

①

Anything living needs to be replicate & reproduce.

small molecules : biological imp small molecules eg amino acids, lipids etc.

1st biological imp molecules when there was nothing on earth : amino acids,

RNA has the properties of replication - not DNA.

RNA → DNA → Protein.

gases → amino acids → RNA, Protein etc.
[without O₂)

RNA forms DNA, DNA forms RNA.

Macronutrients : Vitamins + Minerals + Water.

Whenever in exam if not given assume a D sugar.

Sucrose is made by plants.

caused due to wrong DNA Copying.

①

Mutation is corrected by the machine from DNA before make it inherit to the offspring.

~~Species : Organisms that can breed to give fertile offspring.~~

"Variations are created by mutation."

Humans & monkeys evolved from 1 common ancestor.

- 2nd Variation
- 3rd Speciation
- 4th Adaptation

Mechanical breakdown takes place in mouth & stomach.

Blood sugar level is controlled by liver & pancreas.

Conversion of glucose to glycogen took place in liver & muscles.

Yellow : insulin

Blue : no "

VLDL : bad fat (Very low density lipid)

Reactive Oxygen species : e.g. OH^-

- IRS-1 is not even if it is not activated by insulin.
- ① → No protein attached to DNA : in prokaryotes.
→ Protein (histones) " " " : in eukaryotes.
- Eukaryote has true nuclear membrane which encloses nuclear material.
- How internal structures develop inside cell : endosymbiosis.
- bacteria which were beneficial for the cell were engulfed by cell & after some generations these were called mitochondria.
- ### Proofs
- 1 Mitochondria & chloroplasts have their own DNA.
 - 2 DNA in these matches more to bacterial DNA.
 - 3 Ribosomes in mitochondria ~ ribosomes bacterial.
- Nuclear DNA diff from mitochondrial DNA.
- Paralogues : similar sequence, but 2 diff fns
 $f^n_1 \checkmark f^n_2$
- Cell size : most cells are same size in organism.
- All. Most of the cells like RBC's etc. are same in size in every organism.

Certain specialised cells in diff organisms may vary in size.

Other common cells are about of same size.

for small cell : atleast nuclear material must be accommodated.

for big cell :

large surface area to accommodate nuclear exit and entry.

SA to Volⁿ ratio • diffusion

high S/V → more diffusion

FtsZ : protein : controls cell size

division happens due to this protein.

Cells having FtsZ are smaller in size as compared to others.

ftsZ is needed for division of membrane.

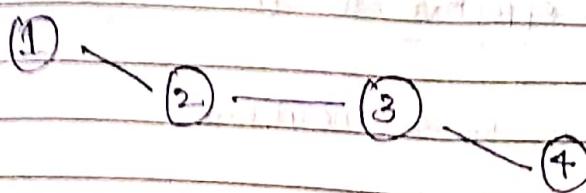
and function of some proteins apart from the division of labour ~ compartmentalization in multicellular life enhances the life in multicellular organisms.

compared to single cellular most life and results are

(*) ribs first animal cells : L + nucleoplasm

Proline

Torsion in proline is more favoured / preferred than cis but that priority isn't that high. There is less gap as compared to others.



θ_1 = angle b/w plane containing 1, 2, 3 & plane containing 2, 3, 4

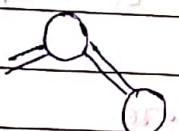
$P_1 = \boxed{1, 2, 3}$: dihedral angle

$P_2 = \boxed{2, 3, 4}$

Angle b/w P_1 & P_2 is dihedral angle.

Dihedral angle is finite except

→ When all atoms are in one plane and each atom has no bond with other atoms.



Then angle is considered

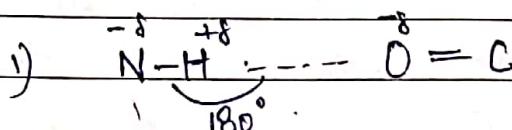
Result is called tetrahedral angle.



