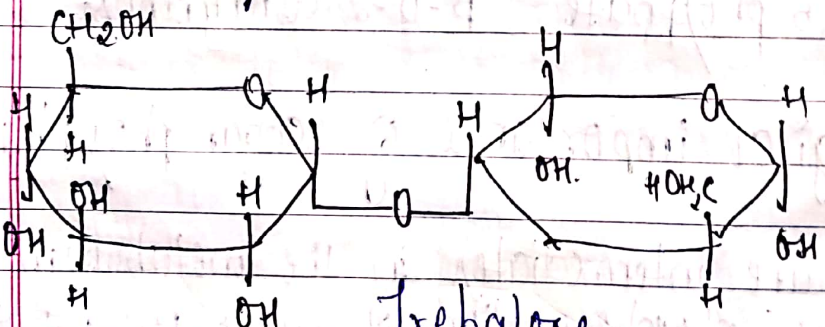
Hawarth structures



cellobiose



Isomaltose,



Trehalose

Biological importance of oligosacchirides.

* Isomaltose is a product of partial hydrolysis of amylopectine of starch & glycogen. it is a reducing disacchiride in Glucose units.

* Cellobiose is a partial hydrolytic product of

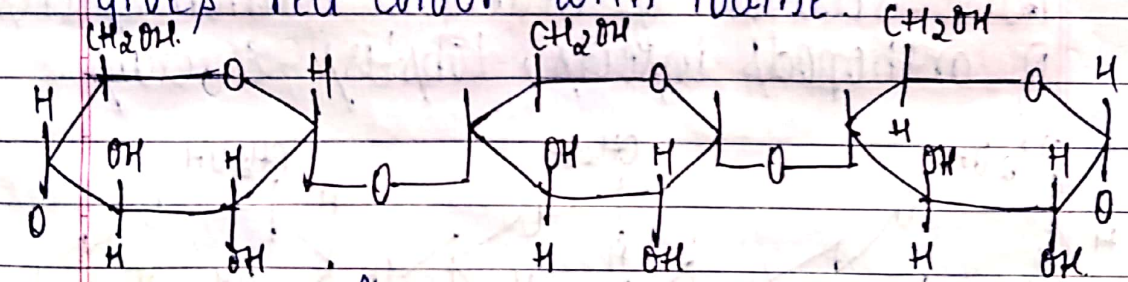
cellulose & is formed during digestion of cellulose
* It is the major carbohydrate energy storage molecule used by insects for flight.
It gives rapid energy requirements of flight.

polysaccharides.

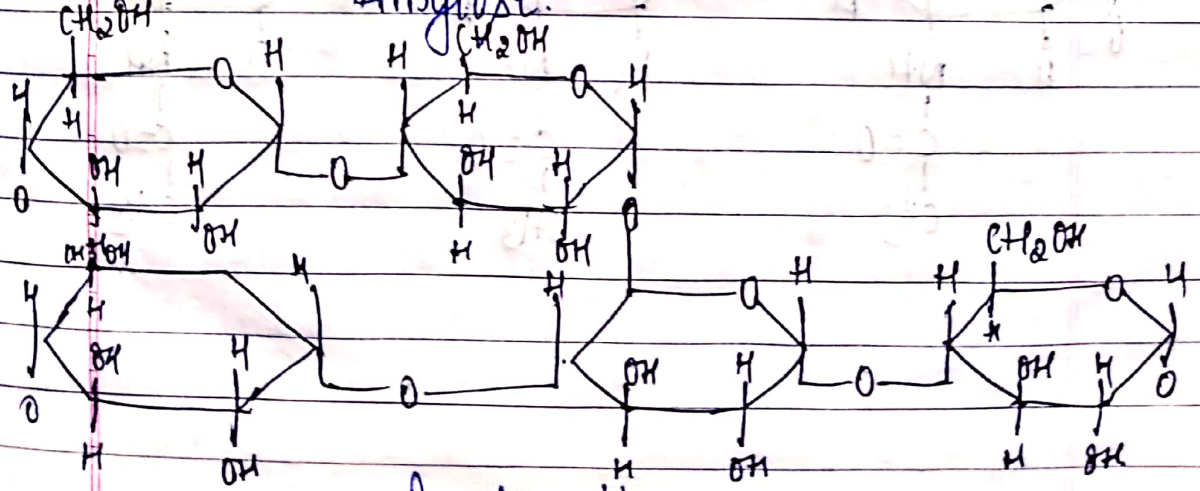
A carbohydrate whose molecules consist of a number of sugar molecules bonded together.

- Starch :- It is the major source of carbohydrates in the human duct. it is digested by the enzymes present in saliva & pancreas juice.
a) Amylose.- It is water soluble & consists of linear chains of D-Glucose units.
b) Amylopectine - It is insoluble in water. It is a branched polysaccharide.

Amylose gives blue colour while amylopectin gives red colour with iodine.



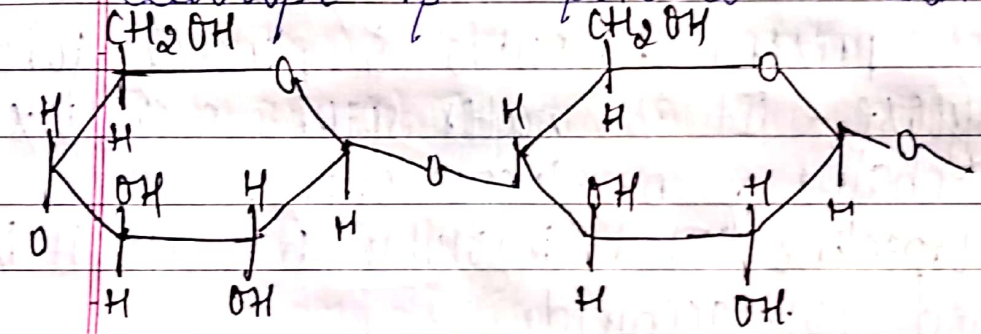
Amylose.



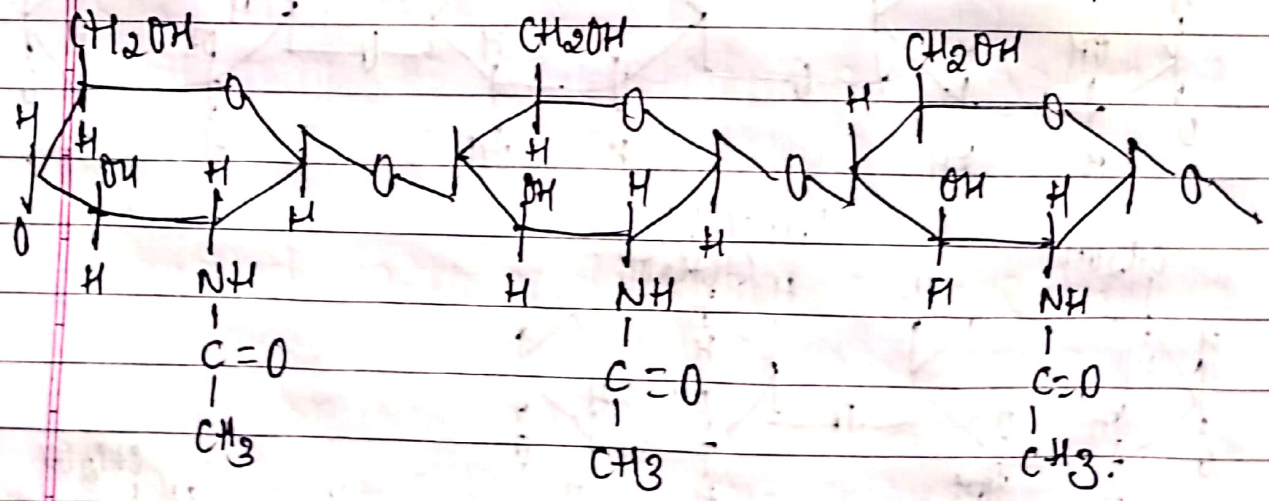
Amylopectine

Glycogen :- It is an main storage polysaccharide of animal cells & is present mainly in liver & skeletal muscle.
Whenever energy is required, glycogen is enzymatically hydrolysed to yeild glucose which oxidised to provide energy it gives red colour with iodine.

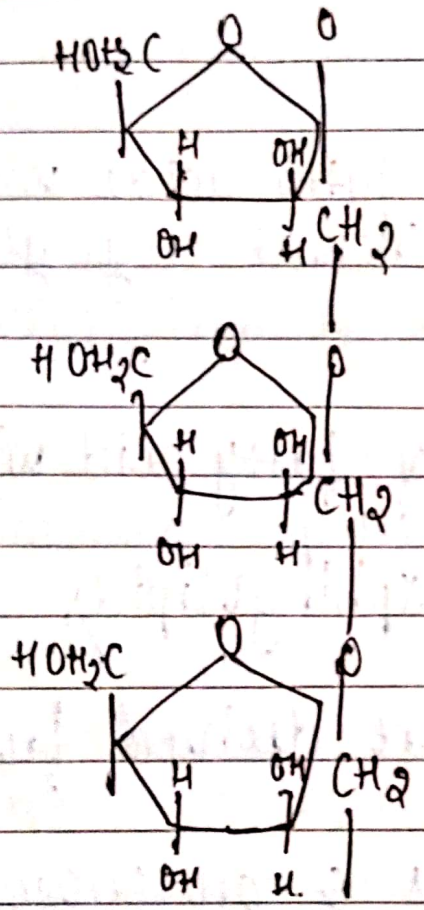
Cellulose - It is most abudant organic compound in nature. it is chief constituents of fibrous parts of plant.
Cellulose is insoluble in water.



Chitin: It is the principal component of the hard skeleton of nearly a million species of arthopods insects, lobsters & crabs.



Inpulin: It occurs in dahlia bulbs, dandelions, garlic, onion etc, as a storage polysaccbride.
Inpulin is a non-redacing Sugar.



Lipids.

It is a extremely heterogenous groups of naturally occuring compounds that are relatively insoluble in water but soluble in non-polar solvents.

classification:-

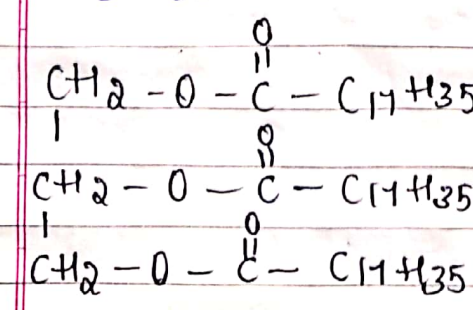
a) Simple lipids: Esters of fatty acids with vasious alcohols. they include acyl glycerols & waxes.

b) Compound lipids: Esters of fatty acid with alcohol & contain additional group.
Ex: phospholipids & Sphingolipids

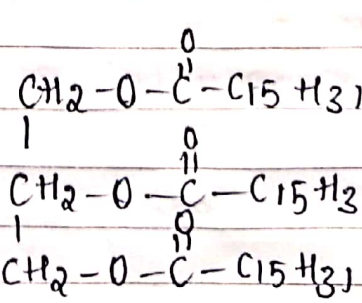
c) Derived Lipids: These are derived from simple & compound lipids.
Ex:- Terpines, steriods & carotenoids.

Fatty acids: It is long chain monocarboxylic acids with a general formula, R-COOH
R is an alkyl (or) alkenyl chain.
They may be saturated (or) unsaturated with one (or) more double bonds.

Saturated fatty acids have general formula $CH_3-(CH_2)_n-COOH$ (or) $C_nH_{2n+1}COOH$.



Tristearin.



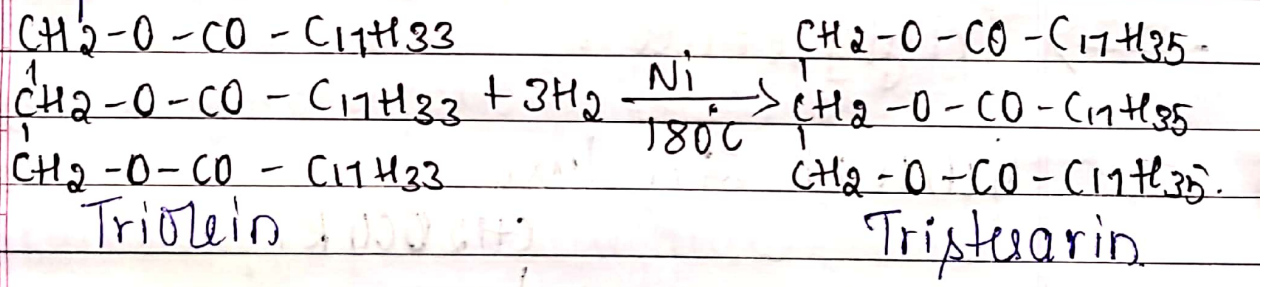
Tripalmitin.

Biological imp of triacyl glycerols

* The fun as reserve material fuel in humans & deposit in adipose tissue. & important in fruits & seeds.
* They insulate the body from cold
* Oxd^{n} of triacyl glycerol it yeilds H_2O reducing the need for drinking H_2O in desert animals

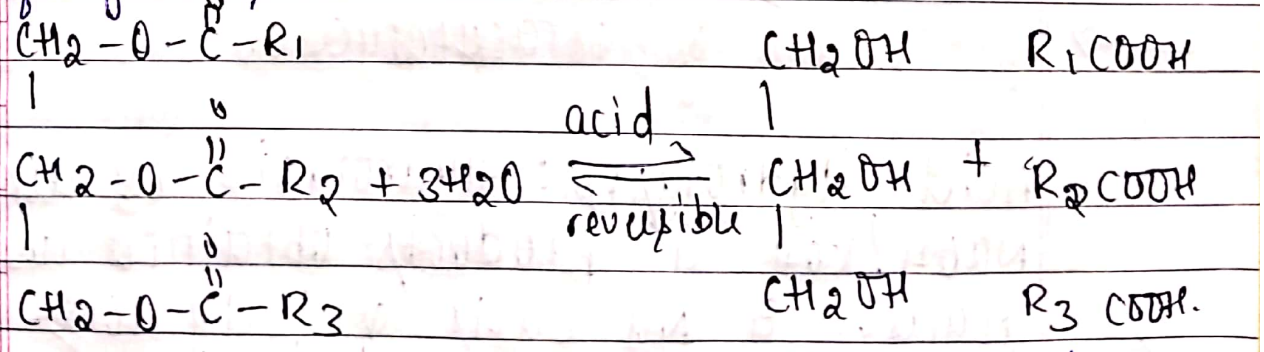
→ properties of triacyl glycerols.

1) Hydrogenation: when hydrogen gas is passed through liquid oils in presence of nickel catalyst at 180°C. solid fats are formed.
Ex: when triolein is hydrogenated tristearin is formed.



Triolein → Tristearin

2) Acid hydrolysis: on hydrolysis mineral acid, triglycerids yield glycerol & 3 molecules of fatty acids.



Glycerol + fatty a.

Saponification: on hydrolysis with alkali triglycerides yeild glycerol & salts of fatty acids. this rxn is irreversible & used in the mfg of soaps

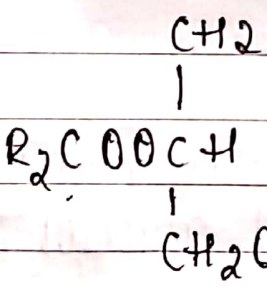
→ Essential & non-essential fatty acids.

Humans can synthesise most fatty acids from acetyl co-enzyme A obtained by the oxidation of glucose - non-essential.

Linoleic ā & linolenic ā are essential because they are essential normal growth They cannot be synthesised by humans & must therefore be obtained.

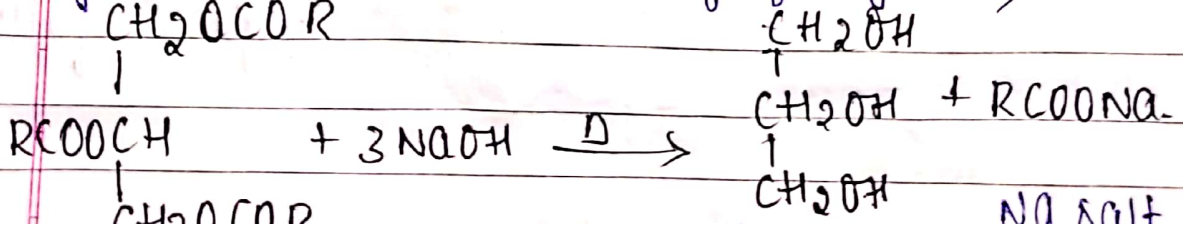
→ Triglyceride:

General structure.



→ properties of triacylglycerol.

Acid Hydrolysis: Hydrolysis by alkali NaOH/KOH & products obtained are glycerol & Na salts of fatty acids



Saponification number: It is a lipid as defined the number mg of NaOH / KOH required to completely saponify one gram of the lipid.

Iodine number: It defined as number of grams of iodine that will combine with 100g of lipid. A high iodine number indicates a high degree of unsaturation in the fatty acids of the lipid.

Rancidity: when oils & fats are exposed to moist air, they develop an unpleasent taste & odour.

a) Hydrolytic rancidity: In the presence of moist air, triglycerides undergo partial hydrolysis by enzymes lipase provided by micro-org. present in air to give low molecular mass fatty acid having degeadable smell.
Ex: Butter.
It prevented by refrigerator.

b) Oxidative rancidity: oils undergo oxidation at position of unsaturation to give short chain aldehydes, keto acids with unpleasent smell.
It prevent by addition of antioxidants, food preservatives.

Biological imp of triglycirides.

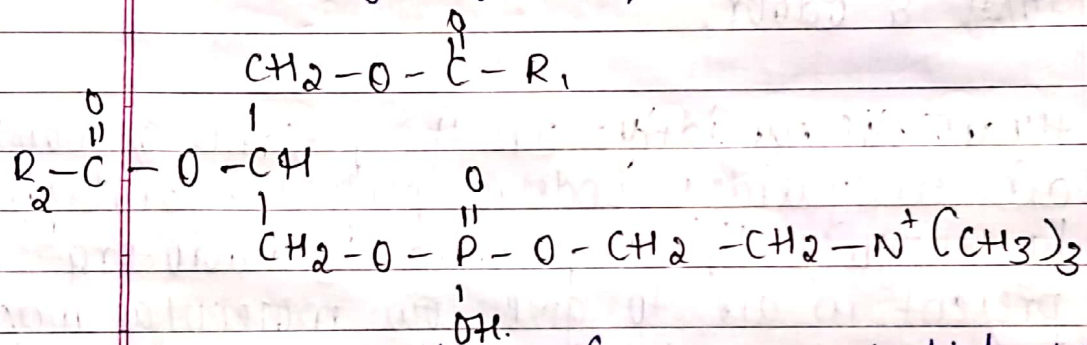
* It yeild more water which is useful for

hibernating animals & camels.

