SECTION-I

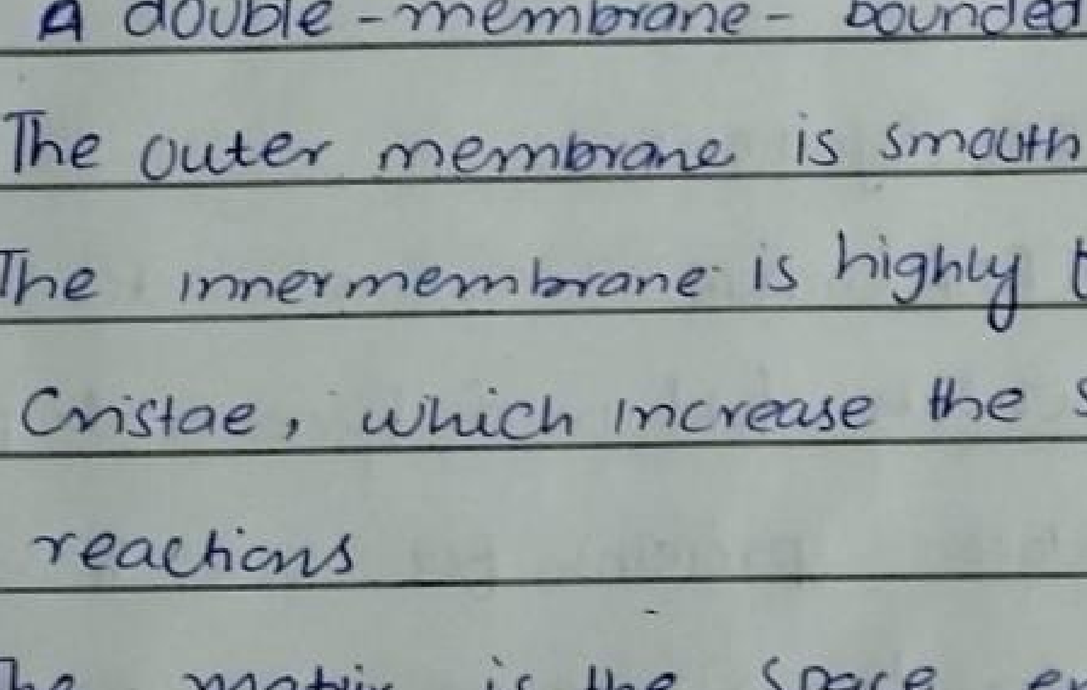
(Q NO: 03)

Describe the Structure and function of the mitochondria and ribosomes in animal cell. why is the mitochondria often called the "powerhouse" of the cell

Mitochondria

Structure:

- A double-membrane-bounded organelle found in eukaryotic cell.
- The outer membrane is smouth and encloses the organelle.
- The inner membrane is highly folded into structures called Cristae, which increase the surface area for chemical reactions
- The matrix is the space enclosed by the inner membrane and contain enzymes, mitochondrial DNA, and ribosomes, allowing some degree of self replication.



Function:

- Mitochondria are the site of cellular respiration. where nutrients like glucose are converted into ATP, the energy currency of the cell.
- They regulate cellular metabolism, apoptosis (Programmed cell death), and to contribute to calcium storage.

Why POWERHOUSE of the CELL

- It Produce the majority of the cell's ATP, which fuels cellular processes. Due to this role, they are also called the "POWERHOUSE OF THE CELL".

