

Date:

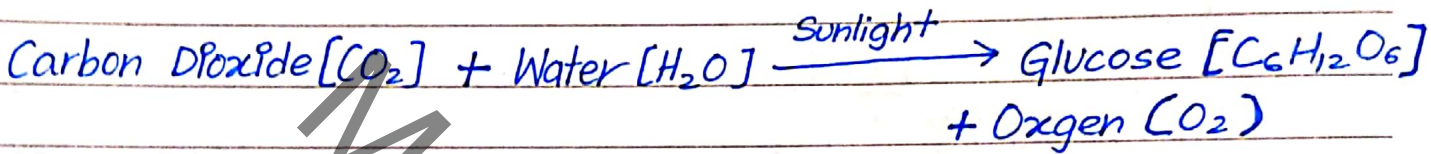
NUTRITION IN PLANTS

Autotrophic

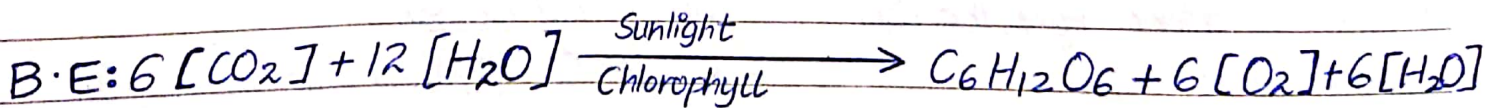
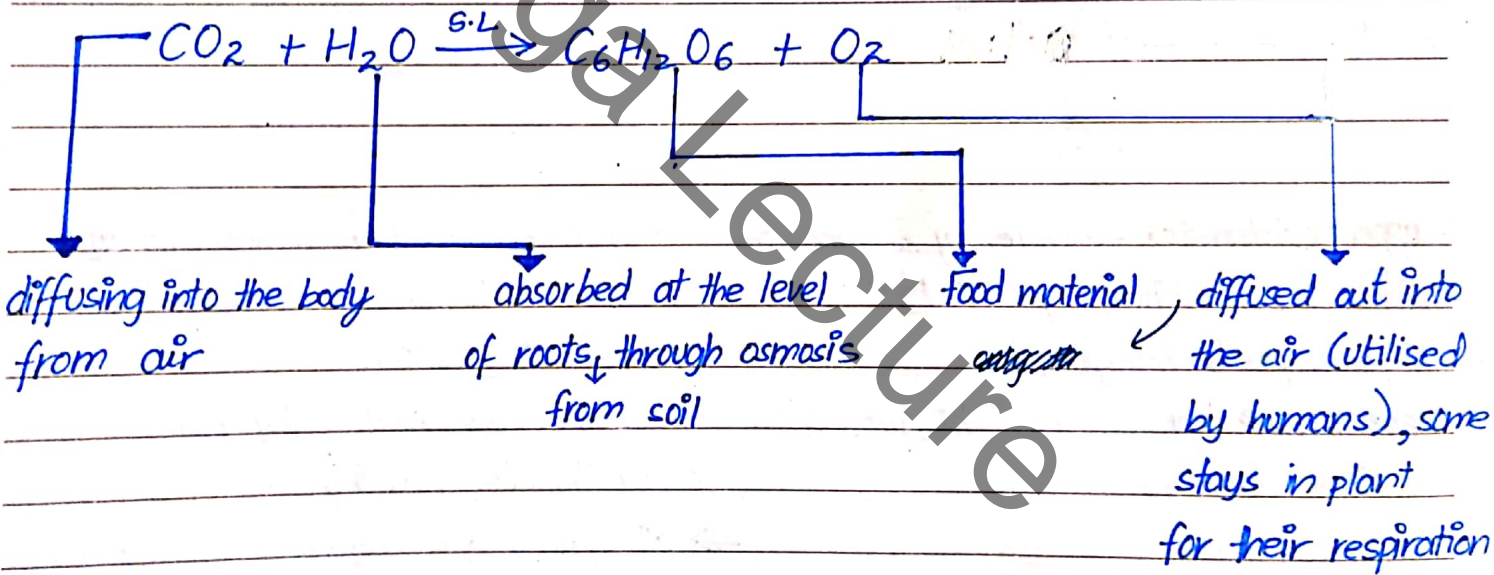
• photosynthesis: production of food using light energy.
↓ ↓
glucose sunlight

→ plants are actually converting light energy into chemical energy stored in bonds of glucose inside the chloroplasts

• energy is always released or converted not produced



→ glucose is product, oxygen is byproduct.