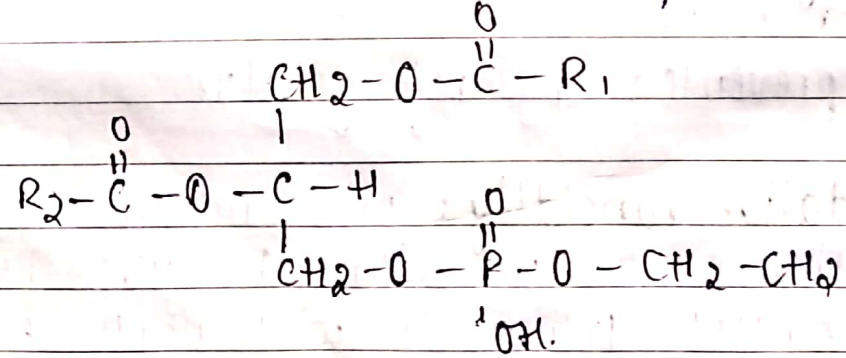
* It survive for long periods without drinking water.
* It stored under the skin, serve not only as energy stores, but also helps in insulation
* It helps in changing the density of their bodies to suit the ambient temp.

→ phosphoglycerides:

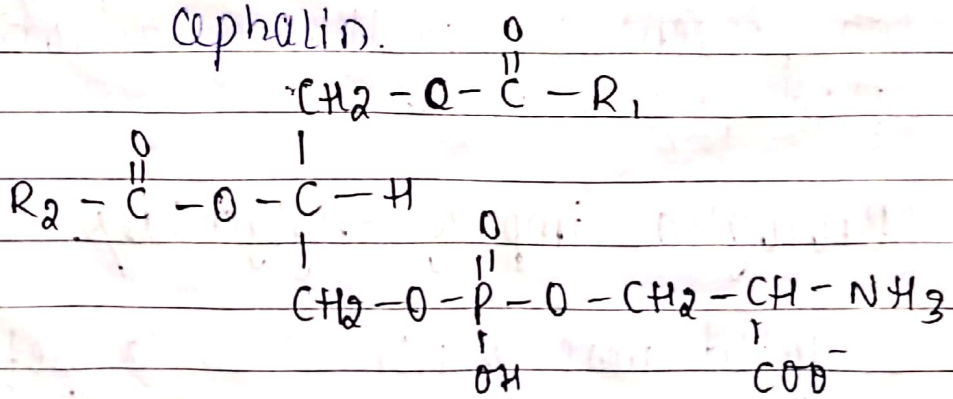
These are derivatives of phosphasidic ā. they contain a phosphate group in addition to glycisor, fatty ā & a nitrogenous Base.



lecithin (3-sn-phosphotidycholine)



cephalin.



3-Sn-phosphatidylserine.

Biological importance of phosphoglycerides

* It is essential compopents of cell membranes & subcellular organells. it regulates the str & permeability of cell membrane
* Several enzymes require phospholipids.
* They are involved in transport of other lipid in the blood stream.
* It plays a role in Blood coagulation process in platelets.
* It serves to anchor glycoproteins to plasma membrane.

Micelles: These are the globular aggregates whose hydrocarbon groups are out of contact with water.

uses :-

* It required in human body that plays a vital role in the removal of complex lipids
* micelles acts as emulsifiers when surfactants are above the critical micelle.
* They used in electrophoresis.

Liposomes: A minute spherical sac of phospholipid molecules enclosing a water droplet.

uses :- * Liposomes in tumour therapy.
* carrier of small cytotoxic molecules
* It is antimicrobial, antifungal & antiviral therapy.

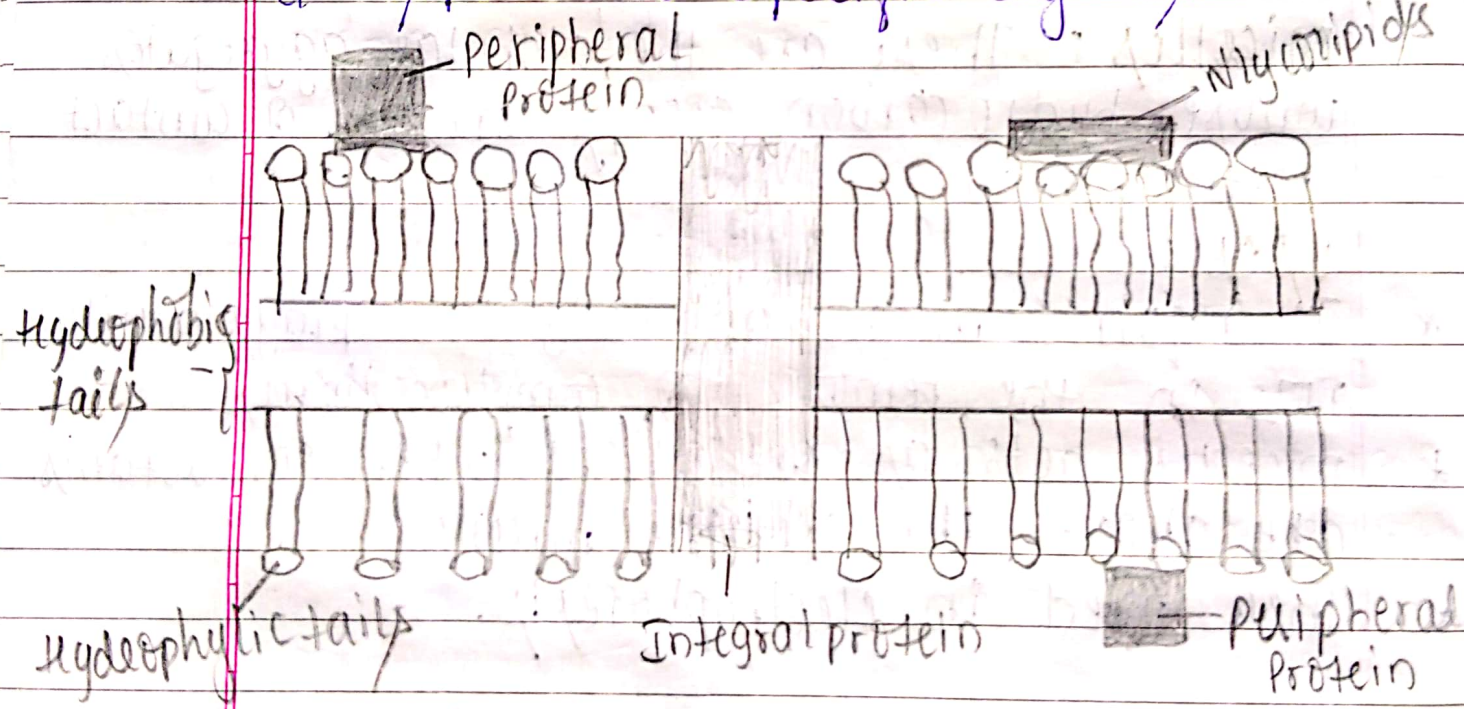
Structure of cell membrane

* cell membrane is a biological membrane seperating the interior of a cell from the outside environment
* It appears thin section with electron microscope as a triple layered str about 7.5 - 10 nm.
* It is a flexible & allows a unicellular organism to move

Chemical composition.

a) lipids b) proteins c) carbohydeate

fun: It contains receptors which recognize & respond to specific signals



fluid mosaic model of cell membrane.

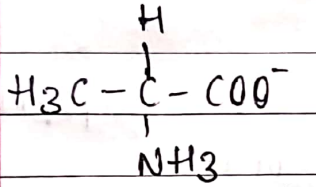
Proteins.

Amino acids: These are simple organic molecules containing both amino ($-NH_2$) & carboxylic ($-COOH$) group.
About 20 amino acids are commonly found in proteins

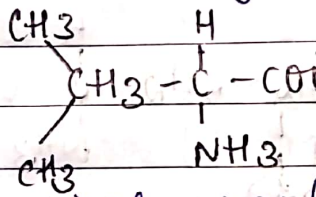
$$R-\underset{\displaystyle NH_2}{\underset{|}{CH}}-COOH$$

classification of amino acids based on polarity of side chain groups.

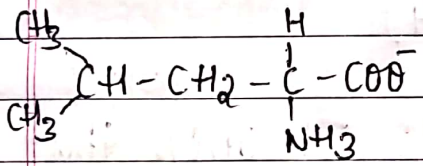
1. Amino ā containing non-polar R groups.



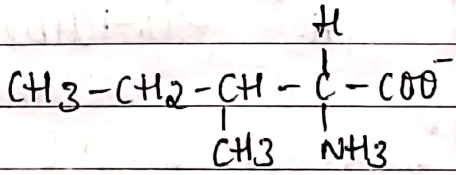
Alamine, Ala (A)



valine, val (V)

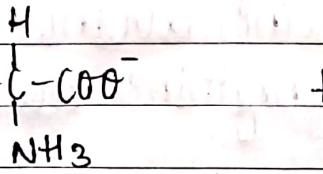


Leucine, Leu (L)

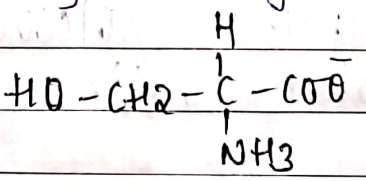


Isoleucine, Ile (I).

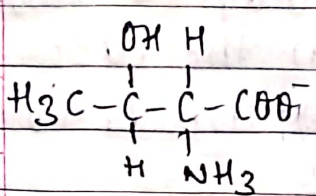
2. Amino ā containing unchanged polar R-group.



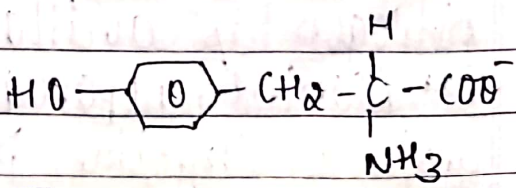
Glycine, Gly (G)



Serine (S)

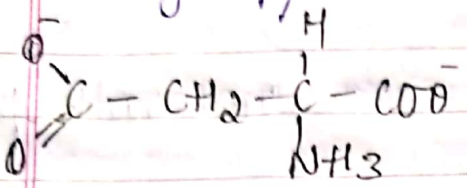


Threonine (T)

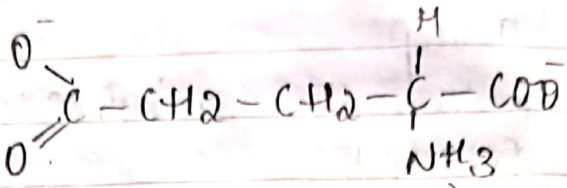


Thyrosine Tyr (Y).

3. Amino ā containing -vely charged polar R-groups.

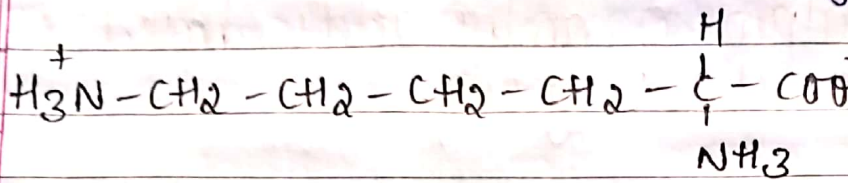


Asparic ā (D)

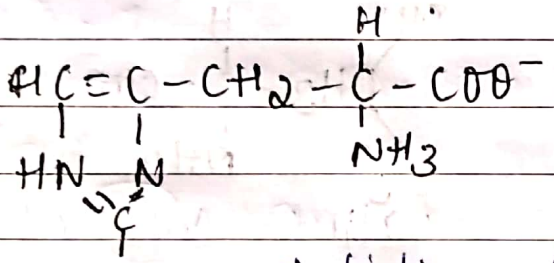


Glutamic acid (E)

4. Amino ā containing +vely charged polar R-group



lysiric (K)



Histidine (H)

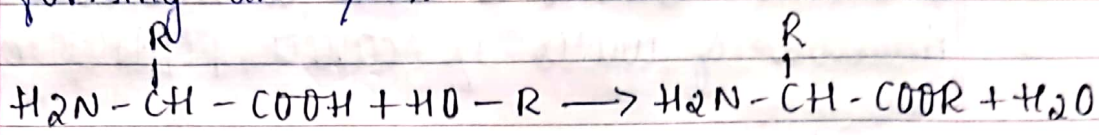
Essential amino acids: It ones that cannot be synthesized by the body rate at sufficient to meet the needs for growth & maintenance.
Exr Histidine, Isolecucine, Leucine, lysine, methionine, valine, Arginine etc.

Non-essential amino ā :- The ones that body can synthesize in adequate amount if nitrogen is available in the diet.
Ex: Alanine, Asparagine, Aspartic ā, Glutamic ā, ystein, Tryosine, proline.

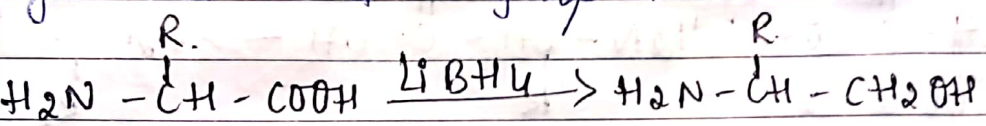
reaction of amino acids.

- Carboxylic group

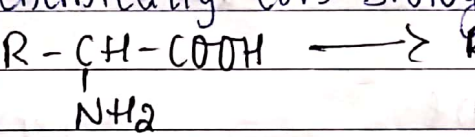
a) form^{n} of an ester: Amino ā react with alcohols forming an ester.



b) Reduction: on reduction using powerful reducing agent like $LiBH_4$ it gives 1^0 alcohol.

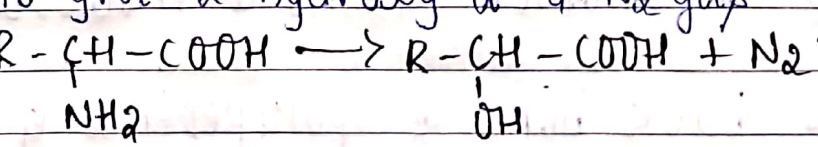


c) Decarboxylation: Amino ā can be decarboxylated chemically (or) Biologically to yeild the amine.

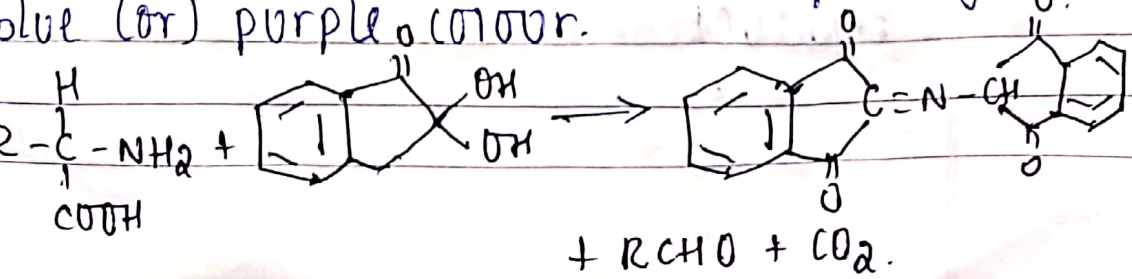


- Reaction of amino groups

a) With nitrous acid: The amino group of an amino ā react with strong oxidising agent nitrous ā to give α-hydroxy ā & N_2 gas



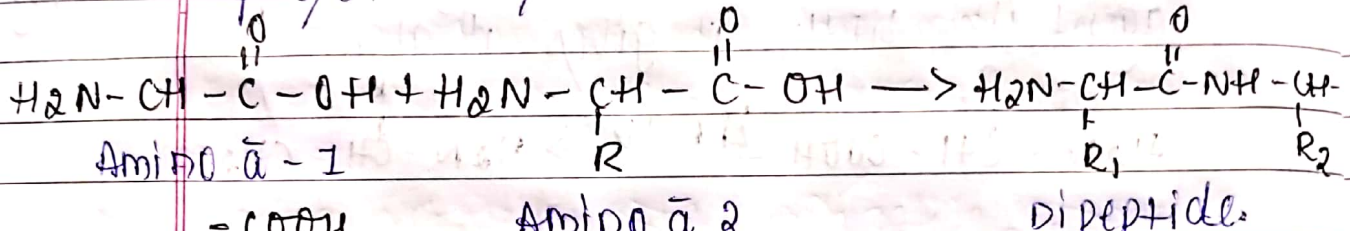
b) with ninhydrin: The reduced ninhydrin then reacts with ammonia liberated forming a blue (or) purple colour.



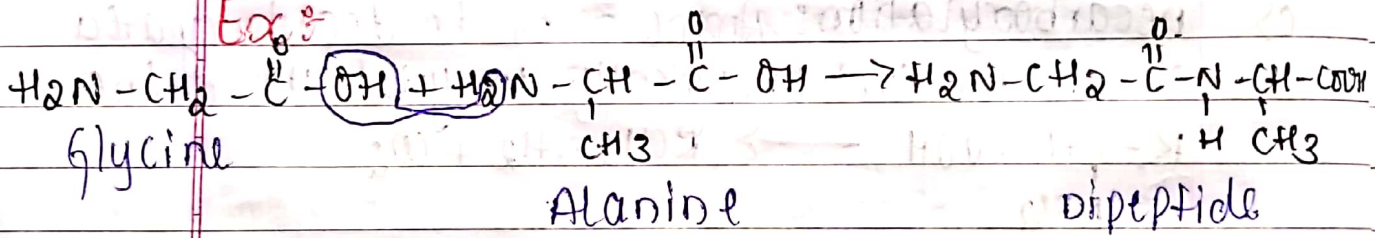
peptide bond:- Two (or) more amino ā condense to form products called peptides.