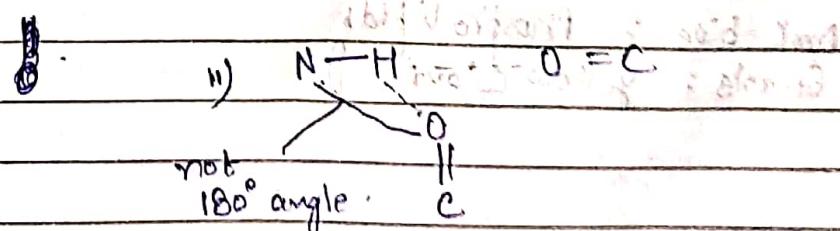
→ When all atoms are in one plane and each atom has bond with other atoms.

How does above configuration prevent NH & COOH from interacting?

- For tert-structure, H_3C groups in place used.
- By involving the backbone atoms NH & COOH , secondary structure is formed and that H_2O freely is avoided.
- Linking 2 tert structure gives quaternary structure.



No repulsion b/w N & O.



(5)

H bonding is more effective in ①.

①

In cell, genetic material is inside membrane.

Ribosomes : needed for making proteins.

→ Yellow strip : capsule (not present in all cells)
mostly tnt. in pathogenic bacteria.

→ Cytosol + Ribosomes = Cytoplasm. (in prokaryotes)

Green strip = Cell wall.

For bacteria to have been on a surface or attach to something, pili are tnt.

→ For locomotion, flagella is there.

Within cell, chloroplasts & mitochondria can make copies of itself.

On cell division (like binary fission), each cell will have equal no. of mitochondria & chloroplasts.

Bacteria & plant cell both have cell wall.

Common b/w prokaryotes & eukaryotic cells is cell membrane, nucleus.

Cell membrane

Dark blue : Phospholipids

Sterols : yellow colour

which spans the protein : Integral membrane protein
 " doesn't span" : Peripheral protein
 only attach to protein.

Membranes are

self sealing : heals itself.

Brown : hydrophobic part { lipid parts)
 White : hydrophilic part

Others membranes in cell

Phosphatidyl serine is on inner membrane when this membrane is npted, membrane is dyed.

- More stronger the interactions of bonds, less fluidity or stability will happen.
- ↑ in T → lead to more fluidity of membrane
- More the cholesterol less the fluidity
- Having more saturated bonds leads to less fluidity of membrane.

Photo bleaching done in 2nd step.
 Then some molecules move from their position & ~~reached~~
 diffusion occurs.

Lipid mol. are on membrane
 fluidity of membrane is determined by rate of recovery of colour.

Mitochondria don't have DNA.

→ Unfolded poly peptide isn't functional inside body.
 Black represents hydrophobic acid
 White " hydrophilic amino "

Urea, $\text{NH}_2 \text{ NH}_2^+ \text{ Cl}^-$ break tertiary structure of protein.
 → unfold protein.

T_m : When half of melting pt is structured.
 More T_m : more stable.

Ribonuclease (4-disulphide linkages)

Sequence of amino acid determines the folding of protein.

101 amino acid \Rightarrow 100 peptide bonds.

Each aa is having 3 conformations.

It will take 1.6×10^{27} years to determine structure of protein and access all conformations.

One amino acid change in a protein can lead to disease, eg change from glutab to glutamyl
 less stable \rightarrow more reactive.

trans-fatty acid is not good for health.

On heating, cis form converts to trans form by crossing energy barrier.

18:1 : ^{cis}_Δ 9,12,15
 ↓ ↓
 no of C no of nature
 =

W3 & W6 : essential fatty acids. High saturation.

Trans in a st chain

(in SFA) → cis can't be packed efficiently.

→ Backbone : glycerol, Sphingosine. of phospholipids.

→ Cholesterol isn't made in liver.

Triglyceride is " " " .

→ HDL : brings triglyceride that it haven't used. → Good.
 LDL → Bad

Cholesterol level may be high due to some injury inside our body.