→ parts with no chlorophyll can not absorb sunlight. Ex. roots (white colour)
→ to photosynthesise chlorophyll is compulsory - chlorophyll converts light energy into chemical energy

★ H₂O can only enter from roots.

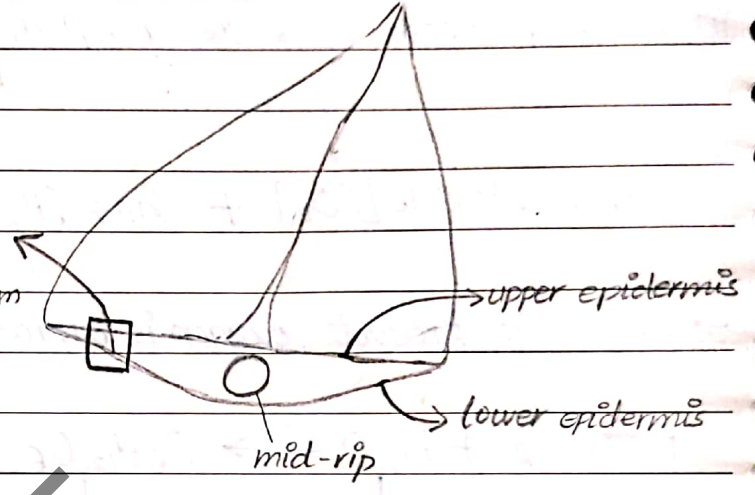
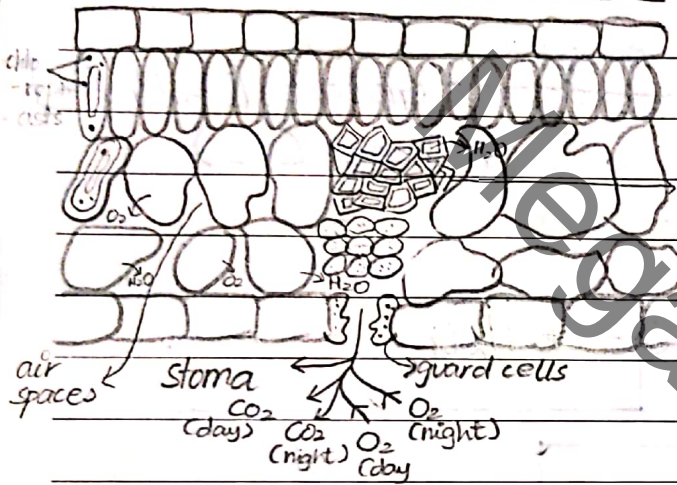
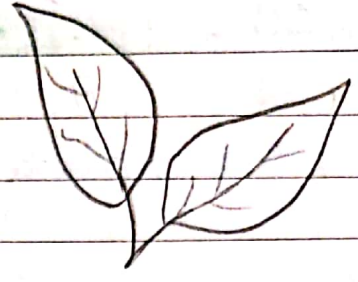
DALMATIAN

- for gas diffusion water is compulsory
- that is why air spaces are important

Date:

LEAVES:

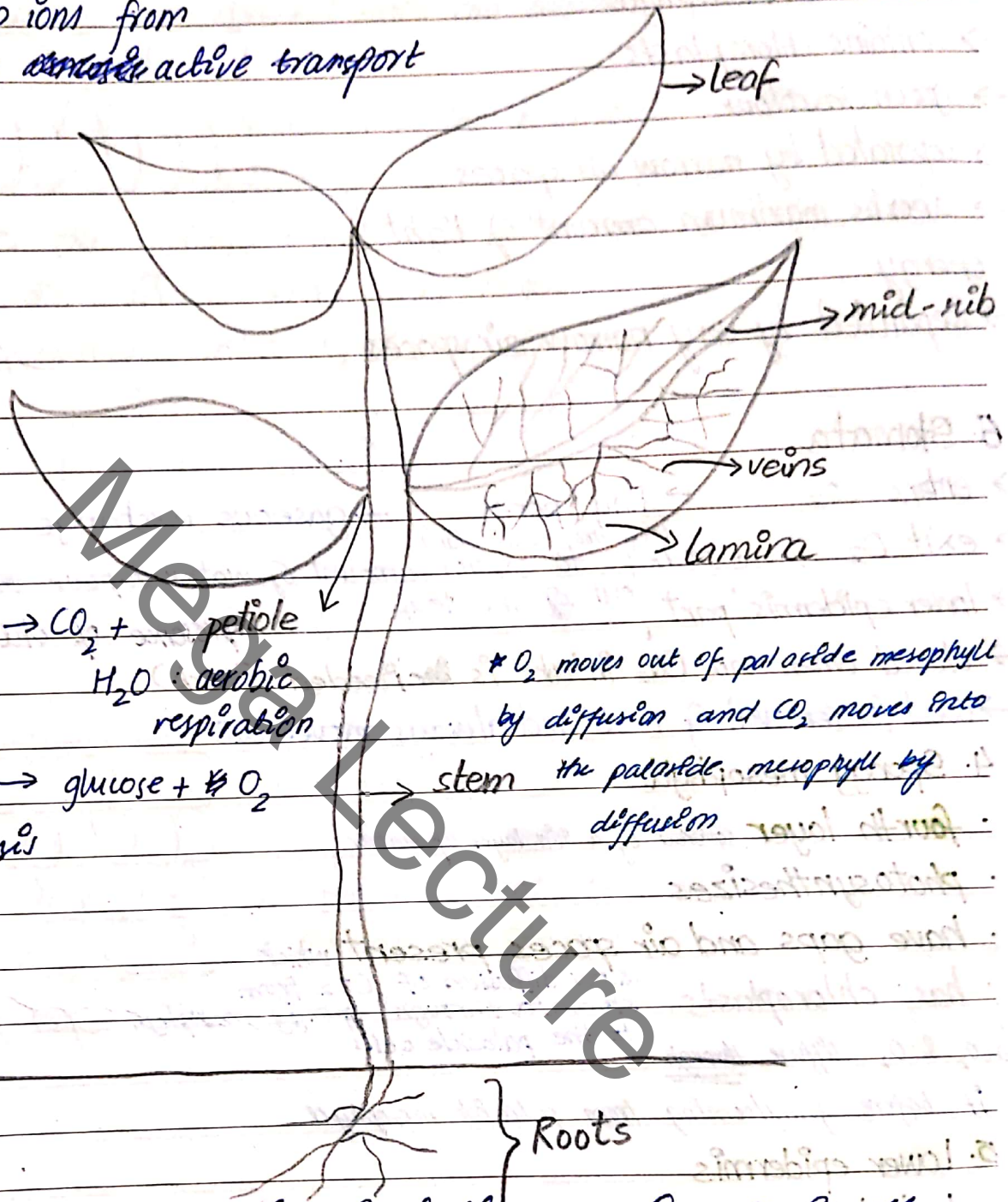
- photosynthesising organs of plants
- lamina's upper side is smooth, shiny and dark green
- lower side has veins bulged, light green, rough, dull
- excretory organ of plants



1. upper epidermis:
 - excretory surface of the plant.
 - single layer without gaps
 - no chloroplasts, transparent
 - ~~transmit~~ transmit the light, protection
 - H_2O produced as a result of Photosynthesis and is termed as Metabolic H_2O .
 - or the excretion by plants
 - (similar to sweating)
 - air spaces are required to accommodate water and oxygen
 - H_2O is diffused out not osmosis because not across a membrane
2. cuticle (wozy)
 - water-proof layer
 - no water can enter or leave the plant from the leaves
 - shiny and smooth lamina
 - upper epidermis → prevents evaporation
 - without gaps → prevents the leaf from drying out

Date:

* plants take up ions from the soil by ~~active~~ active transport



glucose + oxygen \rightarrow CO_2 + H_2O + aerobic respiration

CO_2 + H_2O \rightarrow glucose + O_2
: photosynthesis

* O_2 moves out of palisade mesophyll by diffusion and CO_2 moves into the palisade mesophyll by diffusion

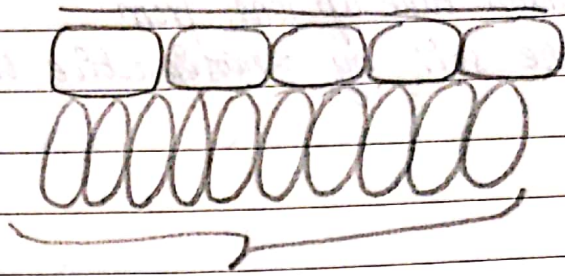
Conditions	Photosynthesis vs Respiration	Overall Result
* Dark	Respiration but no photosynthesis	O_2 taken, CO_2 out
* Dim light	Photo. rate = Resp. rate	Neither in or out
* Bright light	Photo. rate \uparrow = Resp. rate \downarrow	CO_2 taken, O_2 out