The bond formed by condensation of amino group of one amino ā with carboxyl group of another amino ā with elimination of a molecule of water is called peptide bond.

The formation of a peptide bond is represented as shown below.



Ex:-



characters of peptide bond.

* The peptide bond is formed blw the carboxyl group of one amino ā & amino group of another amino ā molecule.
* It is back bone of polypeptide & protein molecules.
* It is an amide linkage blw 2 amino ā residues.

class^{n} of proteins based on composition.

1. Simple protein: These are proteins which on complete hydrolysis yeild only α-amino ā.
   Ex: Albumins, globulins, histones etc,

2. Conjugate proteins: proteins which on hydrolysis yeild α-amino ā & an organic (or) inorganic group called prosthetic group.
   Ex: viruses, ribosomes, cytochromes etc,

class^{n} of proteins based on shape.

1. fibrous protein: These proteins have an elongated shape like of a thread. they are insoluble in water.
   Ex: α-keratin of hairs, nails, feathers

2. Globular protein: These are protein have globular shape they consists of polypeptide chains having complex structure. they are soluble in water.
   Ex: Most enzymes & hormones belong to this class.

→ st^{n} of proteins.
1^{0} st^{n}
2^{0} st^{n} - α-helix & β-pleated sheet
3^{0} st^{n}
quatenary st^{n} of proteins

Not available in this notes.

Biological imp of proteins:

* Enzymes are proteins & are responsible for catalysing & regulating biological rxn.
  Ex: Amylase, pepsin.

* Hormones regulate & co-ordinate physiological function.
  Ex: Insulin, Glucagon.

* Some protein perform transport fun
  Ex: Haemoglobin transports oxygen from lungs to tissue

* Some proteins are contractile & are responsible for muscle contraction.
  Ex: Actin & myosin.

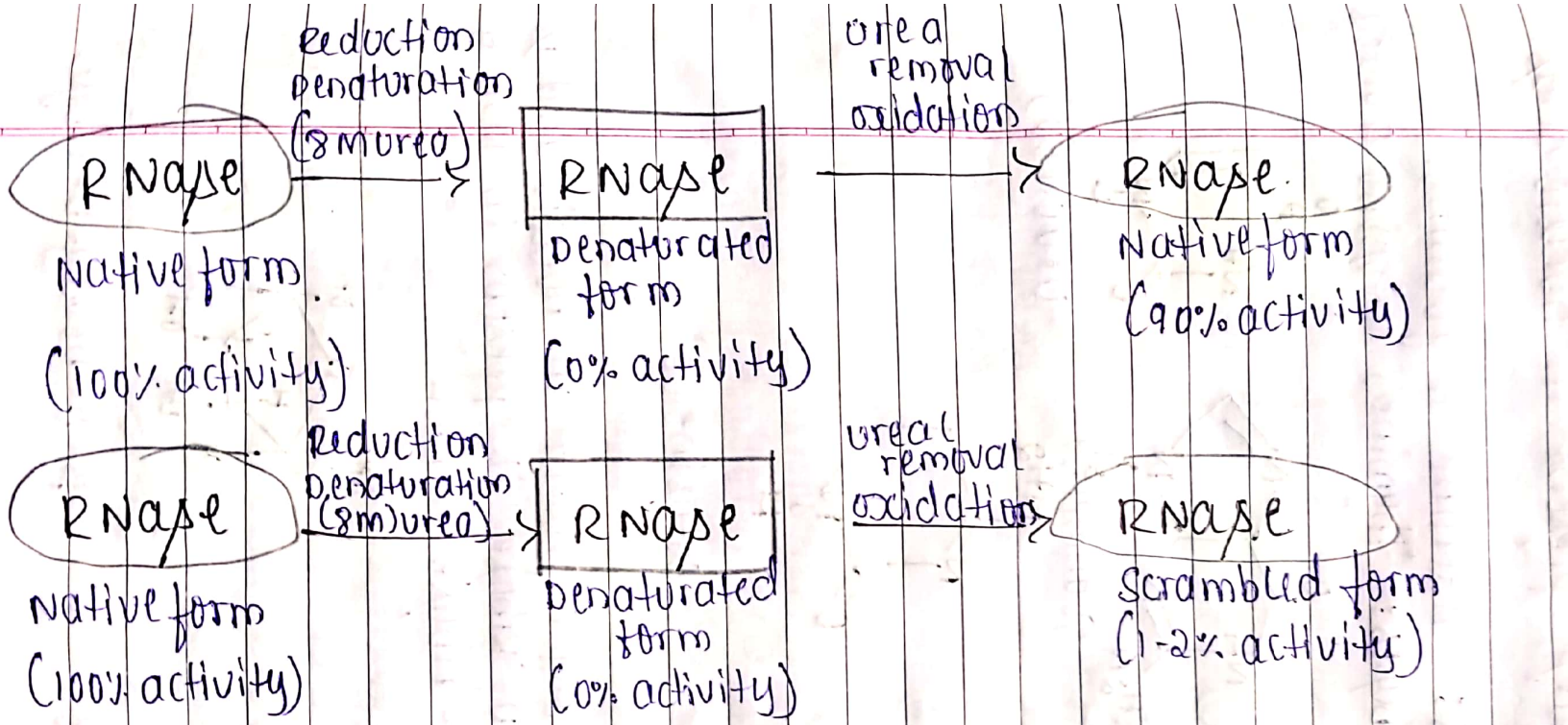
* They also function as nutrients (or) storage proteins
  Ex:- Egg white & Seed protein.

* They also requires for blood clotting process.
  Ex:- Thrombin, fibrinogen etc,

Denaturation of proteins: Destruction of dimension str & shape of protein & loss of biological activity is called denaturation.
Ex: Naturation of protein is the coagulation of egg albumin on bone.

* It also due to exposure to u-v radition & x-rays.

Renaturation of proteins: original str. of a protein is 3-D str. the process of returning a denaturated protein str. to its original 3D with its normal level of biological activity.



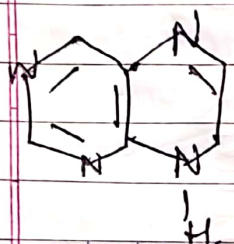
Schematic representation of Anfinsen's Ribonuclease Experiment

Nucleic acids.

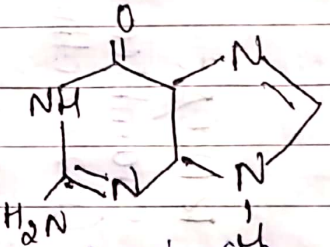
Nucleic acids are viral components of living system responsible for the storage & transmission of genetic information. these are present in the nucleus of cells & cytoplasm.

Base & Sugars present in nucleic acids.

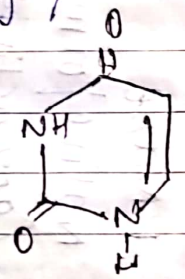
1. purine bases: Adenine & guanine.
2. Pyriamidine bases: Thymine, cytosine & uracil



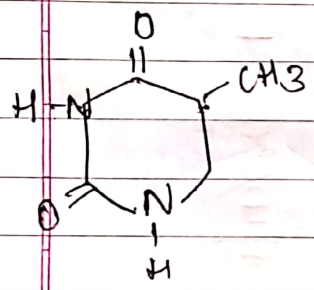
Adenine (A)



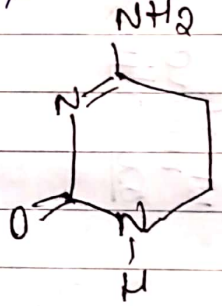
Guanine (G)



Uracil (U)

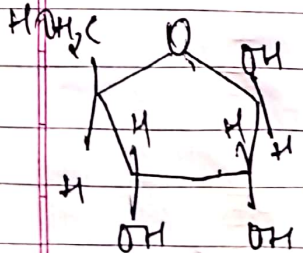


Thymine (T)

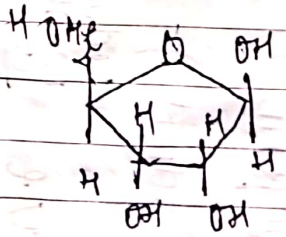


cytosine (C).

Sugars: The sugar present in nucleic acid is a pentose. D-Ribose is present in RNA & 2-deoxy-D-ribose in DNA.



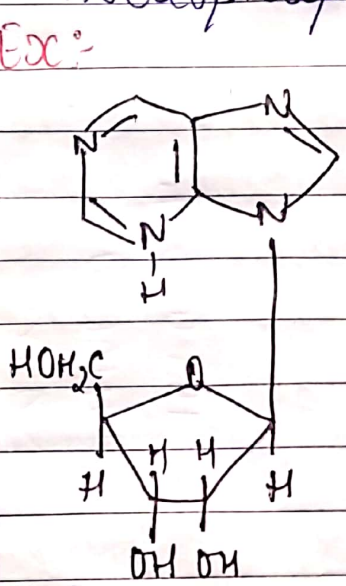
β-D-ribose



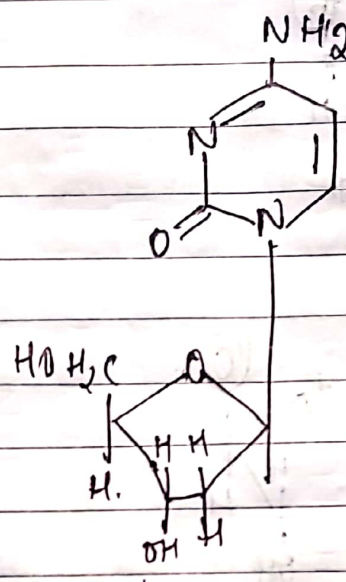
β-2'-deoxy-D-ribose

Nucleoside These are the compounds which ribose is linked to a purine (or) pyrimidine molecule in a N-β-glycosidic linkage. In a nucleoside C-1' of a pentose sugar is linked to the N9 of the purine (or) N1 of the pyrimidine base. These 2 series of nucleosides.

Ex:-

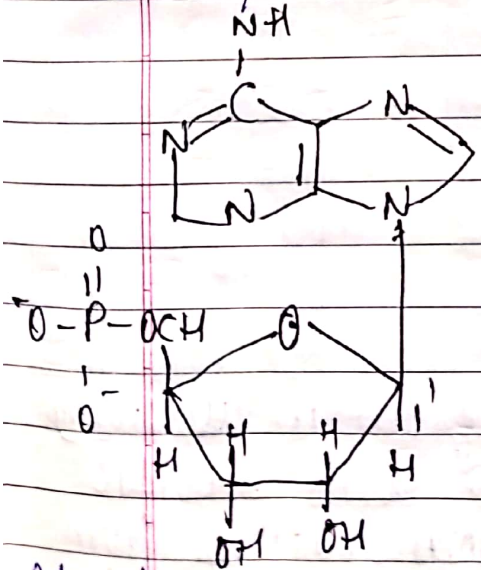


Adenosine

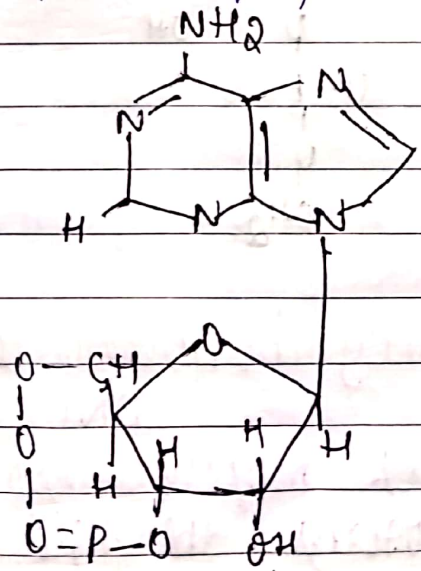


2' Deoxycytidine.

Nucleotides: These are the phosphoric acid esters of nucleosides, generally 5'-OH group of ribose (or) deoxyribose are phosphorylated.

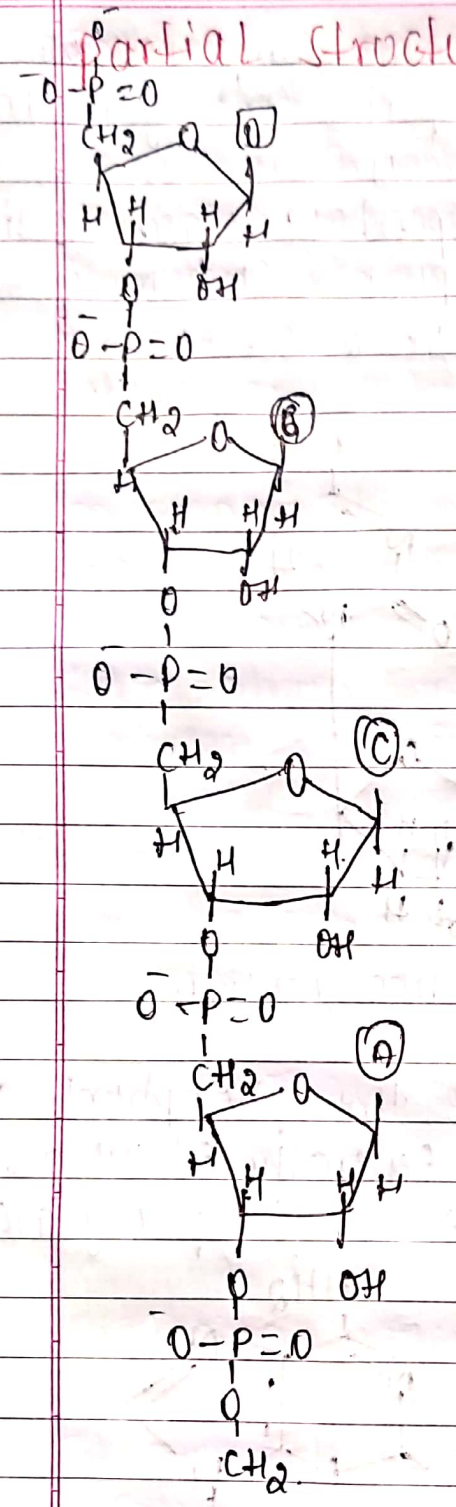


Adenosine-5'-monophosphate (AMP)



3',5'-cyclic (AMP) (cAMP)

Partial structure of polynucleotide.

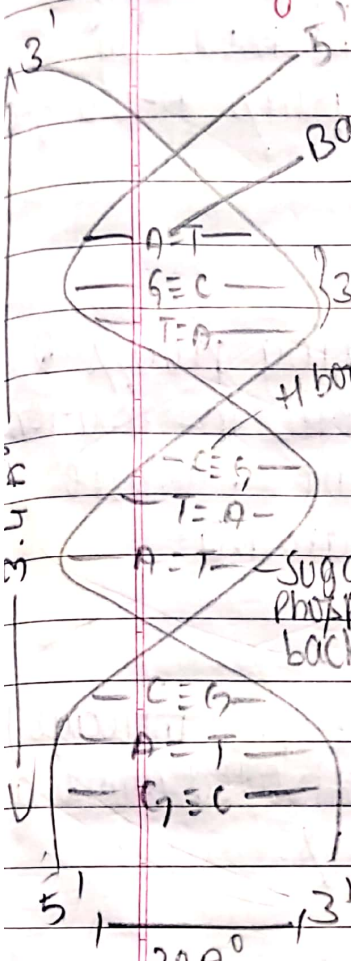


Deoxyribonucleic acid:-

DNA is present in all living cells mostly associated with specific proteins. the size of DNA various from species to species. It contains DNA exists as a double stranded molecule.

Human DNA contains 2.9×10^9 Base pairs

St^n of DNA (watson & crick model)



* DNA consist of 2 polydeoxyribo nucleotide chain coiled around a common axis to form right handed double helix.
* The 2 strands are antiparallel 5' end 3' & 3' end 5'
* The helical structure is stabilized by hydrogen bonds & hydrophobic interaction blw the bases
* The two strands are held together the base pairing occor blw A=T & C≡G
* The DNA double helix is stabilised by hydrogen bond blw specific base pairs.
* Diameter 20A°. dist blw 2 successive base pair is 3.4A°. thus each turns consists of 10 nucleotides

Biological role of DNA

* It stores & transmits the genetic information from parent to offspring
* It directs the synthesis of Ribonucleic a & proteins.
* DNA determines the capability & individuality of each organism.

RNA :- It found in all living cells. they are found in cytoplasm, rough endoplasmic reticulum & mitochondria. it is a single stranded molecule. It stabilized by Hydrogen bonds b/w base pairs A-U & G-C

There are 3 types of RNA.

i) m-RNA :- It synthesized during process of transcription. it carries genetic information from DNA to the ribosomes. where information converted into amino sequence of proteins

ii) t-RNA :- It serves as an adopter molecule by transforming specific activated amino a to site of protein synthesis.

iii) r-RNA :- These are nuclear protein particles in ribosomes which acts as machinery for synthesis of proteins

Biological roles of RNA.