To store triglycerides over extended time must switch

- ① → membranes are asymmetric
- Rigidity is w.r.t the same molecule. It has nothing to do with fluidity.
- fluidity is w.r.t the whole molecule.

Transverse Diffusion
catalyst required → flipper | otherwise very slow)
↓ protein required.

- Protein not trt in membrane : soluble proteins
on the " : membrane "
- generally trt on cytoplasm.
- structure → depends on phospholipids, fm → membrane protein

3 classes → lipid linked (connected to lipid of bilayers)

↓
integral peripheral

③ → β sheet

② → α helices

④ Special → stuck (not peripheral); it's considered integral

For RBCs { fructose → can't enter}

liver → membrane protein assisted diffusion for

fructose.

Nat⁺ : Assisted diffusion.

Active transport: Sometimes goes against rule of high to low conc.

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or assisted.

We need a transporter to mediated glucose, (Na^+, K^+) into cell membrane.

GLUT1 is tut in RBC, make glucose enters into RBCs. This mutation leads to no entry of glucose.

Entry of glucose is assisted by glucose transporter.

Kidney cells need to excrete water.

Aqua porins are not tut everywhere: tut where water needs to go in very fast.

4 pores made in aquaporin.

Excretory sys \rightarrow reabsorption of water essential; thus transport of water imp. in water loss.

Message is transmitted from one to other cell using chemicals called neurotransmitters.

- Vesicle is formed by one neuron. Vesicle \rightarrow membrane bound structure with neurotransmitter.
- Vesicle goes and fuses to the plasma membrane of the next neuron.

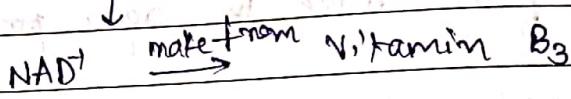
Bacteria in our body produce vitamins.
Water soluble vitamins are required more.

Ribosome has to join 2 amino acid together
manufacturing proteins.

Some proteins cannot work on their own. So,

And enzyme require a cofactor to work.

Mostly vitamins make coenzyme (ORGANIC)



In some reactions FAD also acts as a cofactor.

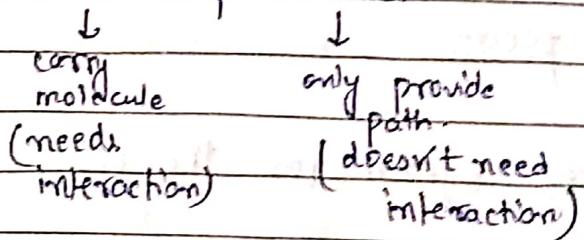
Nothing happens when ATP is mixed with water.

When water molecules don't combine with ATP as the prob of water molecule hitting twin ATP is very low. Entropy raises the E_a (energy barrier). The enzymes hold the ATP molecule in a way such that water can combine & also makes phosphorus +ve & makes water more ~~more~~ neutralophilic.

Proper orientation is essential for ATP hydrolysis ADP.
Improper orientation \Rightarrow increased E_a . In body ATP is held in a proper manner.

①

→ Diff b/w carrier & channel.



- Deficiency of CFTR protein fnt on plasma membrane leads to disease CF.
- Mucus is in the passage b/w cells. water enters via osmosis (mucus remains hydrated)

Carbohydrates

- form a physical barrier on plasma membrane.
- carbohydrates fnt on plasma membrane of red blood cells determine blood grp.

- Based on antigens, body will produce antibodies.
- if you have A antigen, B antibodies will be produced if won't produce B antibody.
- AB → produce both.
- Antigen → carbohydrates fnt on plasma membrane of RBCs.
- O : H antigen

- Archaea : extremophiles (extreme conditions / environment)
(sterol - absent in prokaryotic)

- Chirality of glycerol in archael membrane → ether bonds
↓
strong.