DALMATIAN

Date:

3. Palaside Mesophyll

- contains chloroplasts
- green in colour
- separated by narrow air spaces
- absorbs maximum amount of light energy
- separated by very narrow air spaces



Palaside

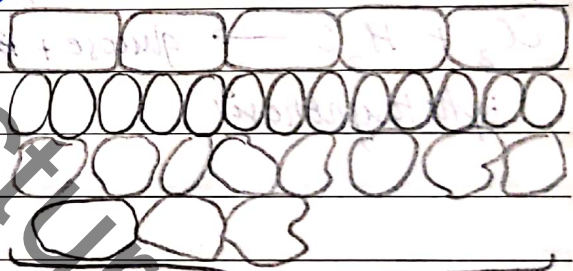
mesophyll

6. Stomata

- enters CO_2 → tiny pores → gaseous exchange
- exit O_2 → ^(regulates transpiration) helps to control amount of water vapour that can pass out of the leaf
- lower epidermis' part → presence of chloroplasts
- closed when no CO_2 intake is needed (Dark)
- Used for removal of H_2O and always moves out

4. Spongy mesophyll

- fourth layer, covered by a thin layer of water
- photosynthesizes
- have gaps and air spaces present which allow diffusion of CO_2 from stomata through spongy mesophyll to the palaside cells
- has chloroplasts



Spongy

mesophyll

CO_2 & O_2 diffuse through it before going/coming from palaside mesophyll

5. Lower epidermis

- last layer
- no chloroplast
- does not perform photosynthesis
- protection

Date:

- * xylem cells have more lignified walls, are columned cells and are also cornered.
- * the metabolic water is released with the metabolic reaction in plants also termed as excretion.
- * the air spaces are always filled with water which maintains concentrations, as the diffusion takes place inside
- * every cell is present in a liquid environment.

- xylem : water, mineral ions (Mg)

- phloem : glucose,

↓
movement through phloem is called translocation

TRANSPIRATION: movement of water evaporations.

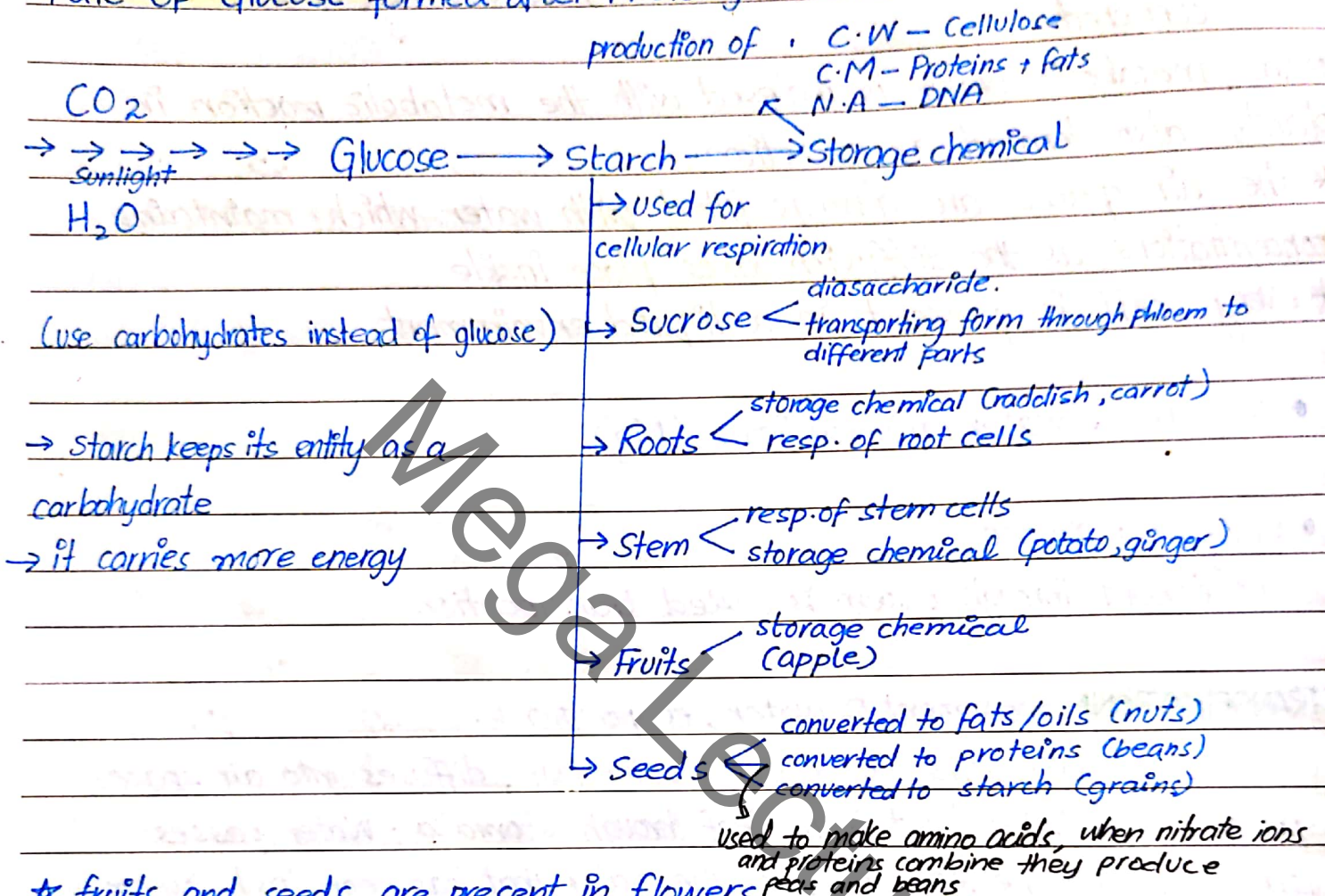
- water evaporates from the cells inside the leaf, diffuses into air spaces (spongy mesophyll) and out of the leaf through stomata. Water passes from xylem into the leaf to replace the water that has been lost. Xylem then gets water from the roots • **Transpiration Stream**
+ rate is higher in warm temperatures, dry conditions, windy weather, light intensity increases