- It assemble proteins & modify other RNAs
- RNA molecules regulate gene expression.
- It serves temporary copies of information found in DNA.
- It acts as messenger b/w DNA & ribosomes.

protein - nucleic ā interaction

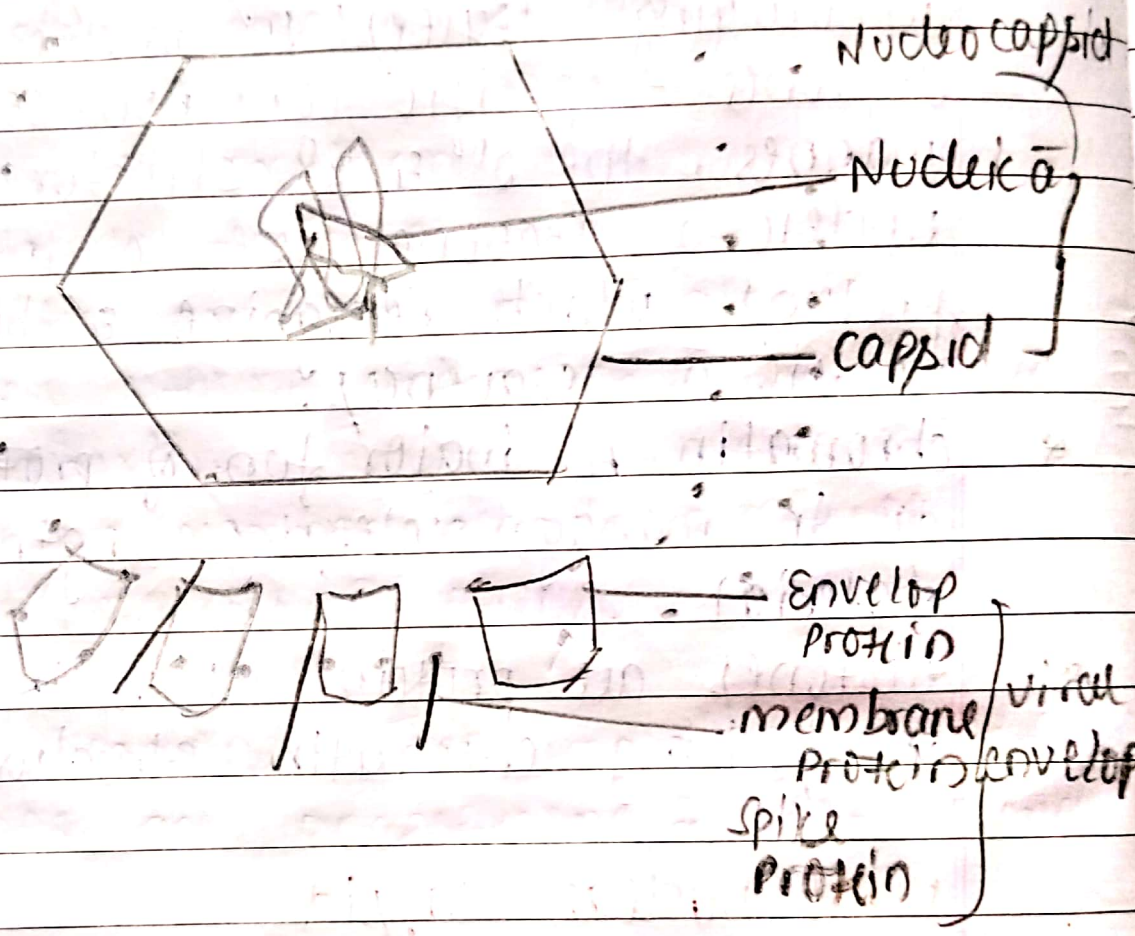
protein interact with DNA & RNA through physical forces which include electrostatic interaction, dipolar interaction, entropic effect & dispersion forces. this forces contribute in varying degrees to protein binding in a sequence - specific (or) non-sequence specific manner. the 2^0 & 3^0 structure formed by nucleic ā sequence due to interaction of proteins which recognize & bind particular nucleic ā sequences.

* chromatin - A major fun of protein - DNA interaction is to manage extensive length of genetic material.
* Histones are proteins which interact with DNA in forming chromatin structure.

viral nuclear capsid.

viruses are obligate cellular parasites with very simple organization. A complete virus particle is called viron. the viral genome, often with associated basic proteins is packaged inside a Symmetric protein capsid.

A capsid is almost always made up of repeating structural subunits that are arranged in one of 2 symmetrical st[illegible], a helix or an icosahedron. in the simplest case the subunits consist of a single polypeptide. In many cases however, these st[illegible]al subunits are made up of several polypeptides.



General str. of virus showing nucleas capsid.

Hormones.

It is a chemical that acts as a messenger transmitting a signal from one cell to another.

classification.

i) Amino ā derivatives :- It made by chemical modification of amino acids mainly tyrosine.

a) Thyroxine: * It is a hormone which thyroid gland secrets into the blood stream.
* Thyroxine plays a cruical role in heart & digestive system.
* And also metabolism, Brain development, bone health & muscle control.
* It affects almost of all the body's system.

b) Epinephrine [adrenaline]
* It is involved in flight response in humans.
* It is responsible for breakdown of glycogen in liver cells.
* It causes smooth muscles of lungs to relax.
* It causes the contraction rate of the heart to increase.

ii) peptide & polypeptide hormones: It acts on their target cells by binding to receptors located on the cell surface.
vasopressin & oxytocin are 2 imp peptide produced in the hypothalamus of brain.

a) function of vasopressin
* It tends to increase B.P.
* It helps in con of urine & retention of H_2O.
* It secretion is stimulated by reduced quantity of body fluid.

Target cells: cells of kidney.

b) function of oxytocin
* It tends to decrease B.P.
* It mainly produced in females.
* It causes uterine contractions helping in child birth.

Target cells: mammary glands & Smooth muscles of uterus.

iii) steroid hormones: Two important steriod hormones are progesterone & Teptosterone.

a) progesterone: female sex organ.
* ovaries produces majority of progesterone.
* fun :- Improving sleep, Balancing bodyfluid Improving fat metabolism.
* It helps in promoting bone form & maintaining pregnancy in females.
* progesterone prepares the lining of uterus for implantation of a futilized egg.

b) Teptosterone: male sex organ
* It is responsible for 2^0 male sex character.
* It plays a key role in development of male rep^{ve} tissue such as teptis & prostate.
* It helps in sperm maturation, increased

muscle & bone mass as well the growth of Body hair.

Role of Insulin & Glucagon in glucose Homeostasis.

Insulin: when blood Glucose level rise, Insulin secreted by B-cells of the pancreas, lowering Blood glucose by increasing its uptake in cells & liver to convert glucose to glycogen.

- Insulin impaired mean increased urine output & dehydeation.

Glucagon: when blood glucose levels fails, Glucagon is secreted by cells of pancreas which increase blood glucose levels by Simulting the breakdown of glycogen to Glucose

- The effect of Glucagon is make to liver release the glucose.

cyclic AMP (cAMP)

* Binding of the hormones to its receptor activates a G protein which in turns activates adenylyl cyclase.
* The resulting rise in cAMP turns on response in the cell by changing molecular activites in cytoplasm.

Calcium ions (Ca^{2+})

* Secretion of hormones like Insulin
* Activation of T & B cells

- Adhension of cells to extracellular matrix (ECM) & cell death
- A variety of biochemical changes mediated by protein kinase C (PKC)

Enzymes

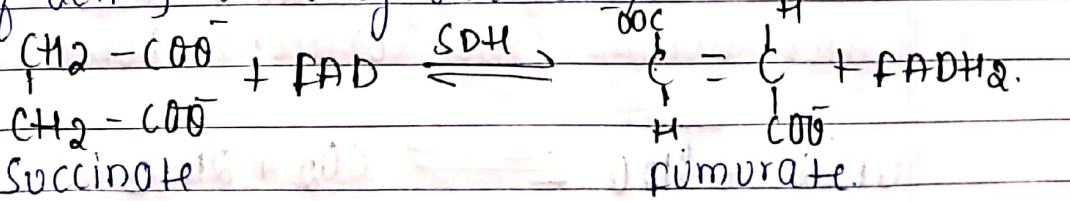
Enzymes are soluble, colloidal proteins & behave as biochemical catalyst in many biological reactions

Non protein component may be either a covalent molecule generally refued to as cofactor co-factor called as coenzyme If it is a covalent molecule & an activator if it is a metal ion. the protein part of the enzyme is. Apoenzyme.

Active site :- Generally enzymes are large molecules compare to the molecule whose reaction they catalyze. A small portion (or) region of the enzyme. the surface which interact with substrate is called Active site.

Enzyme specificity: The enzymes are very specific in their action in Biochemical reaction
There are dif types of specificity.

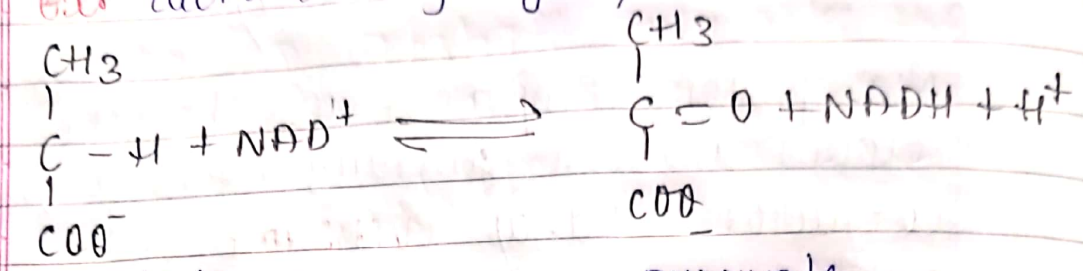
i) Absolute specificity : Some enzymes are capable of acting on only one substrate.



ii) Group specificity: A few enzymes catalyze the reaction of a structurally related group of compounds

D-Glucose + ATP $\xrightarrow{\text{Hexokinase}}$ D-Glucose-6-phosphate + ADP.

iii) Stereochemical specificity: An enzyme is active for only one isomer.
Ex: lactate dehydrogenase



→ Classification of enzymes.

1) oxidoreductases: These enzymes oxidases or reduca substrates by transfis of hydrogen (or) electron.

Alcohol + NAD^+ ⇌ Aldehyde + $NAD^+ + H^+$

2) Transfuase: These remove geoups from the substrate & transfis then to acceptors.

D-Glucose + ATP ⇌ Glucose-6-phosphate

3) Hydrolases: These catalyse the hydeolysis of their substrates by adding constituents of water acroas the covalent bond they split.

urea + H_2O ⇌ $CO_2 + 2NH_3$

4) Lyases: These are enzymes which remove groups from their substrate to leave double bond.

L-malate ⇌ fumarate + H_2O

Isomerases: The enzymes bring about isomerisation i.e structural rearrangement with in a molecule

D-glyceraldehyde-3-phosphate ⇌ Dihydroxyacetone phosphate

Ligases: They catalyse linking together of two molecules utilizing the energy made available by simultaneous breakdown of ATP

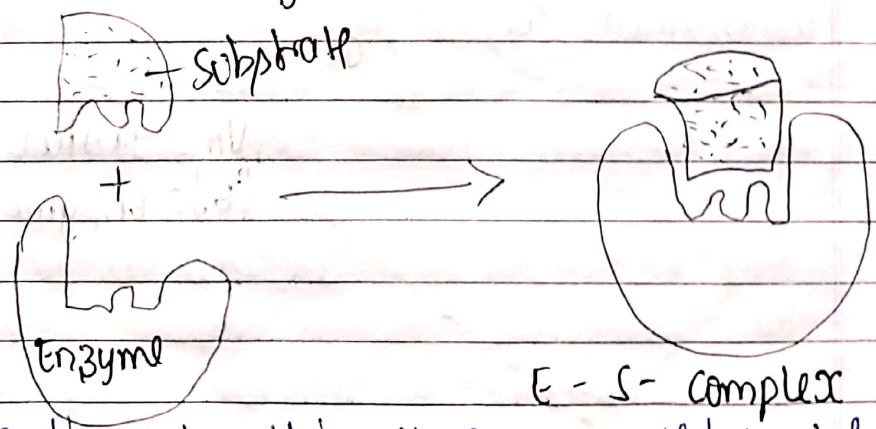
L-Aspartate + NH_3 + ATP ⇌ L-Asparagine + AMP + PPi

Fischer & Koshland methods

Two theories have been proposed to explain the interaction of substrate & enzyme one is Lock & key model & Induced fit theory

Lock-key model

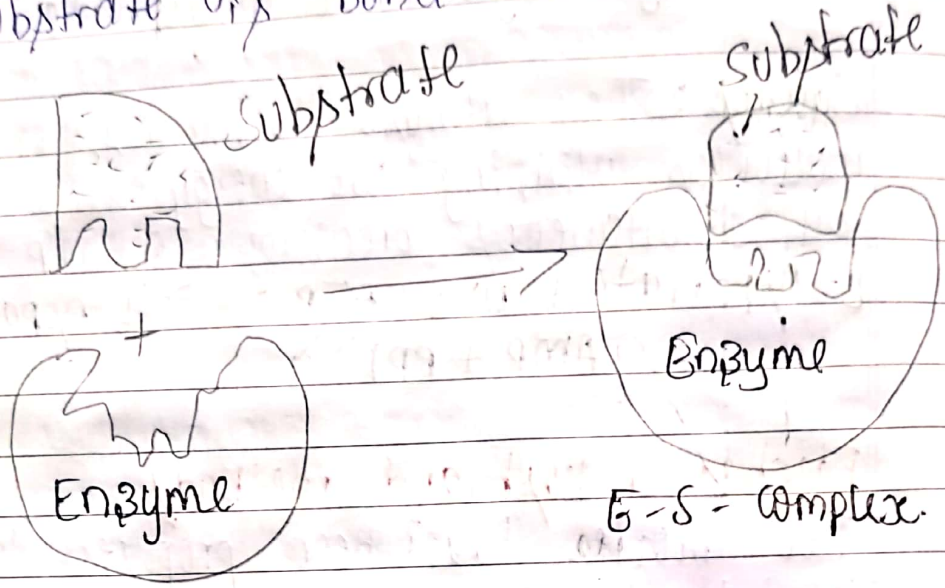
According to this model the substrate & enzyme have structural complementary & fit together in the active site is a rigid template.



E-S-complex

According to this theory proved to be essentially correct in case of enzymes known as exhibit absolute specificity.

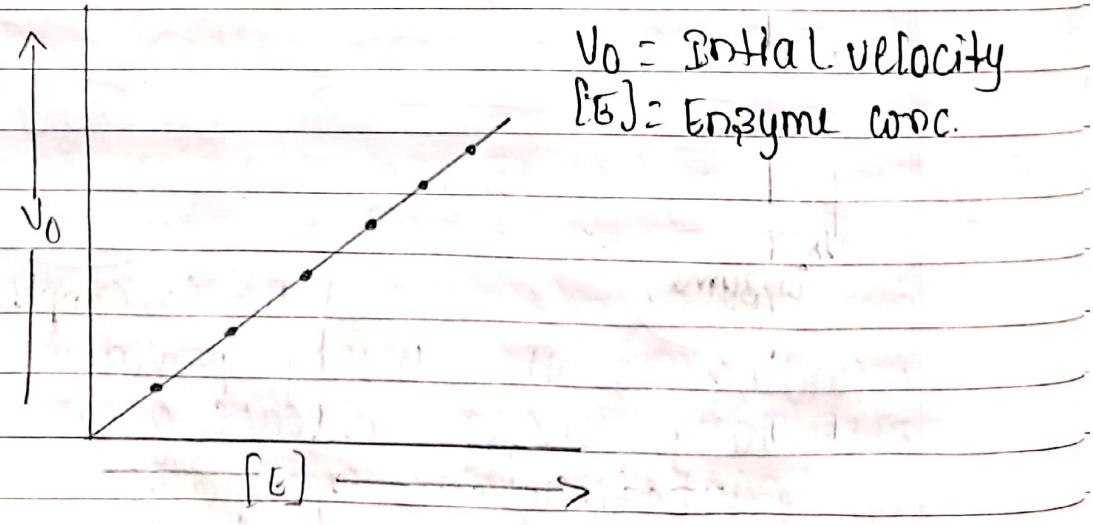
Induced fit theory: The shape of active site is modified by bringing of substrate. The active site has a shape complementary to that of substrate only after the substrate is bond



Enzyme kinetics. factor affecting.

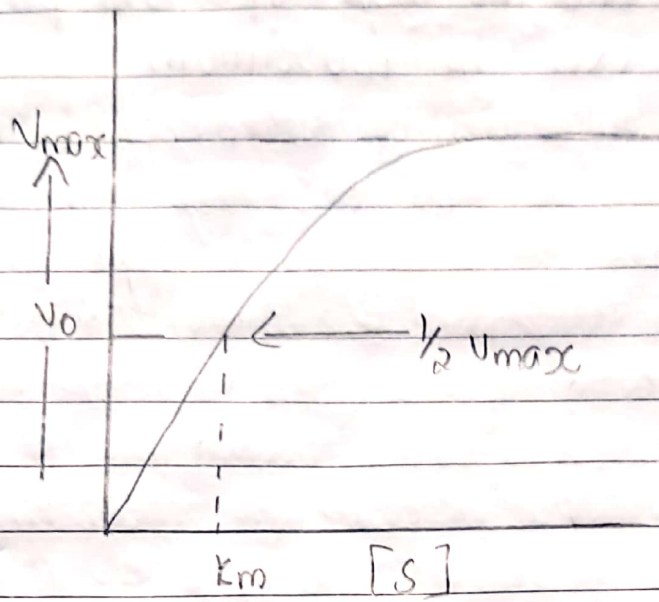
i) Enzyme concentration

The effect of varying the conc of the enzyme on the rate of enzyme catalysed rxn can be represented as given below. during the rxn, the conc of substrate, temp & pH are maintained constantly.



ii) Substrate concentration.

When the conc of the substrate alone is varied keeping the conc of enzyme const the rate of rxn varies as shown below

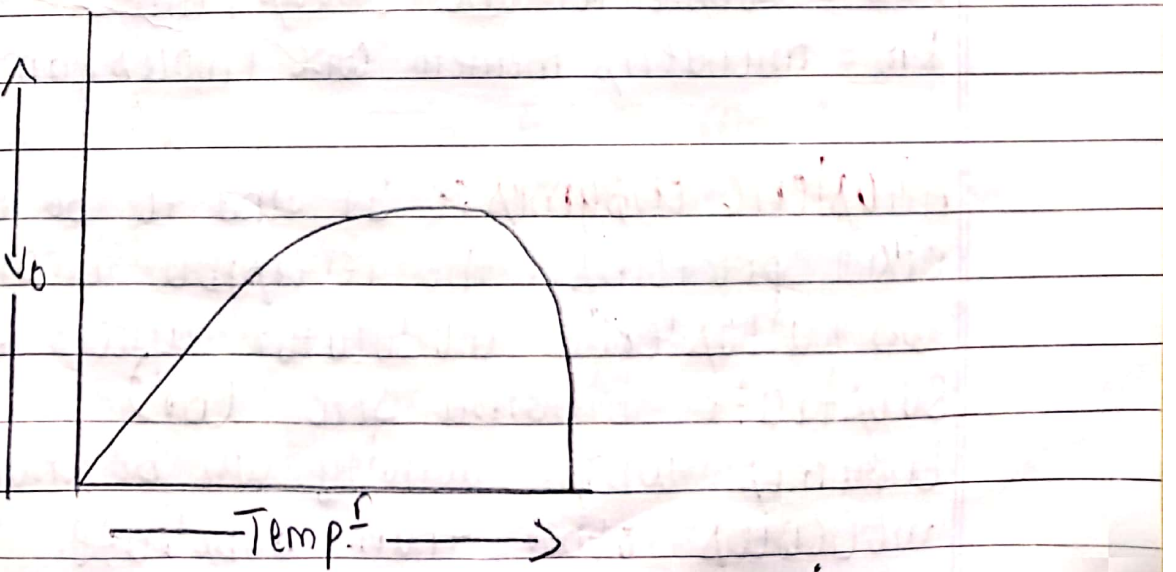


V_0 - initial velocity
[S] - Substrate conc
V_{max} - max. velocity
K_m - michaelis menten const

iii) Temperature.