⑬

→ synthesized by ribosomes inside cell.
Proteins have to be on plasma membrane to react.
How do they reach there?

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→ Branched nature of ~~isoprene~~ isoprene ^{In archae}, gives a single monolayer.

→ Structure: called pseudo.

→ Called secretory system for the cells.

→ DNA $\xrightarrow{\text{converted to}}$ RNA inside nucleus.

RNA come out through pores from nucleus.

Ribosomes read message on RNA, produce amino acids & protein form.

→ ER: helps in transport of proteins.
Golgi apparatus \rightarrow

→ On RER: have ribosomes on them.

→ On SER: lipid synthesis.

→ Protein synthesis occurs on ER with help of mRNA & ribosomes.

Glyco protein: carbohydrate chain attached to protein molecule in ER.

→ Protein moves to golgi complex.

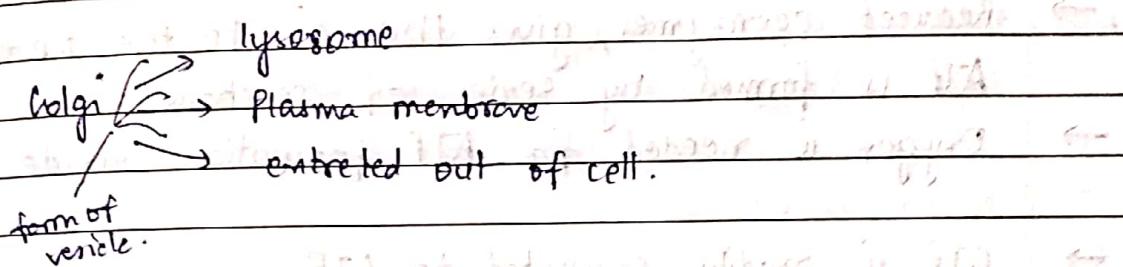
Some proteins are gone out at golgi apparatus eg hormones.

From golgi: golgi away from ER.

- Hydrolase produced at ER digests waste.
- Protein : glycosylated in ER.
- Golgi → phosphatic attachment occurs.

- How do the vesicles know where to go?

Motor proteins : Motion of vesicles.



- Protein has a localisation signal
- " processed & modified on ER.
- Golgi apparatus do segregation of protein or separation of protein to diff vesicles. Also minor modifications occurs at golgi
- Signal from mRNA is recognised by protein & go to RER.
- Transport from ER to golgi carry certain imp proteins in form of vesicles need to be transported back to ER from golgi.

ER → golgi → antigrade

golgi → ER → retrograde.

- Coenzyme : help enzyme to work.
 - CoA : coenzyme A
 - Acetyl CoA : formed inside mitochondria by taking $\text{CH}_3-\overset{\text{C}}{\underset{\text{O}}{\text{—}}}-$ from pyruvate. It enters mitochondria.
 - Reduced coenzymes give the e^- to the proteins of ATP is formed by series of reactions.
 - Oxygen is needed for ATP formation inside mitochondria.
 - GTP is readily converted to ATP.
- Krebs cycle.
- Colours disappeared (as it has symmetry).

NADH, FADH_2 is formed.

→ I-IV accept e^- from NADH, FADH_2 are formed.

$\text{NADH} \xrightarrow{\text{it's e}} \text{I}, \text{II}, \text{III}, \text{IV}$

can pump

proton from matrix to intermembrane space.

then

H^+ can't come back from I, II, III, IV back to matrix due to conc difference. H^+ moves through channel back to matrix in which ATP is formed.

NADH can pump H^+ using I, III, IV. But FADH₂ can pump through III, IV only.

∴ FADH₂ can create less gradient or conc diff as compared to that of NADH.

ETC: e^- transport chain.

CAC: cyclic acid cycle.

← glycolysis (inside cytoplasm).

To get energy from protein, body can't store amino acid.

- Shuttle system: Removes NADH from cytoplasm & produces it in mitochondria by some reaction.
- in muscles 1 NADH is destroyed & 1 FADH₂ is produced in oxidation of fat.