RIBOSOMES

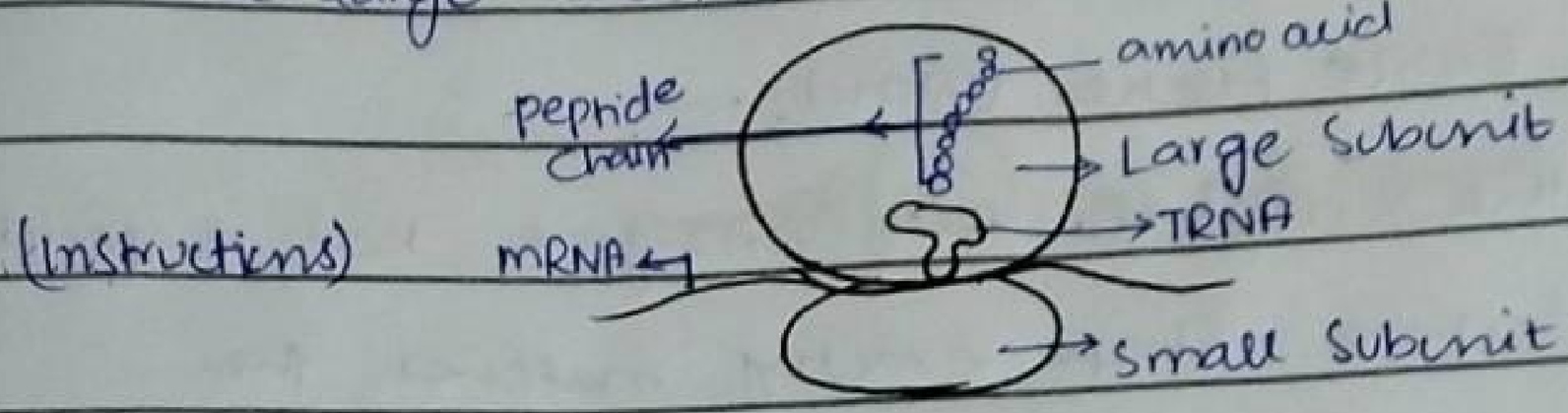
~~Structure~~ Function

- Are the Site of protein synthesis.
- They translate messenger RNA (mRNA) sequences into amino acids chains, which fold into functional proteins.
- Free ribosomes produce proteins for use inside the cell, while bound ribosomes make proteins for export or incorporation into membranes

Structure:

- Ribosomes are non membraneous organelles composed of ribosomal RNA (rRNA) and proteins.
- They can be free-floating in cytoplasm or bound to rough endoplasmic Reticulum (RER).

- In animal cells, ribosomes are smaller (80s type: 60S large subunit + 40S small subunit).



Ribosome

(b)

What are enzymes? Explain 'Lock and Icey' model and list 2 factor that affect.

Enzymes:

Enzymes are biological catalysts, usually proteins, that speed up chemical reactions in living organisms without being consumed in the process.

Characteristics:

- Highly specific for their substrate (the molecules they act on).
- Function under mild conditions of temprature and PH.
- Lower the activation energy required for a reaction occur.

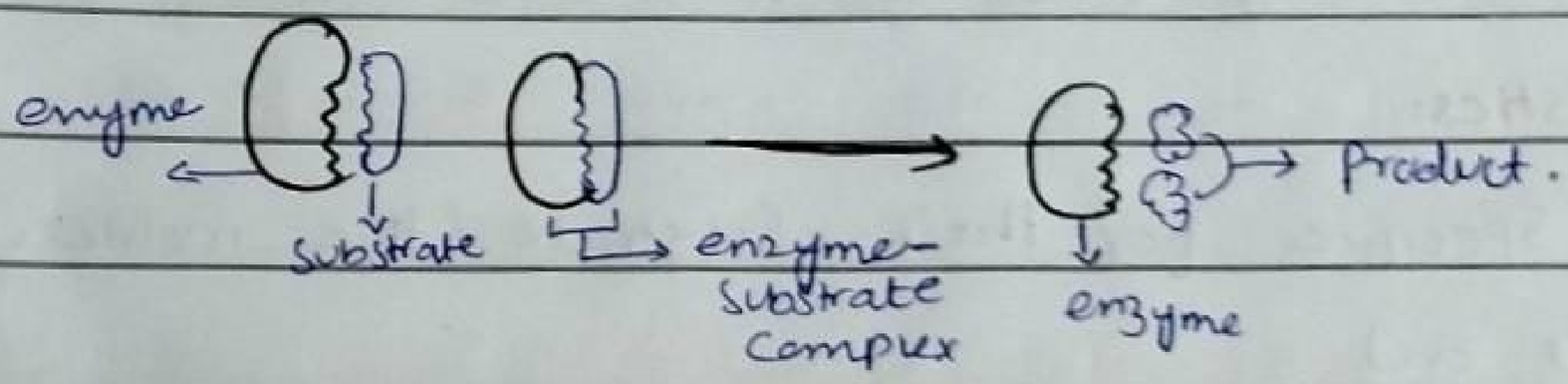
Lock and Key Model of Enzyme

Concept:

- Proposed by Emile Fischer (1894).
- According to the model, the enzyme has a specific active site whose shape exactly matches the substrate, much like key fits into a specific lock.

Steps:

- The substrate binds precisely to the enzyme's active site
- This forms an enzyme-substrate complex.
- The enzyme catalyzes the reaction, converting the substrate into product(s).
- The products are released, and the enzyme remain unchanged & ready for another reaction.



Factors Affecting Enzyme Activity

Temprature:

- Optimal temprature allow maximum activity.
- Too high can denature the enzyme, reducing activity.

PH

- Each enzyme has an optimal PH. Deviations can alter shape & reduce catalytic efficiency.

(C)

Difference b/w Renewables and non renewables energy resources? Discuss the Potential of wind energy as a Sustainable Source for the future.

Aspects	Renewable Energy	Non-Renewable Energy
Definition	Energy obtained from source that naturally replenish over short periods	Energy obtained from sources that exist in finite quantities and take millions of years to form.
Enviromental Impact	eco-friendly, minimal GHG emission	high pollution, GHG emissions, environmental degradation.
Sustainability	Sustainable if properly managed	unsustainable, will eventually depleted
Cost	Inital high, Operational low	initial cheaper, extraction high
Availibility	Unlimited or replenished within human time scale	limited, may runout within decades or centuries
Example	Solar, wind, hydro, biomass, geothermal	Coal, Petroleum, Gas (natural).

Wind Energy as a Sustainable Source

Potential:

- wind energy is renewable, abundant, and clean making it major candidate for sustainable electricity generation
- Modern turbines convert kinetic energy from wind into electric without emitting GHG.
- It can be deployed in onshore & offshore locations allowing flexible energy production.

- Technological advances have increased efficiency, reduced costs and enabled large scale wind farms globally.

Advantages.

- Reduce dependency on fossil fuels.
- Minimal environmental footprint once turbines are installed
- Provides employment opportunities in manufacturing, installation and maintenance.

Challenges:

- Wind is not constant; energy storage or grid integration is needed.
- Initial setup costs can be high.
- Possible impacts on wildlife (birds) and local landscape.

(Q NO: 04)

(a)

Explain rock cycle? Differentiate b/w Igenous, sedimentary and Metamorphic rocks with examples

Rock cycle:

The rock cycle is a continous process in which rocks are formed, broken down, and transformed from one type to another over geological time. It illustrates how the threee main rock types - igneous, sedimentary and metamorphic are interrelated.

Stages Of The Rock Cycle

(i) Magma formation: Rocks melt deep in the earth to form magma

(ii) Igneous Rock formation Magma cools and solidifies to form Igneous rocks (granaite, basalt).