The rate of an enzyme catalysed rxn increase with temp$^{\underline{r}}$. the effect of temp$^{\underline{r}}$ on the rate of the enzyme catalysed rxn in the result of 2 process

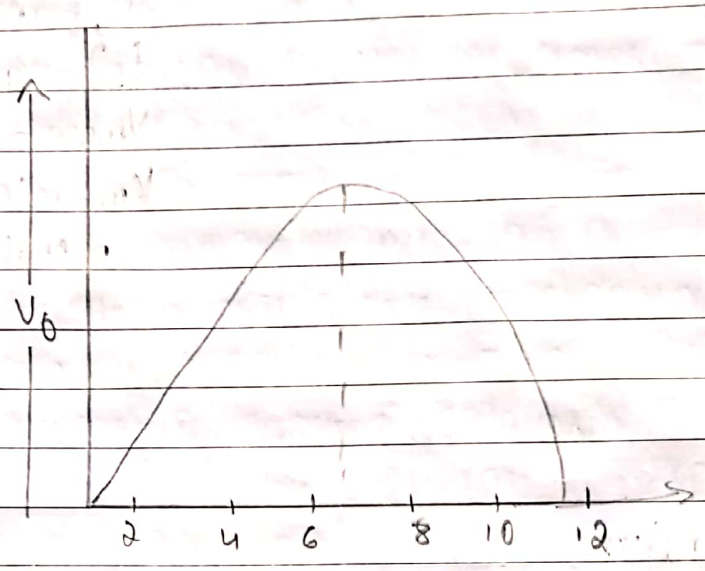
1) Increase in reaction rate with temp$^{\underline{r}}$
2) Increase in the rate of thermal rxn of the enzyme in critical temp$^{\underline{r}}$



iv) pH.

When the velocity of an enzyme reaction is plotted against pH, a bell shaped curve is obtained.

Each enzyme has optimum pH at which time rate of rxn is maximum



Michaelis - menten Equation.

$$V_0 = \frac{V_{max} \cdot [S]}{K_m + [S]}$$

V_0 = Initial velocity
V_{max} = max. velocity
$[S]$ = substrate conc (moles / dm^3)
K_m = michaelis mentem conc (moles / dm^3)

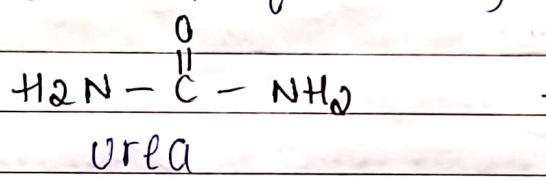
Allosteric enzymes:- It tend to be multi-sub unit proteins. the reversible binding of an allosteric modulator affects the substrate binding site (or)
Enzymes whose activity can be changed by molecules other than substrate.
↳ [Effector molecule]

Ex:- Glycogen, phosphorylase, apparate Glucamine etc.

Enzyme Inhibitons: A number of compounds can combine with certain enzymes thereby blocking the catalysis. such compounds called Inhibitors. this phenomenon called Enzyme Inhibitons.

i) **Competitive inhibition:** In this type & inhibitor closely resembles the substrate in str., hence it competes the substrate binding to active site.

Thiourea is the competitive inhibitor in the hydrolysis of urea by urease.

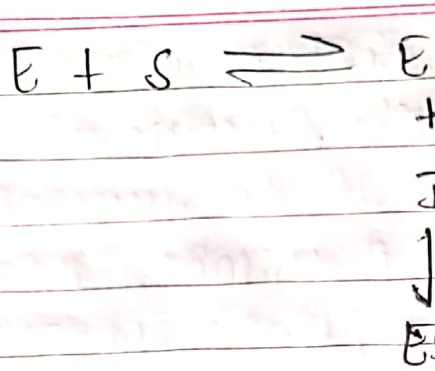


urea Thiourea.

ii) **Non-competitive inhibition:** The inhibitor has no resemblence to substrate & they do not exhibit mutual competition for binding enzyme molecule. Bcoz the substrate & inhibitor bind diffuent sites on enzyme molecule. ∴ possibility of form. of ES, EI & ESI.

$$E + S + I \rightleftharpoons ESI \text{ complex}$$

iii) **uncompetative inhibiton:** this is 3rd class of reversible inhibition not very common, in this case inhibitor does not bind with enzyme but only binds with E-S complex.



Uncompetative inhibitor decreases both Km & Vmax values of the enzymes.

Importance of Enzyme Inhibition studies:

- It helps in regulatory mechanism of metabolism
- It provide valuble information on mechanism & pathway of enzyme catalysis.

Biological oxidation.

Bioenergetics It is the qualitative study of the energy transformation that occur in the living cell (or) whole organisms.

Energy transformation.

Stage I :- Photosynthesis.
Green plants absorb solar energy & convert it into organic food by a process called photosynthesis.
Solar energy is captured by photosynthetic cells in green plants & it transformed into chemical energy plant utilizes to synthesis nutrients like carbohydrates, lipids & protein from CO_2 & H_2O.

Stage II :- Respiration.
Animals & other heterotrophs depends for food directly / indirectly on plants. Animals use these nutrients molecules & oxidise them during respiration to synthesize chemical energy.

Stage III :- Utilization of Energy.
The chemical energy is utilized by the cells for various cellular activites & the energy returned to the sorroundings in a less useful from largely as heat.

Excergonic rxn :- If ΔG for a given rxn is -ve the rxn can occur spontaneously with loss of free energy. Such energy yeilding rxn is called excergonic (energyout) rxn.

Endergonic rxn :- ΔG is +ve, the reaction is non spontaneous & this requires input of energy. if the rxn is occur such an energy requiring reaction is known as endergonic (energy-in) rxn

→ Relationship blw ΔG & K_{eq}

In the reaction

$$A + B \rightleftharpoons C + D.$$

The free energy change, ΔG of this reaction is given by

$$\Delta G = \Delta G^0 + RT \ln \frac{[C][D]}{[A][B]}$$

ΔG^0 = std free energy change.
R = Gas const
T = absolute temp.
[A][B][C][D] = molar conc of substance.

At equilibrium the ratio $\frac{[C][D]}{[A][B]}$ is

$\Delta G^0 = 0$ substituting

$$0 = \Delta G^0 + RT \ln K_{eq}$$

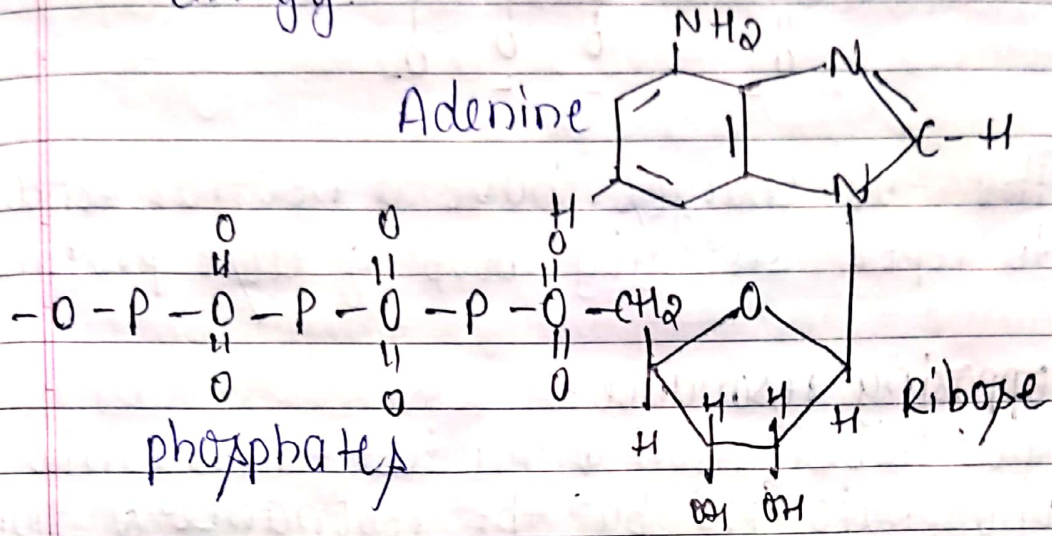
$$\Delta G^0 = RT \ln K_{eq}$$

$$\boxed{\Delta G^0 = -2.303 RT \log_{10} K_{eq}}$$

→ High energy compounds :- These are called energy rich compounds
Exc 1, 3 diphosphoglycerate.
Acetylcoenzyme
creatine phosphate.

→ Adenosine triphosphate (ATP)

ATP is the principal substance used for the exchange of intercellular energy. therefore it is reffred as universal currency of free energy.



Adenosine Triphosphate (ATP).

It composed of adenine, pentose sugar - ribose & 3 phosphate groups

Significance of ATP.

* ATP is a universal constituents of living cells & plays a important role in biological exchanges of energy.

$$ATP + H_2O \longrightarrow ADP + Pi$$

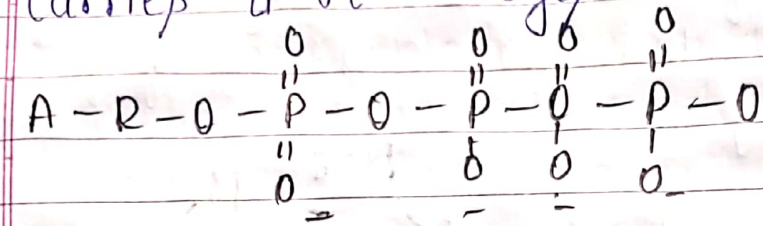
* Sometime ATP can also hydrolyse to produce Amp & PPi

$$ATP + H_2O \longrightarrow AMP + PPi$$

* The free energy liberated in hydrolysis of ATP used to power endergonic reaction.

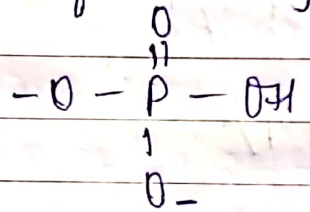
→ factor contribution to energy rich nature of ATP.

i) Electrostatic repulsion:
At pH 7.0 the triphosphate unit of ATP carries 4-ve charges.



The -ve charges have a neutral tendency to repel strongly bcoz of close proximity.

ii) opposing resonance
The stabilization of product - inorganic phosphate (P_i) by the resonance of dianionic spcs also favour hydrolysis of ATP.



iii) Solvation effects- when ions are solvated, they are electrically sheilded from each other. the decrease in repulsion blw phosphate groups help in carrying out hydrolysis.

Energy coupling

The principle of bioenergetics explain law of thermodynamics unfavorable cond^n can be forward direction by coupling it to highly exergonic rxn through a common intermediate this concept is known as Energy coupling.

The concep conversion of glucose to glucose-6-phosphate.

step i: Utilization of Glucose
Glucose + Pi ⟶ Glucose-6-phosphate + H_2O
$\Delta G^0 = 13.8$ KJ/mol

step ii: Hydrolysis of ATP
ATP + H_2O ⟶ ADP + Pi
$\Delta G^0 = -30.5$ KJ/mol.

step iii: According two rxn:
ATP + Glucose ⟶ ADP + Glucose-6-phosphate
$\Delta G^0 = +13.8 + (-30.5$ KJ/mol)
$= -16.7$ KJ/mol

The overall rxn is exergonic
In this coupled rxn the energy stored bonds of ATP is used the synthesis of Glucose-6-phosphate.

Mitochondrial electrotransport chain.

During the flow of electron from the metabolite to molecular oxygen, utilisable energy becomes available & it is coupled at contain specific stages to the phosphorylation of ADP to synthesis ATP.
Synthesis of ATP consequent to transport of $\bar{e}$ from metabolites to oxygen is known as oxidative phosphorylation.
mitochondria are the site of oxidation phosphorylation in eukaryotes.
"The reduced coenzymes NADH, $FADH_2$ in turn donate a pair of $\bar{e}$ to a specialized set of

electron carrier, collectively called electron transport chain.
The inner mitochondrial membrane can be carefully disrupted into 4 enzyme complex designated I-IV. Each complex is capable of e^- transport through a portion of the chain

Calculation of energy yeild - reduction of Aldehyde by NADH.

Consider the rxn in which acetaldehyde id reduced by the biological electron carrier NADH:

$$\text{Acetaldehyde} + NADH + H^+ \longrightarrow \text{Ethanol} + NAD^+$$

The relevant half rxn & their E_0 values are,

$$CH_3CHO + 2H^+ + 2e \longrightarrow CH_3CH_2OH \quad E_0 = -0.197V$$

$$NAD^+ + 2H^+ + 2e \longrightarrow NADH + H^+ \quad E_0 = -0.320V.$$

for overall rxn, $\Delta E_0 = -0.197V - (0.320V)$

$= 0.123V$, & n is 2.

$\therefore \Delta G^0 = -n F E_0' \longrightarrow -2(96.5 KJ/mol)(0.123V)$

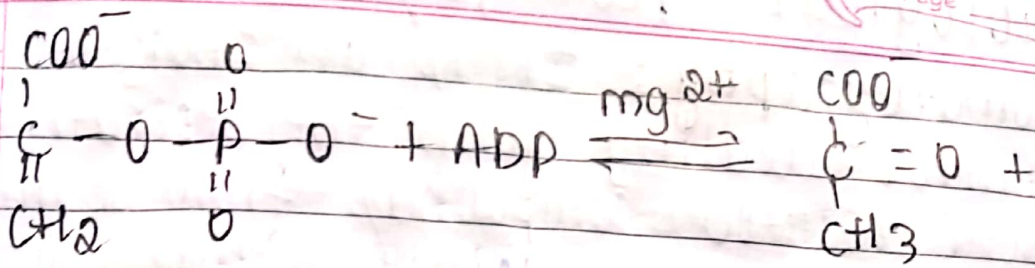
$= -23.7 KJ/mol$

This is the free energy change for oxd^n - red^n rxn when NAD^+ & NADH are all present at 1m conc.

Substrate level phosphorylation

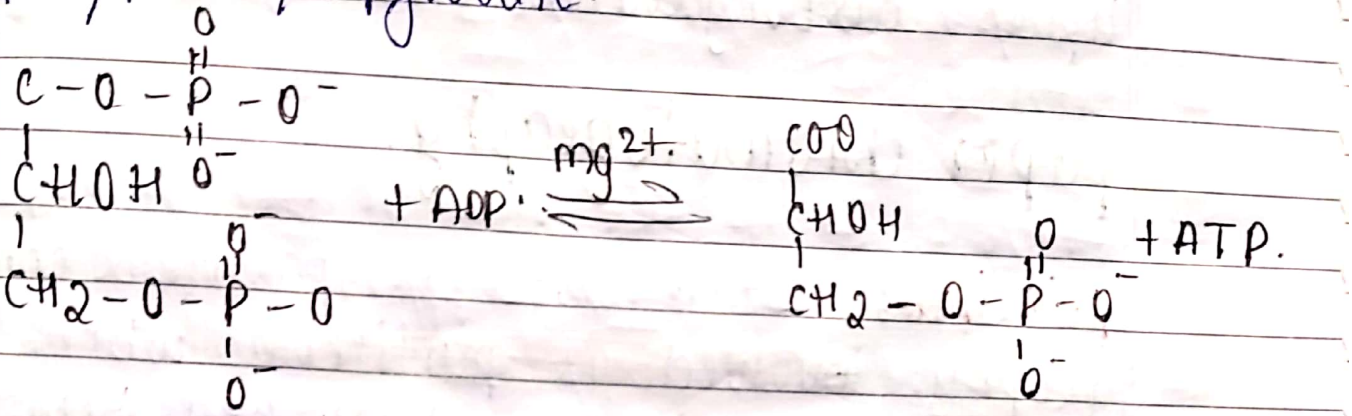
A high energy metabonic intermediate donates the free energy necessary for during the synthesis of ATP by phosphorylation of ADP. this process is called substrate level phosphorylation.

Step 1:



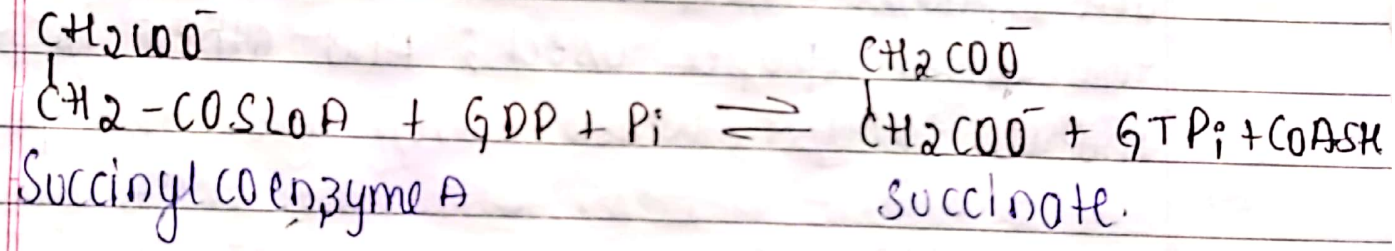
phosphoenol pyruvate — pyruvate

Step 2:



1, 3 - Diphosphoglycerate — 3-phosphoglycerate

Step 3:



Succinyl coenzyme A — Succinate.

Biological Techniques.

chromatogeaphy: It is an analytical technique dealing with the seperation of closely related compounds from a mixture These include proteins, peptides, amino a, lipids, casbohydsates, vitamins & drugs.

paper chromatogeaphy.

principle: It involved is partition chromatography ~~involved is partition~~ where in the substances dee disturbed blw liquid phases
one phase is the H_2O. which held pores of the filter paper used; And other is the mobile phase which moves over the paper

Applications:

* Seperation of a mixture having polar & non-polar compounds
* seperation of amino acids, sugars
* Detemination of hormones, drugs etc,
* used for evaluation of inorganic Compounds.
* used to detemine organic compounds in wine.