- ① → Those protein which do not have a targeting signal formed in cytosol remains inside cytosol.
- Those which have a targeting signal goes to the targeted organelles.
- Chaperone proteins help in folding of proteins.
- Protein having targeting signal at peroxisome have C terminal. Otherwise N terminal.
- inner membrane of mitochondria: cristae.
- Mitochondria has own DNA, ribosomes.
- ATP synthase resides on inner membrane of mitochondria.
- ATP synthase (F_0, F_1) proteins → needed for energy (cristae uses SA)
- Cristae: foldings in mitochondria. (foldings of inner membrane)
- Only 1% of proteins coded by mitochondria itself.
- 99% of proteins on mitochondria are generated by cytosol.
- Cardiolipin maintains the proton gradient for ATP synthase → helps in energy synthesis.

→ Cardiolipin : present on inner membrane.

→ Mitochondria frequently divides & fuses continuously.

→ Lipid granules : needed for energy synthesis.

Cytoskeleton

Scaffold : Cytoskeleton. (provides rigidity).

→ Scaffold on which cytoplasm rests.

Microfilaments always made of Actin. } have same

Microtubules } " " with Tubulin. } protein all time.

Intermediate filaments can vary in composition.

All 3 interact together in a cell.

formed
of diff
proteins

→ Tracks inside the cell. (vessel for vesicle formation)

→ Vesicles attach top of these tracks & move inside the cell. (use cytoskeleton as pathway).

→ Cytoskeleton has a massive SA. ($94000 \mu\text{m}^2$)

functions

Actin rearranges itself to give movement to cell.

Actin is useful in joining 2 cells (cell adhesion)

Lamins (proteins) of intermediate filaments are found around nucleus.

It acts like a cage with gas in it.

→ maintains organelle structure.

cell shape / support / rigidity

tracks / vesicle guidelines.

Actin: house keeping protein found everywhere in every cell.

F actins are disassembling to form G actin always.
G " " assembling " " F "

- G actin (mtt inside cytosol bounded by ATP activation) undergoes oligomerisation (in absence of ATP).
- After ATP is lost, transport of vesicles is stopped, finished and G actins disassortiates. ATP is consumed here.
- Phagocyte → immune system cell.
- Polymerisation of actin and destroying of apoptotic cells occurs in the process of phagocytosis resulting in metabolism and mitosis.
- Microtubules helps in spindle formation.

Microtubulin

- Motor protein assists tubulin & actin in their functionality / functioning. Helps in movement of cell organelles.
- Motor proteins assist in directing vesicles to tubulin / actin.
- Intermediate filaments don't have any sites for GDP, ATP, ADP. These intertwine by default due to interaction.

Action & tubulin are required for cell division in bacteria whereas only actin is required for cell division in eukaryotes.

classmate

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Prokaryotes have proteins with diff sequences as compared to eukaryotes. ↓
positioning of amino acids.

→ Cytoskeleton has imp role in cell division.

→ Whenever cell divides or DNA divides it has to be error free (we can't afford it to be of error).

→ frequency with which cell divides depends on cell types.

Highly differentiated cell :-

nerve cell : do not divide in body.

↳ its deficiency lead to diseases.

stem cell : site for differentiation → produce all types of cell.

Eukaryotic cell without a nucleus : RBCs.

RBCs lose their nucleus when they are formed from bone marrow.

Bone marrow is a site for stem cells.

RBCs : generated in bone marrow (don't divide).

Heart cells : generally non dividing.

Divide on demand :-

WBCs : divide when required.

Continuous

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Orientation is eqⁿ

chromosome no : genetic content

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Stem cells : self renewable (can divide)
can from any type of cells

DNA division occurs first, then cell divides.