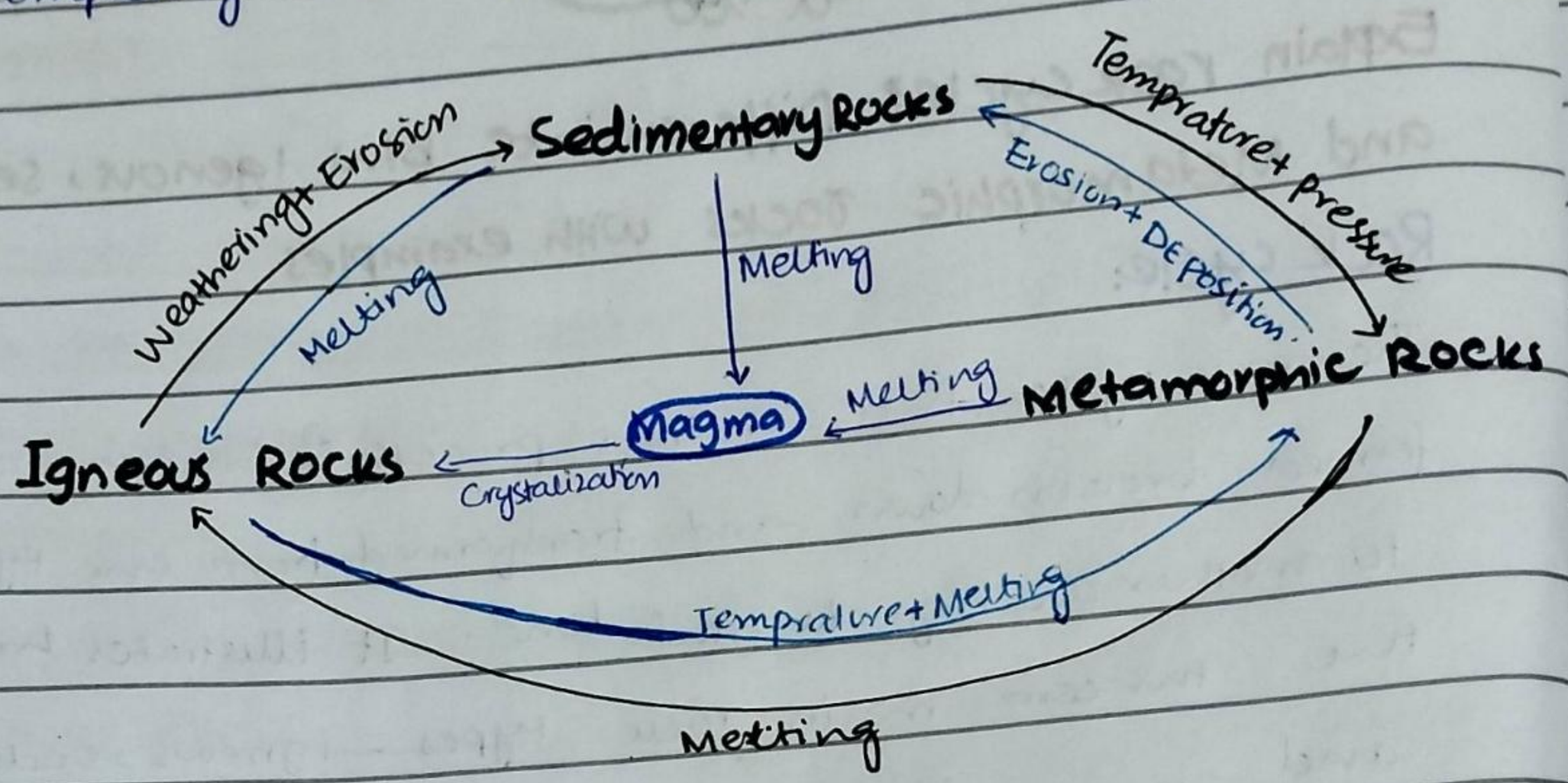
(iii) Weathering and Erosion: Igneous rocks are broken down by wind, water, and ice into sediments.

(iv) Sedimentary Rock formation: Sediments compact and cement over time to form sedimentary rocks (e.g. limestone, Sand Stone

(v) Metamorphism: Igneous or Sedimentary rocks undergo heat and pressure transform into metamorphic rocks.

eg (Marble & Slate.

vi) Melting: Metamorphic rocks can melt into magmas completing the cycle.