TLC (Thin Layer chromatogeaphy)

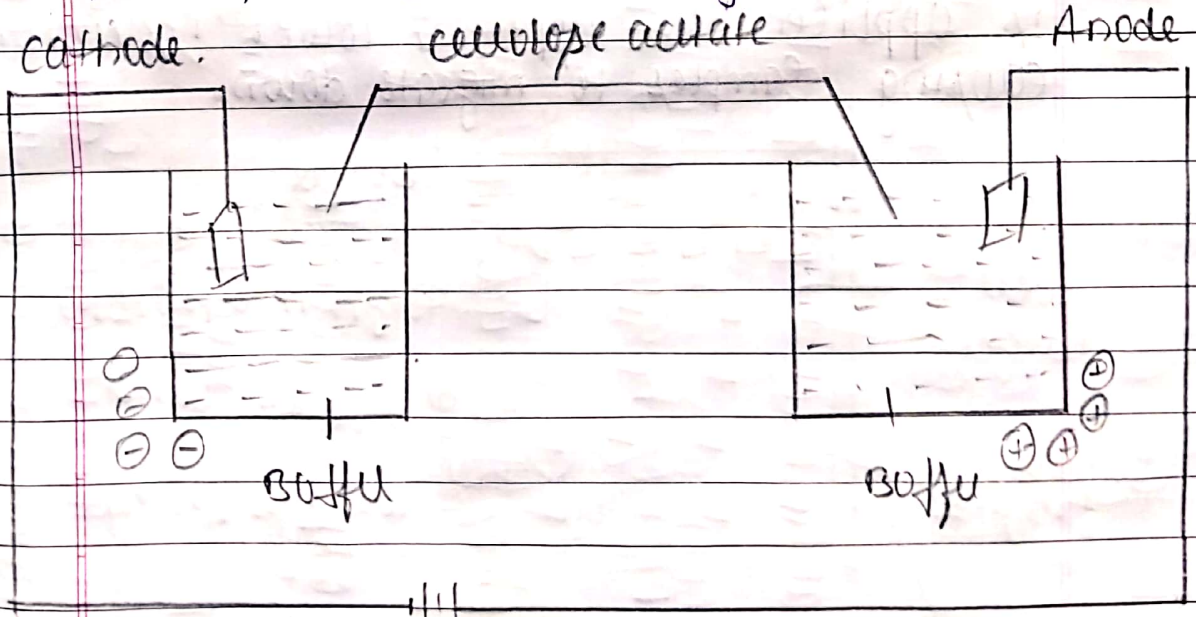
It works on diffuent compounds will have dif solubities & adsorption to the 2 phases blw which they are to be partitioned.
TLC is a solid-liquid technique in which the 2 phases are solid & a liquid.

Applications:

* To check the purity of given samples.
* Identify the compounds like proteins, amines & more.
* To purity samples.
* To keep a check on peeformance of other seperation process.

Cellulose Acetate Electrophoresis

* CA is an acetate salt of cellulose produced by treating cotton with acetic a using H_2SO_4 as catalyst.
* migration takes place on buffer film on the surface of cellulose acetate plate.
* It contain 2-3 acetyl geoups per glucose unit & its adsorption capacity is less than that of paper.
* It gives sharper bands
* provides a good back geound.



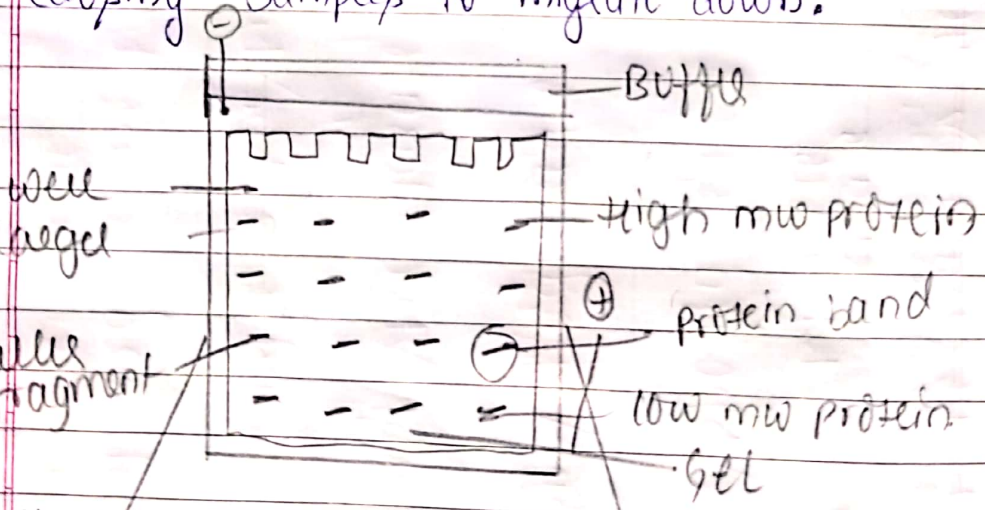
* It used in film base photogeaphy
* used as a synthesis of fibre
* mfg of cigeate filters & playing cards.

polyacrylamide Gel Electrophoresis (PAGE)

Gel Electrophoresis :- It is a method for seperation & analysis of macromolecules & their fragments, based on their size & charge.

PAGE :- It is the normal gel is replaced with PAG used as support matrise

* Gel are made by free radical-induced polymerization of acrylamide & N,N-methylenebisacylamide.
* It is most widely used technique of electrophoresis.
* A typical setup consist of gel slab sandwiched blw 2 glass plates, with the ends enclosed in upper & lower reservior of buffer
* Samples be run are loaded top of ge. in conjuction with tracking dye. electrical voltage is applied blw upper & lower resevior causing samples to migrate down.



* it is very useful in Bio & forensic chemistry
* Seperation of Biological macromolecules

Metaboilsm.

Date
Page

Catabolism: Total of all degradative rxn

Anaboilsm: Total of all synthetic rxn.

	Catabolism	Anaboilsm.
*	Degradative rxn	Synthetic rxn.
*	oxidation process	reduction process
*	oxd^{n} of carbohydeates fats & proteins	Biosynthesis of various molecule
*	Chemical enegy reduced	C.E is consumed

Carbohydrate metabolism: major fun of carbohydrates in metabolism is that they serve as fuel which is oxidised providing energy for various metabolic process.

- Glucose, Fructose & Galactose are the major fuel of the most organisms

→ Reaction of Glycosis.

Step 1: phosphorylation of glucose to glucose-6-phosphate

D-Glucose —(ATP → ADP; Hexokinase & Mg^{2+})→ D-Glucose-6-phosphate.

Step 2: Isomerisation of G-6-P to D-fructose-6-phosphate

D-G-6-P —(Glucose-P-2 isomerase)→ D-fructose-6-phosphate

Step 3: fructose-6-phosphate —(ATP → ADP; phosphofructokinase; Mg^{2+}/Ca^{2+})→ 1,6 D-fructose diphosphate.

Step 4:- D-fructose-1-6-diphosphate $\xrightarrow{\text{Aldolase}}$ D-Glyceraldehyde-3-phosphate + Dihydroxy acetone phosphate.

Step 5:- D-hydroxy acetone phosphate $\xrightarrow{\text{Triosephosphate isomerase}}$ Glyceraldehyde-3-phosphate.

Step 6:- Glyceraldehyde-3-phosphate $\xrightarrow[\text{Dihydrogenase}]{\text{Glyceraldehyde phosphate}}$ 1,3-Diphosphoglycerate.

Step 7:- 1,3-Diphosphoglycerate + ADP $\xrightarrow[\text{Kinase}]{\text{phosphoglycerate}}$ 3-phosphoglycerate.

Step 8:- 3-phosphoglycerate $\xrightarrow[\text{mutase}]{\text{phosphoglycerate}}$ 2-phosphoglycerate.

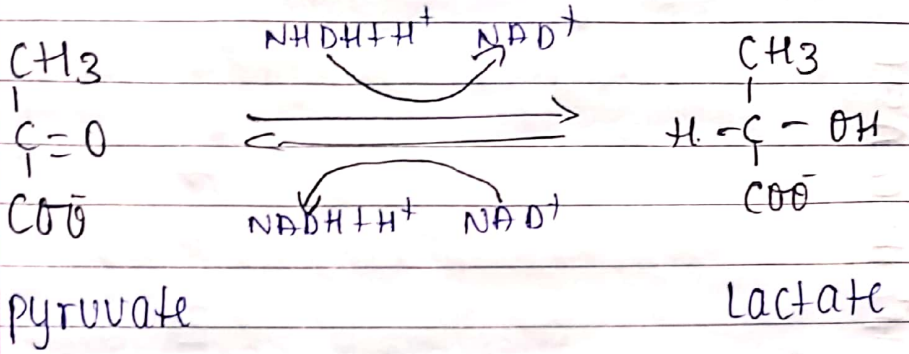
Step 9:- 2-phosphoglycerate $\xrightarrow[Mg^{2+}/Mn^{2+}]{\text{enolase}}$ phosphoenolpyruvate (PEP)

Step 10:- PEP $\xrightarrow{\text{Pyruvate Kinase}}$ pyruvate + ATP.

Note:- However the reactions step 1 & 3 one molecule of ATP is utilized for phosphorylation, hence the net yeild of ATP in anerobic glycolysis is $4-2=2$.

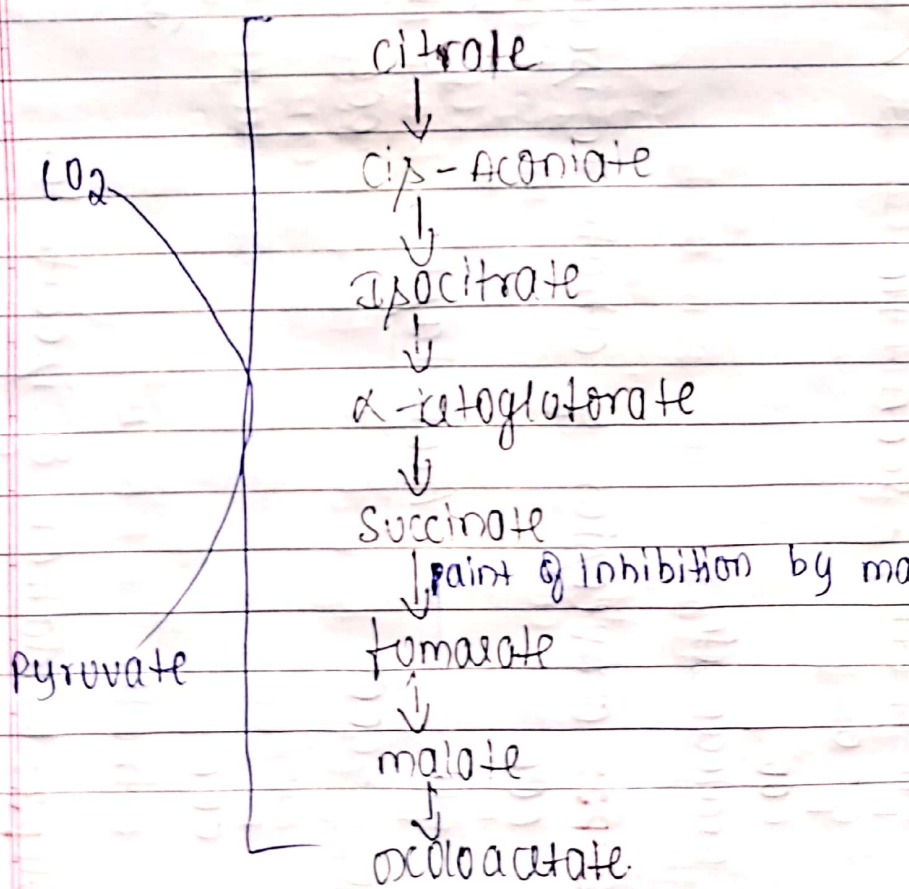
Reduction of pyruvate to Lactate.

pyruvate reduced to Lactate. the rxn catalysed by enzyme lactate dehydrogenase which uses up reduced co-enzyme NADH to pyruvate.

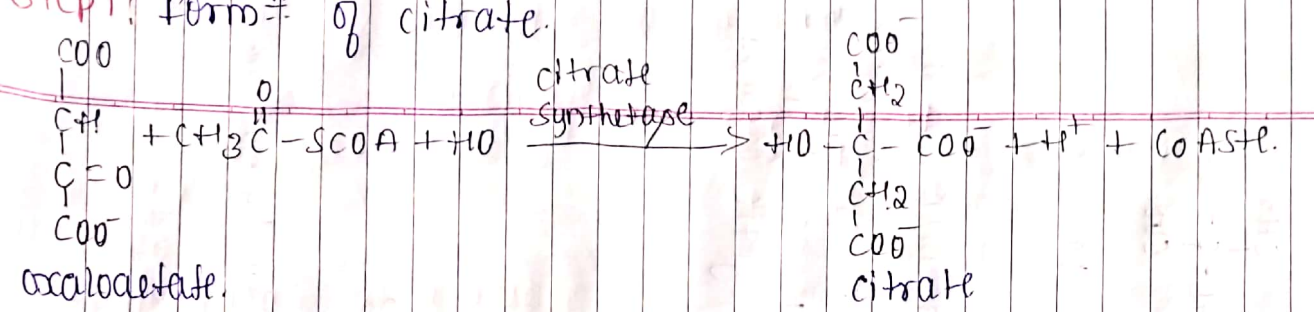


TCA (or) krebs cycle.

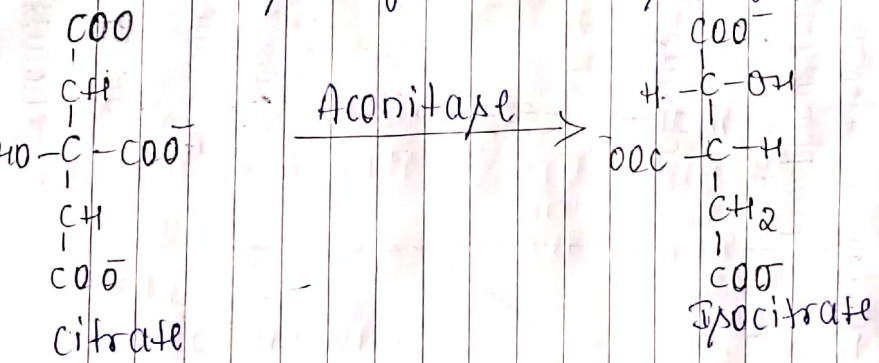
It serves in nearly all organisms as the central pathway flow of carbon among all of the classes of biomolecules & with process of oxidative phosphorylation. it occurs in the mitochondrian in eukaryotic organisms



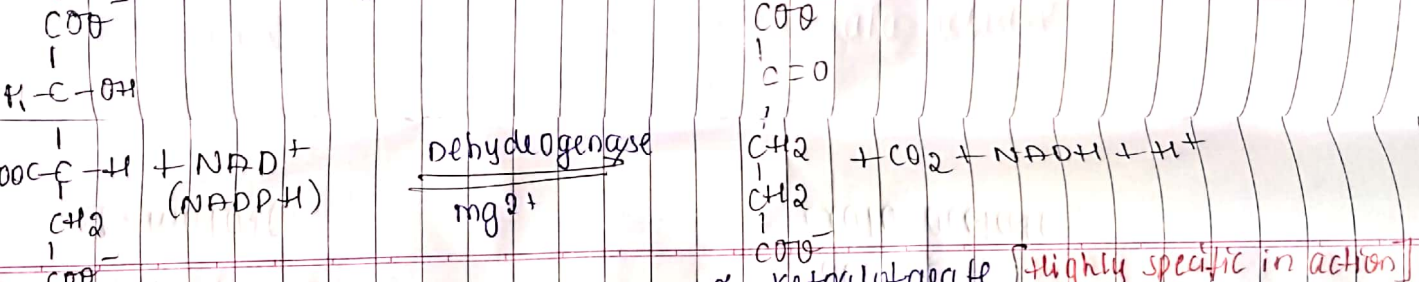
Step 1: formation of citrate.



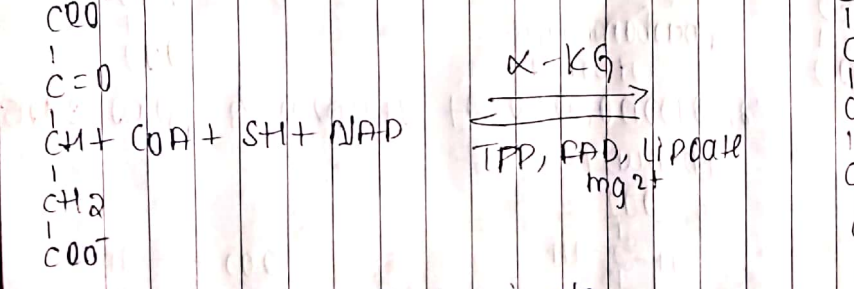
Step 2: conversion of citrate to isocitrate.



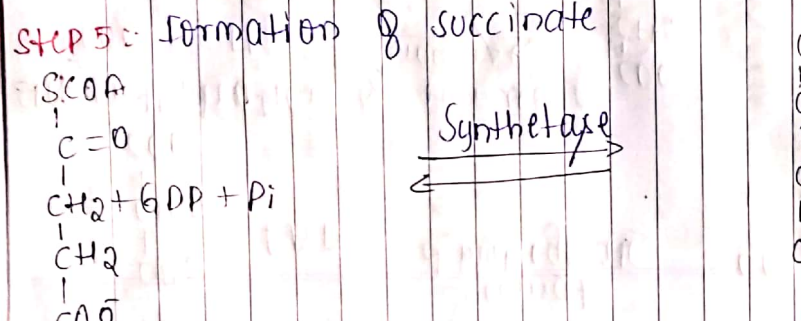
Step 3: oxidation of isocitrate.