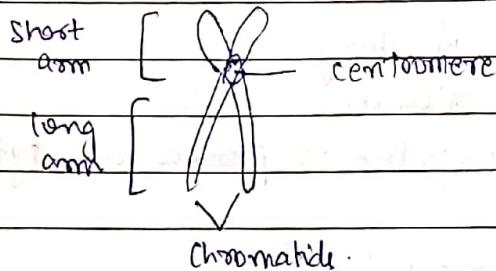
Nerve cells are so busy that they didn't have a time to divide.

Our DNA is arranged as chromosomes.

DNA is in compact form in eukaryotes.

DNA in our cells is not always in as chromosomes.

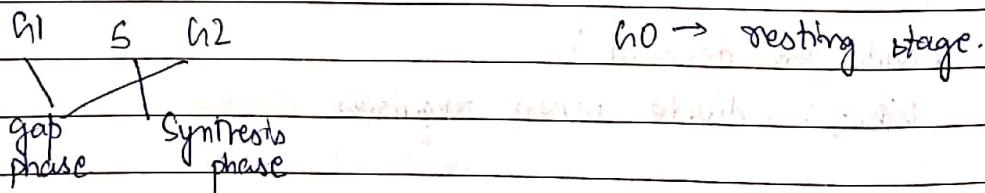
It is in as chromatin & at time of cell division it divides into chromosomes.



Interphase : where DNA replication happens.

↳ Division of DNA happens in it.

M phase : nucleus & cell division occurs.



2 types of cell division :

Mitosis

Miosis

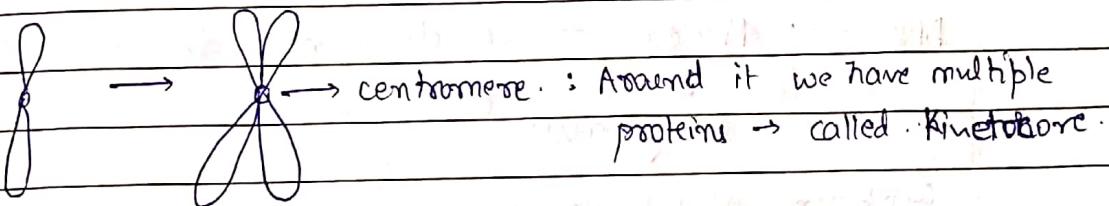
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→ 20 hrs is almost gone in Interface out of 24 hrs for cell division.

Making of histone proteins fibres in G1 cycle for condensation of chromatin to chromosomes.

All the things needed for cell division are prepared in G2 phase.

S: DNA synthesised / divided

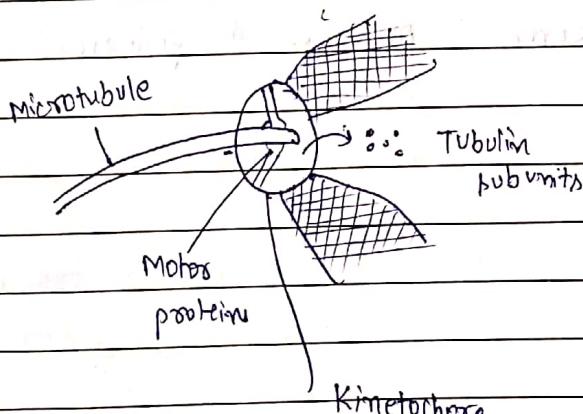


M phase starts with prophase.

Nuclear membrane have to be disappeared.

Centrosomes → spindle fibres are polymer of tubulin.

Spindle molecules start depolymerising & pull chromosomes.



(Spindle apparatus)

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hankies

Anaphase

(away from centre)

The nuclear membrane is again formed after cell division.

last phase

: Telophase of Cytokinesis

Actin : depolymerise on both sides → pinched on both sides.

→ In plant cell, a new cell plate is formed helped in clinching of 2 cells.

DNA → Nucleus → Cell division.
 ↓
 Karyokinesis

Cytoplasm division : Cytokinesis

23	23		
46	46		
23	23	23	23

In Meiosis : 2 chromosomes are there : maternal, paternal.