ROCK CYCLE

Difference B/w Igneous, Sedimentary, Metamorphic Rocks

FEATURE	IGNEOUS	SEDIMENTARY	METAMORPHIC
Formation	Solidification of magma	Compaction and cementation of sediments	Transformation of existing rocks under heat + pressure
Texture	Crystalline, Coarse or fine	Layered may contain fossils	Foliated (banded) or non-foliated, dense
Origin	Igneous (internal (extrusive)	From pre existing rocks broken down	Igneous or sediment rocks transformed.
occurence	volcanoes, deep crust	Riverbeds, lakes, oceans	Mountain belts, tectonic regions
	Granite, Basalt	sandstone, Limestone	Marble, Slate

(b)

What is acid rain? Discuss the chemical reactions involved in its formation and its harmful effects on aquatic life and vegetation.

Acid Rain

Acid rain is a precipitation (rain, snow, fog or dry particles) that becomes abnormally acidic when Pollutants like SO_2 and NO_x react in the atmosphere to form acids. while the normal rain has a PH of 5.6, acid rain can drop to 4.2 - 4.4 or lower.

Its major sources include industrial emissions, vehicle exhaust, Power plants, and fossil fuels burning.

Chemical Reactions Involved In Formation of Acid Rain

(i) Formation of Sulphuric Acid (H_2SO_4)

SO_2 released from industries, and coal combustion undergoes Oxidation

$$SO_2 + O_2 \longrightarrow SO_3 \longrightarrow SO_3 + H_2O \longrightarrow H_2SO_4 \text{ (sulphuric acid)}$$

(ii) Formation of Nitric Acid (HNO_3)

NO_x from vehicle exhaust and high temprature combustion react with oxygen and water.

1: $2NO + O_2 \longrightarrow 2NO_2$

2: $3NO + H_2O \longrightarrow 2HNO_3 + NO$

Harmful Effects of Acid Rain on Aquatic Life

- Acid rain decreases water PH, making it too acidic for many species to survive.
- Disruption of fish reproduction: eggs fail to hatch at PH below 5.0. Acidic water also damage gills.
- Loss of biodiversity: Sensitive species like trout, salmon and amphibians die first, causing ecosystem imbalance.
- Release of toxic metals: Acidic rain water dissolve Al^{+3} from soil which flows into lakes and becomes toxic to fish

Harmful Effects of Acid Rain on vegetation

- Damage to Leaves: Acid rain destroy the protective waxy layer on leaves, reducing photosynthesis and making Plants vulnerable to diseases.
- Leaching of nutrients: Essential nutrients like Ca^{++}, Mg^{++} and K^{+} are washed away from soil, leading to poor plant growth
- Toxic metal uptake: Acidic soil releases harmful metals like Al^{+3}, which interfere with root function.
- Forest decline: Trees at high altitudes (e.g. Pines, Spruce) are severely affected due to direct exposure to acidic clouds and mist.