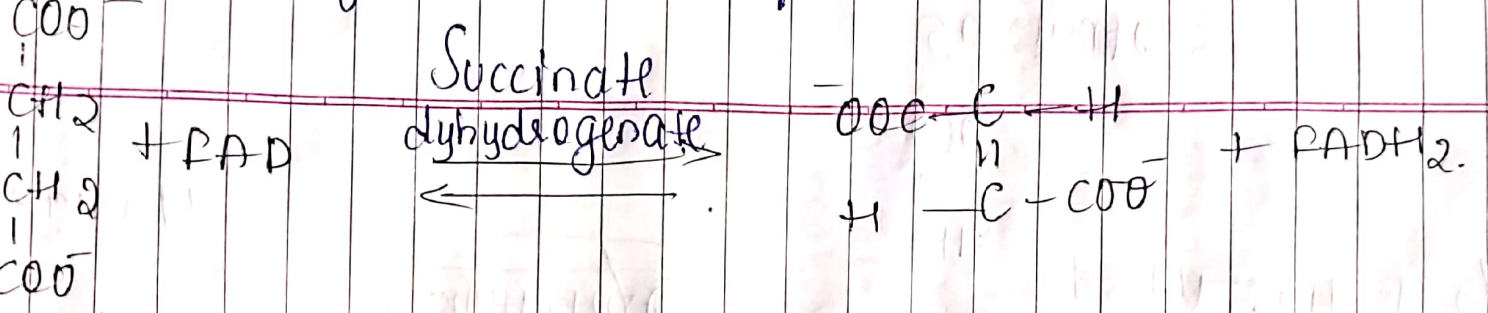
Step 4: conversion of α-ketoglutarate (α-KG) to succinyl-CoA.



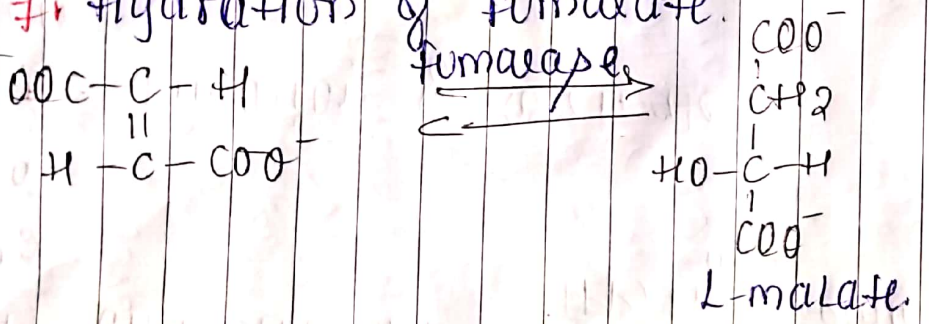
Step 5: formation of succinate



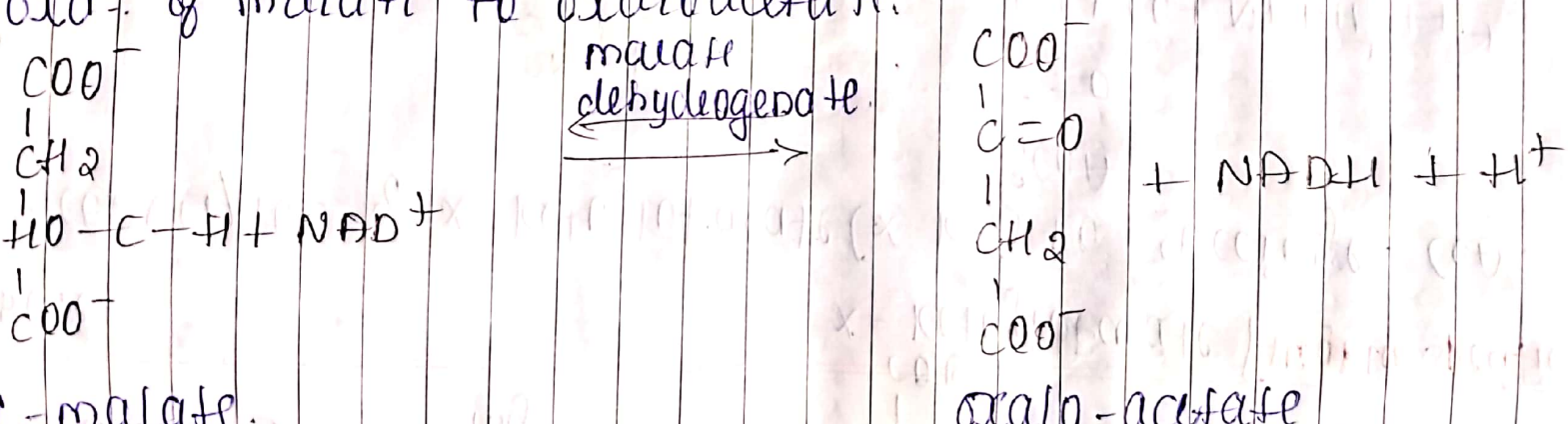
Step 6: Oxidation of Succinate to fumarate.



Step 7: Hydration of fumarate.



Step 8: Oxd? of malate to oxaloacetate.



Thus the TCA cycle completes degeadation acetyl CoA to CO_2 & H_2O.

ATP yeild during TCA cycle.

Reaction →	No. of ATP formed.
Isocitrate → oxalosuccinate.	03
α-ketoglutrate → Succinyl CoA.	03
Succinyl CoA → succinate.	01
Succinate → fumarate.	02
malate → oxaloacetate.	03
	12.

one glucose gives 2 pyruvate molecules so, the total number of ATP molecules formed from TCA cycle. $12 \times 2 = 24$, ATP molecule.

Energetic of kreb cycle.

Isocitrate → α-ketpglutarate (α-KG) = 3
NAD → NADH ETC 3ATP

α-KG → Succinyl CoA. = 3
NAD → NADH ETC 3ATP

Succinyl CoA → Succinate. = 1
GDP & Pi → GTP → ATP

Succinate → fumarate = 2
FAD+ → FADH ETC 2ATP

L-malate → oxaloacetate = 3
NAD+ → NADH ETC 3ATP

Energetic of krebs cycle. 12

Thus 12 molecules of ATP are produced as per acetyl CoA Total energy output from Glucose.

Glucose

↓ Glycolysis

2pyruvic acid + 2ATP + $2NADH_2$

↓

$2CO_2$ + 2acetylcoenzyme A + $2NADH_2$

↓ krebs cycle & resp^{n} chain.

$4CO_2 + 6H_2O + 24ATP$

$6CO_2 + 6H_2O + 26ATP + 4NADH_2$.

12ATP via resp chain

38ATP.

Gluconeogenesis:
Synthesis of Glucose from lactate.

Glucose

Glucose 6-phosphate ⇄ (Pi, H_2O) Glucose-6-phosphate

phosphoglucose isomerase

Fructose 6-phosphate

fructose 1,6 biphosphate ⇄ (Pi, H_2O) Fructose 6-phosphate

Aldolase

Glycerol Dihydroxyacetone Phosphate ⇌ Glyceraldehyde 3-phosphate.

Glyceraldehyde 3-phosphate dehydrogenase — P_i, NAD^+ / $NADH$

1,3 Biphosphoglycuate.

Phosphoglycuate kinase — ADP / ATP.

3-phosphoglycuate.

phosphoglycuate mutase

2-phosphoglycuate

Enolase — H_2O

phosphoenolpyruvate.

phosphoenolpyruvate carboxykinase — GDP + CO_2 / GTP

oxaloacetate. ⟶ Some amino acids.

pyruvate carboxylase — ADP + CO_2 / ATP + HCO_3^-

pyruvate. ⟶ ~~Gluco~~ lactate

Some amino

Gluconeogenesis pathway.

Fatty acid metabolism.

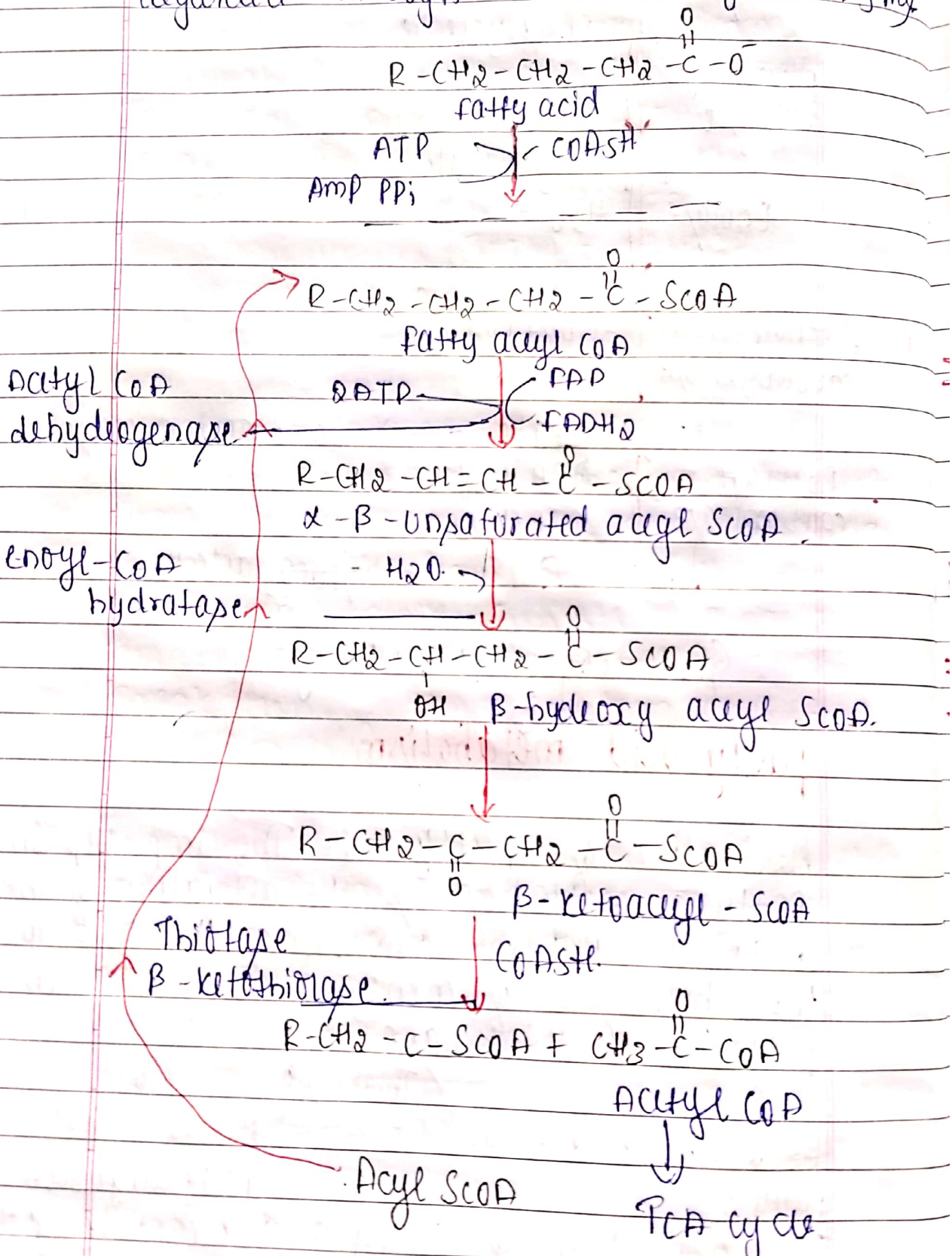
Activation of fatty ā: The imp step in fatty ā oxidation is the activation of the ā is achieved by converting the acid to the thiol ester of coenzyme A by ATP in presence of thiokinase.

$$RCH_2COO^- + ATP + CoASH \xrightleftharpoons{\text{Thiokinase}} R\text{-}CH_2\text{-}\overset{O}{\overset{\|}{C}}\text{-}SCoA + AMP$$

fatty ā — fatty acyl SCoA.

The activation of fatty acid occurs in cytol but oxd^n occurs in the mitochondria. this fatty ācyl-SCoA enters into mitochondria membrane

with the help of carnitine. Inside the mitochondria acyl-SCoA compound is degarded through the action of 4 enzyme



β-oxidation of fatty acids

Step 1: Convertion of fatty a to fatty acyl-SCoA by CoASH & in presence of ATP

Step 2: Conversion of acyl SCoA to α, β-unsaturated acyl SCoA.

$$R-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-SCoA + FAD \xrightleftharpoons{\text{dehydrogenase}} R-\overset{H}{\overset{|}{C}}=\overset{H}{\overset{|}{C}}-SCoA + FADH_2$$

Acyl SCoA

α, β-unsaturated acyl SCoA.

Step 3: Hydration of α, β-unsaturated acyl SCoA.

$$R-\overset{H}{\overset{|}{C}}=\overset{H}{\overset{|}{C}}-\overset{O}{\overset{\|}{C}}-SCoA + H_2O \xrightleftharpoons{\text{hydrase}} R-\overset{OH}{\overset{|}{C}}H-CH_2-\overset{O}{\overset{\|}{C}}-SCoA$$

α, β unsaturated acyl SCoA.

β-hydroxy acyl SCoA

Step 4:

$$R-\overset{OH}{\overset{|}{C}}H-CH_2-\overset{O}{\overset{\|}{C}}-SCoA + NAD^+ \xrightleftharpoons{\text{dehydrogenase}} R-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-SCoA + NADH + H^+$$

β-ketoacyl SCoA

Step 5: Cleavage of β-ketoacyl SCoA.

Cleavage occur in presence of coenzyme A is catalyzed by acetyl SCoA acyl-transferase (or) β-ketothiolase.

$$R-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-SCoA + CoASH \rightleftharpoons R-\overset{O}{\overset{\|}{C}}-SCoA + CH_3-\overset{O}{\overset{\|}{C}}-SCoA$$

acyl SCoA.

oxidation of palmitic acid & ATP yeild.

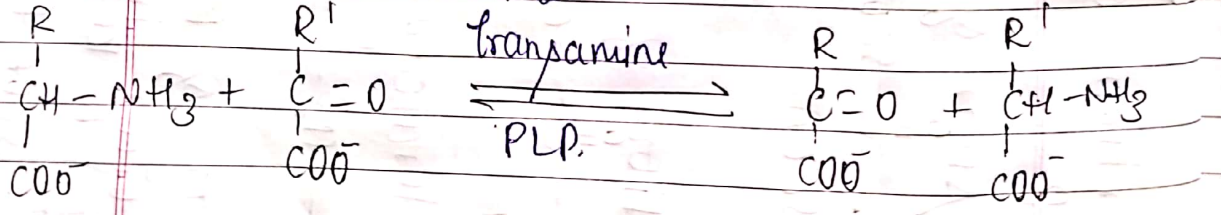
palmitic acid ($C_{15}H_{31}COOH$) = 7 times
β-oxidation produces 5 ATP molecules
∴ Total no of ATP molecule formed through β-oxidation (7×5) = 35 ATP
Total no of ATP molecule formed on oxd of acetyl CoA through.
TCA cycle = 8×12 = 96 ATP
Total = 131 ATP

protein metabolism

Amino acid degradation.

Amino acids are used for protein Synthesis as well as energy liberating molecule in the form of ATP. the degradation of amino acid mainly consists of 2 parts.
: The removal of the amino groups & the Breakdown of the resulting caebon skeleton.

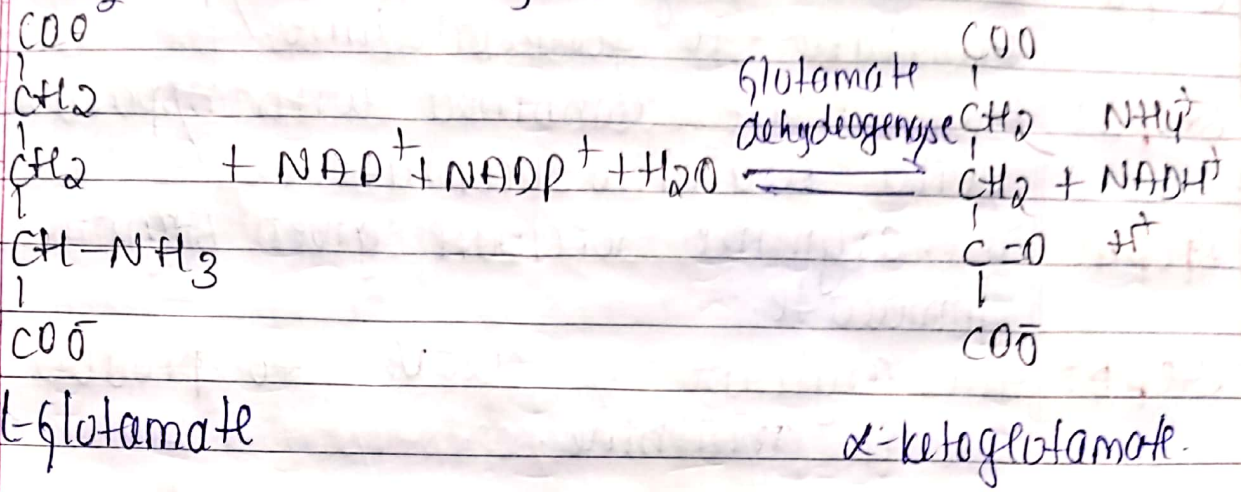
Transamination: A rxn which involves the transfer of an amino grouping from amino acid to α-keto acid. this reaction is called Transamine.



Amino acid - 1 α-keto acid - 1 α-keto acid 1 amino acid 2.

Deamination: A rxn in which amino group is removed from an amino acid in presence of enzyme & co-enzyme.