1 set of chromosome : maternal + paternal.

- FD region ~~isnt~~ in the membrane.
 - F₁ : intermembrane space. lies in matrix.
 - Region to left of stator stalk : matrix.
- always remain stationary.

H⁺ (matrix)

H⁺ (intermembrane)

ADP + Pi binds to 3 parts of $\alpha\beta$ ring with mostly β parts.

what is the function of α ?

↳ helps in tuning the binding site of β .

→ Due to rotation β part converts ADP + Pi \rightarrow ATP.

γ stalk : asymmetric. 3 prods (mostly in β subunit) generate ATP.

→ C ring in F₀ can rotate due to proton inflow.

→ ADP & Pi come close in 1 site.

Amino acid may come in next stage & catalyze.

ATP is released from site in next stage.

? How movement of H⁺ from high to low conc give rise to rotation.

1 360° of $\gamma \rightarrow 3$ ATP released (3 sites total)

→ C ring of a ¹⁷ is embedded in membrane.
B/w them there is a channel formed by ¹⁷
¹⁸ residue of protein molecule. At center
Asp is at middle of a strip in C ring.
Carbon R group of amino acid aspartine

H⁺ will bind in such a way that it binds to C.
and move in 1 direction only.

The protonated asp is less favoured to move in 1 direction \Rightarrow barrier created. Thus the other direction is the only possible one.

each β -B is at 120° angle & will provide 1 ATP each.

Asp releases the H⁺ in matrix.

Formation of β -B \rightarrow ADP + inorganic P \rightarrow inorganic P \rightarrow ATP

reaction working at each site of membrane.

Step in which energy is β -GDP \rightarrow
reaction of energy here is same as first ADP conversion
residue forms a strip across membrane at TFA

water was used at acidic part of the membrane and
neutralization at basic part.

(not added) breaking time \rightarrow after 1

U is the property of system.

Compression or expansion is called mechanical work.

(W_{mech})

State f^n , path f^n .

Enthalpy is a state f^n .

$Q \rightarrow$ path f^n .

→ T_H, T_C remains same on transfer of Q .

→ if $\Delta S > 0$, there is a driving force,

e.g. diamond is converted to graphite since its process is too much slow, yet there is a driving force;

$$\text{Average } -LF = \frac{3}{2} kT$$

→ inside the cell T is same = 37°C .

Entropy \rightarrow S.F.

Exothermic and compression, endothermic and expansion.

Exothermic cooling is of endothermic type.

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(in SOMATIC CELL)

MITOSIS

proteins (present in eukaryotic cell)

- Histones are attached to DNA.
- All chromosomes are arranged in center of cell in metaphase.
- Microtubules arise from centrosomes which form spindles which pull chromosomes in diff. direction.
- Meta phase → ana phase → decondense phase
- No variation.
- DNA duplication - once, Cell division - once.

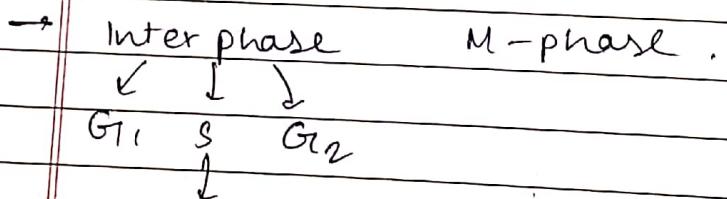
★ MEIOSIS (10 marks)

(IN GERMLINE CELL)

- Variation arises due to Meiosis.
- Daughter cells are called gametes.
- Maintains no of chromosomes in offspring.



Cell Division



Synthesis of DNA

In interphase, amount of DNA doubles,
or DNA replication + duplication.

Every chromosome has a partner that comes from mother or father.

8 : before replication

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8 : after replication

chromosomes of each mother & father

Father.

Mother.

Sister.