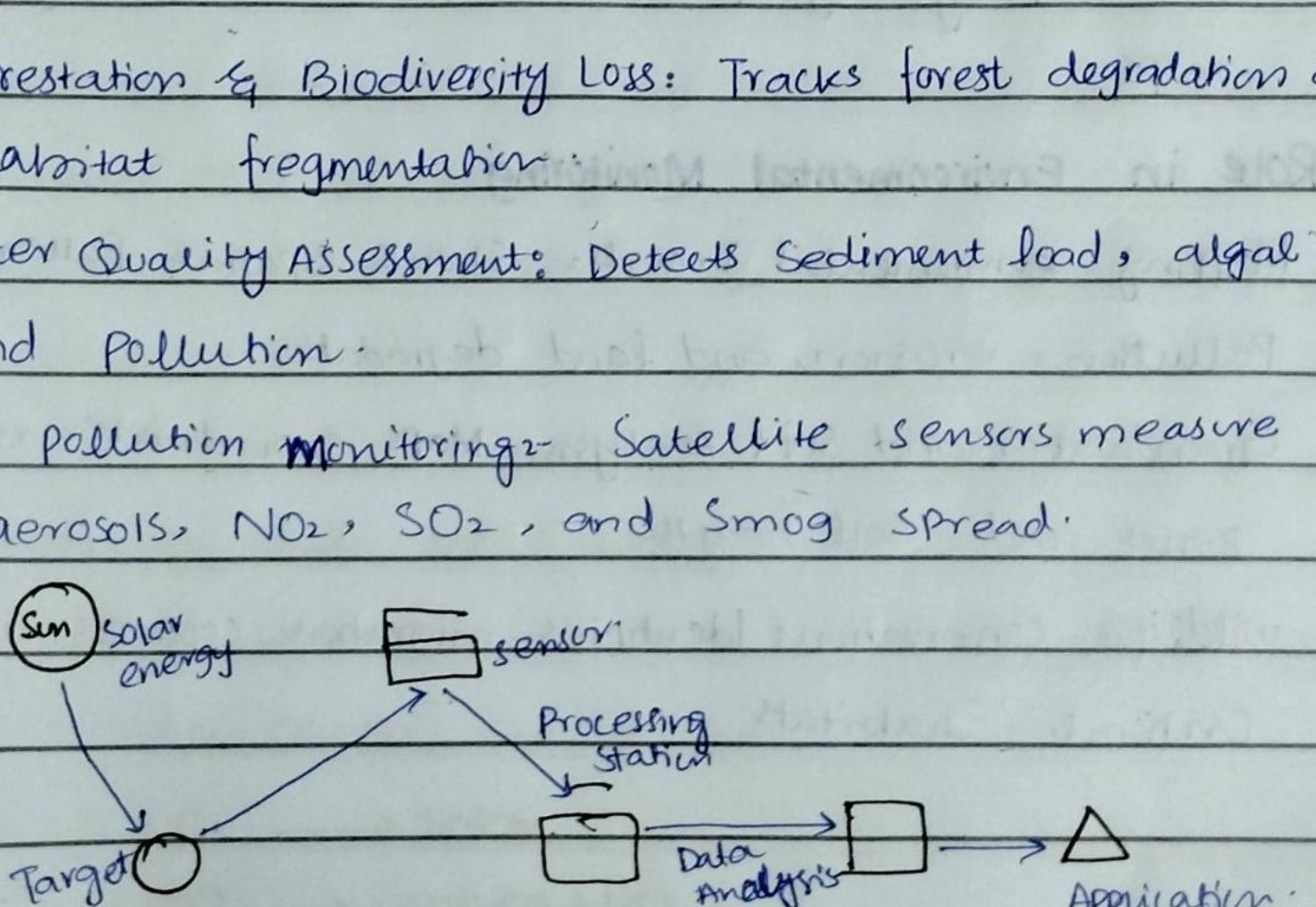
ROLE of Remote Sensing and GIS in environmental monitoring and disaster management

Remote Sensing

Remote sensing involves collecting information about the earth's surface without direct contact, using satellites, drones, and aerial sensors.

Role in Environmental Monitoring

- Land use/ Land cover mapping: Detects changes in forests, agriculture, water bodies, and urban expansion
- Climate and weather observation: Monitors temprature, rainfall, and storms.
- Deforestation & Biodiversity Loss: Tracks forest degradation and habitat fragmentation.
- Water Quality Assessment: Detects sediment load, algal blooms, and pollution.
- Air pollution monitoring:- Satellite sensors measure aerosols, NO_2, SO_2, and smog spread.



Role in Disaster Management

- Early warning systems: Helping predict cyclone, floods, droughts, and forest fires using real-time satellite data
- Damage Assessment: Identifies affected areas after disasters such as floods, earthquakes, landslides, and fires
- Resource Allocation: Helps authorites. Plan rescue routes and distribute aid efficiently.
- Monitoring Disaster progression: Traces flood inundation, wildfire Spread, or lava flow in real time.

Geographic Information Systems (GIS)

GIS is a computer-based tool that Stores, Analyzes, and displays geospatial data in the form of layered maps.

Role in Environmental Monitoring

- Mapping Enviromental Trends: Shows Spatial Patterns of Pollution, erosion, and land degradation.
- Groundwater and Soil Analysis: Maps groundwater recharge zones and Soil health.
- Wildlife conservation: Identifies migration corridors and Critical habitats.