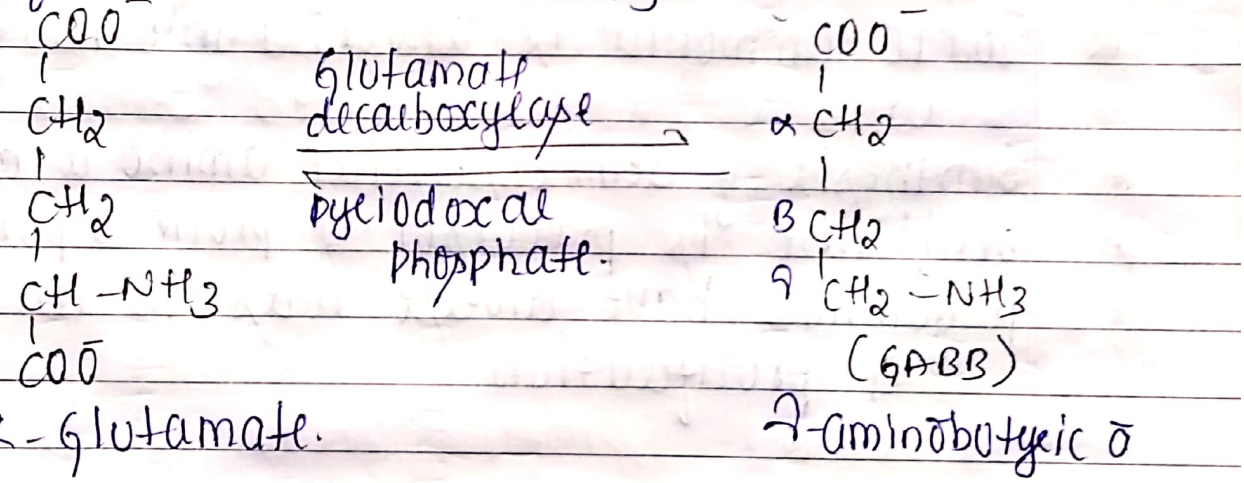
Ex:



L-Glutamate — α-ketoglutamate.

Decarboxylation: A reaction in which carboxye group is removed from amino a. in presence of an enzyme & co enzyme.

Ex:



L-Glutamate. — γ-aminobutyric a

Urea cycle: The excretion of excess of unwes nitrogen resulting from amino a degradation in human being is urea. urea is formed in the liver & is passed into the circulating the blood & is eventually excreted in urine.. urea is formed by a special group of enzyme whose combined operation constitutes the urea cycle.

Step1: form of carbomoyl phosphate from CO_2, NH_3 & 2 molecules of ATP.

Step2: Condensation of carbamoyl phosphate with ornithine to form citrulline.

Step3: L-citralline combined with Asparate to yeild argininosuccinate.

Step4: The argininesuccinate given Arginine & fumarate.

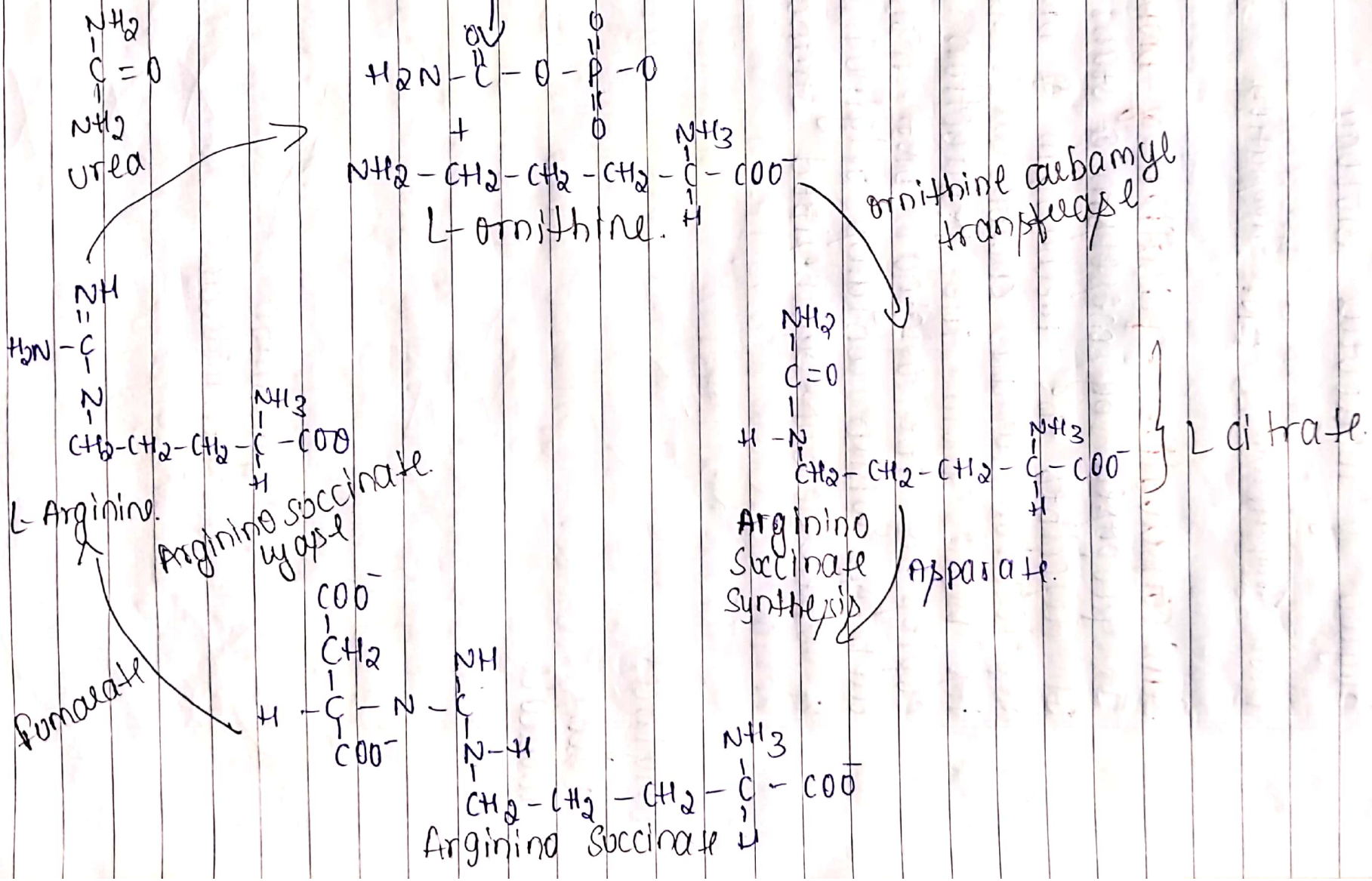
Step5: The arginine is cleaved to produce urea & ornithine.

Significance of urea cycle

* Toxic ammonia is converted into non-toxic urea
* Synthesis of semi essential amino a arginine.
* ornithine is precursor of proline, polyamines
* polyamines have diverse roles in cell growth & proliferation.

Urea cycle

$NH_3 + HCO_3 + ATP$



Molecular Biology

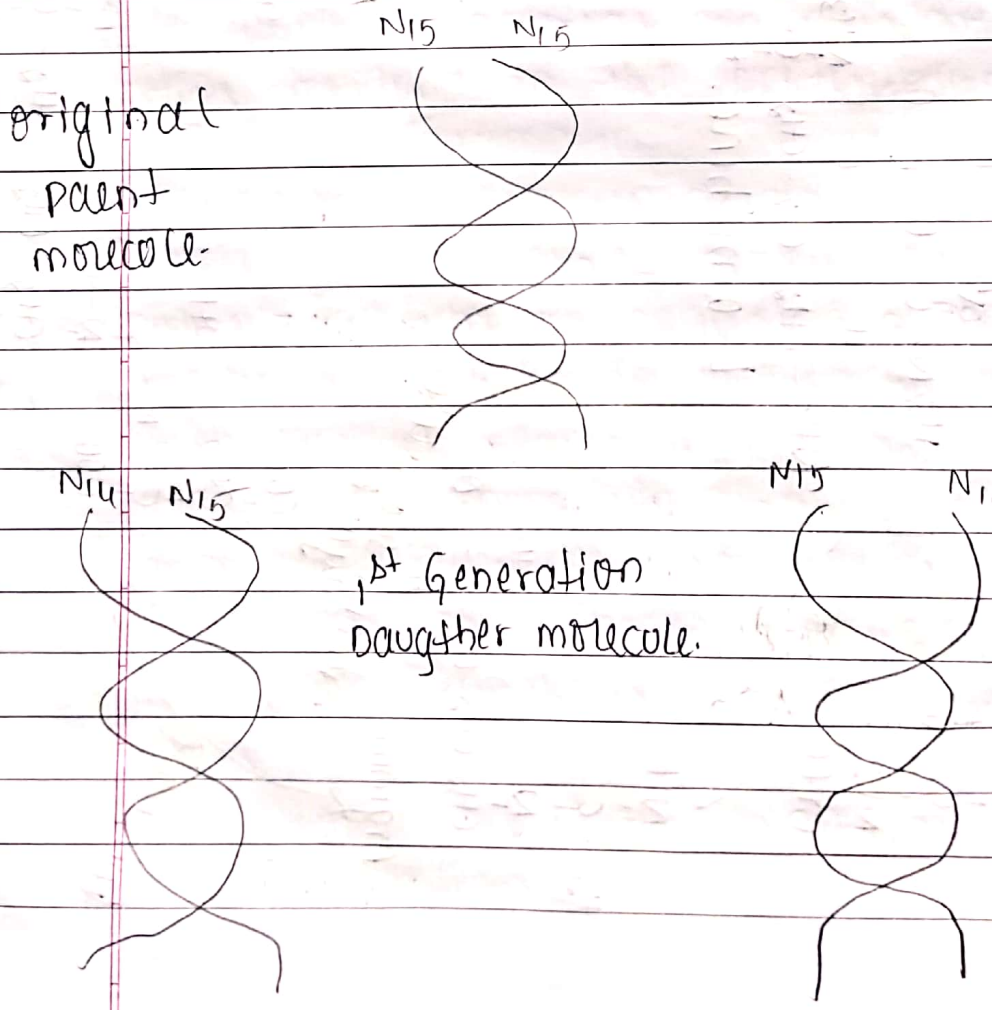
central dogma of molecular Biology

The flow of genetic information in cells from DNA to RNA & RNA to proteins is refered to as the central dogma of molecular Biology.

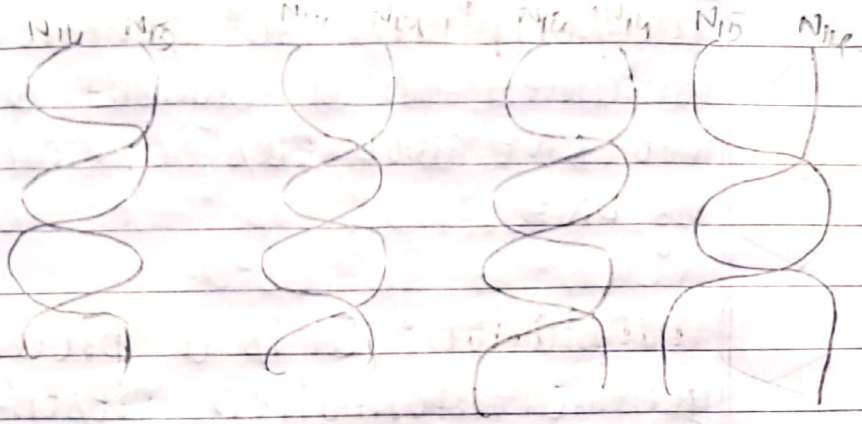
DNA $\xrightarrow{\text{Transcription}}$ RNA $\xrightarrow{\text{Translation}}$ proteins

Semi conservative replication of DNA

It proposed by meselson & stahl.
It describes the mechanism of DNA replication in all known cells. it derives its name from the production of 2 copies of the original DNA molecule each of which contains original strand, & one newly-synthesized strand.



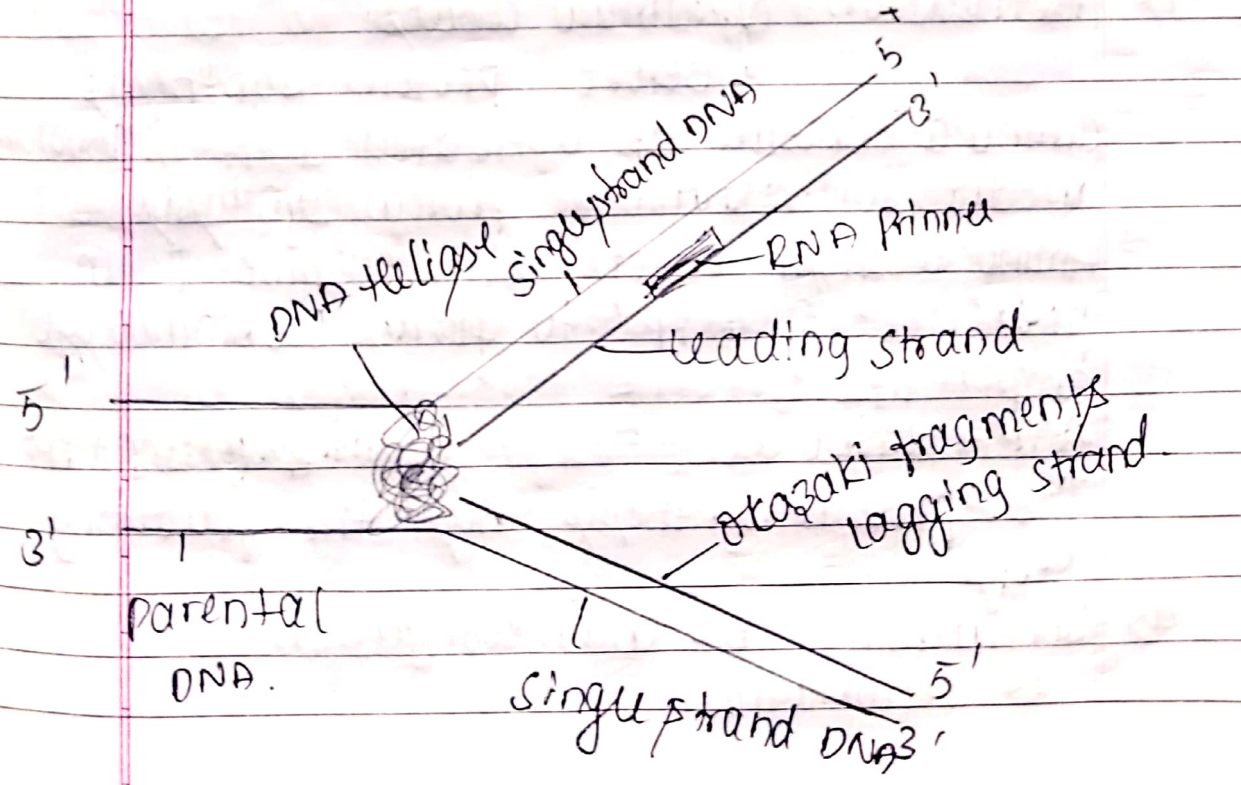
Second gen daughter molecule.



DNA replication.

Watson & crick suggested that DNA replicates by a semi-conservative mechanism.

According to this model, the double helix DNA molecule during rep: & 2 strands seperates. each strand serves as a templete for the synthesis of a new strand which has a complementary for base sequence & then combines with it DNA intact. the new two molecule result each with one new strand & one old strand.



Transcription: The genetic information contained in a segment of DNA is transcribed into RNA molecules during the replication of DNA

Translation: It is a process in which the genetic information present in m-RNA directs to order of specific amino acids to form the polypeptide chain in the protein synthesis.

Components required for translation.

* All 20 amino acids
* Every amino acid required a specific t-RNA
* A group of enzyme called amino acetyl-t-RNA
* Ribosomal RNA.
* Energy source ATP & GTP.

Steps involved in the protein synthesis

1) Activation of amino acids.

Before protein synthesis amino a should be activated & it is involved in the initiation of protein synthesis. Amino a first reacts with enzyme-E in presence of ATP to form E-aminoacyl amp + PPi

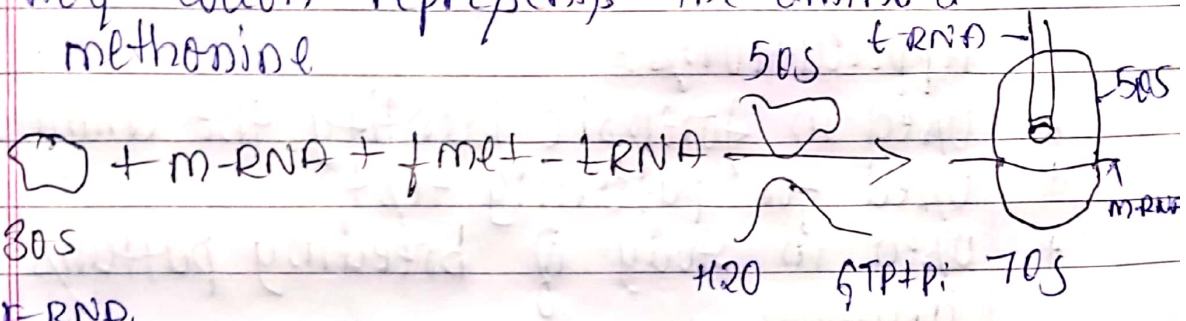
$$ATP + \text{amino a} \xrightarrow{E} E\text{-aminoacyl amp} + PPi$$

The protein synthesis has the following steps.

a) Initiation b) Chain elongation
c) Termination

2> Initiation of protein synthesis.

In this process, m-RNA, 30s subunit, formyl methanine - t RNA - GTP + Initiation factors. Here AUG to initator codon present on the m-RNA. Thus AUG codon represents the amino ā methonine



Genetic code (or) Codon

The relationship blw nucleotide sequence of m-RNA & the amino ā sequence of polypeptide

General features:

* The genetic code is triplet code i.e a codon for a single amino ā
* 64 all triplet codons are possible ($4^3 = 64$)
* The genetic code is specific. i.e a specific codon always codes for the same code.
* The code of degenerates, since there are 20 amino ā for 61 codons. Each amino ā is coded by more than one codon
* UAG, UGA & UAA are called termination codons
* The code is universal. i.e, all organism use the same codon to specify amino acids

DNA fingerprinting: It is a technique to identify & compare sets of DNA. it is now used for a lots of purposes but forensic is the major field in which it is used.

Applications:-

* used in forensic identify the criminals
* used for paternity test.
* used in study of breeding patterns of animals
* used in determining lineages of human & other animal for checking the genetic makup.
* used to diagnose the genetic disorders & heridatory disorders.
* used to determine about the antibiotics to which bacterias are resistant

Role of chromatin: It is a complex of DNA & protein found in eukaryotic cells

* It's function is packing long DNA molecules into more compact, dense structures
* DNA into chromatin allows for mitosis & meiosis prevent chromosomes breakage & controls gene expression & DNA replication.