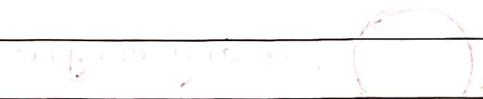
Homologous

chromosome

chromosomes

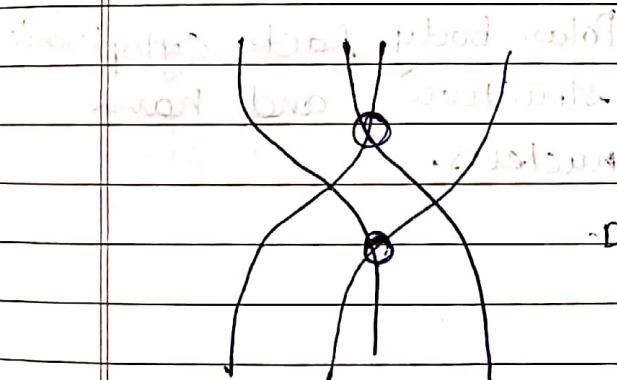
separated.

4 such produced ✓



↓ chiasmata

4 chromosomes come close together to form a tetrad.



Tetrad

in prophase,

certain fragments of

DNA are exchanged.

(before rearrangement).

↳ Tetrad changes into

chiasmata.

(after rearrangement)

(= assorting of chromatids)

Segregation of chromosomes is completely random.

↳ Segregation is random. ↳ inheritance

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23 tetrads are formed.

Variation in meiosis comes due to cross over.

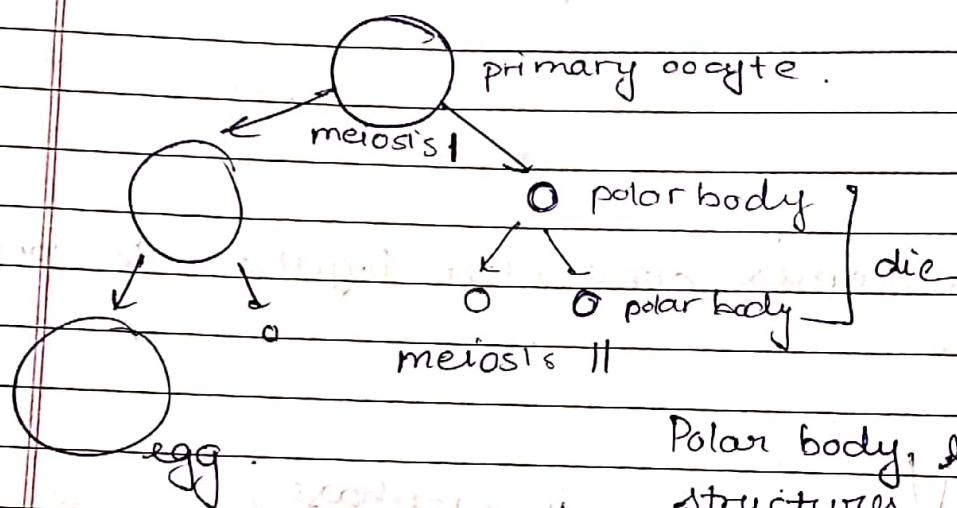
XX : 1 pair of chromosome.

tetrad formation \rightarrow aligning of tetrads (rearrangement).

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* Nuclear Membrane formation takes place in Telophase

\rightarrow Oogenesis.



Polar body, lack cytoplasmic structures and have nucleus.

Down's Syndrome

↳ 3 chromosomes of number 21

(generally we have 2).

(in Anaphase,

Problem of Separation of chromosomes)

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- * Scars on a mother cell can help to estimate no of offsprings produced.
- * Archaea don't have a true nuclear membrane.
- * Prokaryotes does not have histones.
- * Secretory system
= ER + Golgi
- * Actin is needed for furrow formation which divide the cell into 2 parts.
- * "How Rigidity comes to Archaeal membrane?"
Imp.

* Binary Fission

↳ division happens through cell wall.