STOMATA:

→ are surrounded by two guard cells. When the light intensity is high for example during the day the guard cells swell and change their shape. This causes it to open and CO_2 can diffuse into the leaf. Under hot conditions, the plant closes its stomata to reduce water loss by transpiration. The plant stops photosynthesizing.

Date:

Fate of Glucose formed after Photosynthesis



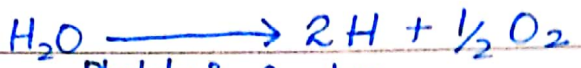
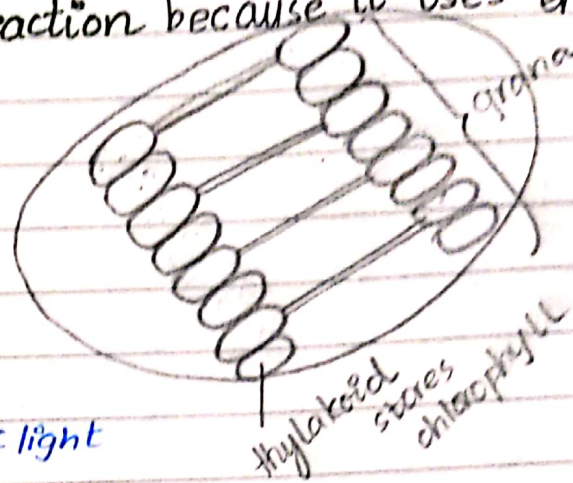
- ★ fruits and seeds are present in flowers
- ★ storage form is for the future use of the plant
- glucose is immediately converted (because it dissolves) so that it does not disturb the contents of cell
- In phloem tissue for glucose test we will find sucrose
- After photosynthesis in the plant body, identification of glucose is not possible so we will test for starch

Date: _____

Photosynthesis: is an endothermic reaction because it uses energy

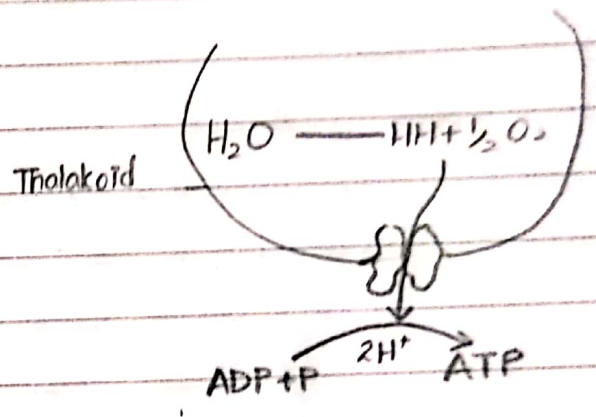
1. **Light Dependant Phase** (Light Reaction)

- sunlight is absorbed by chlorophyll
- light energy → chemical energy



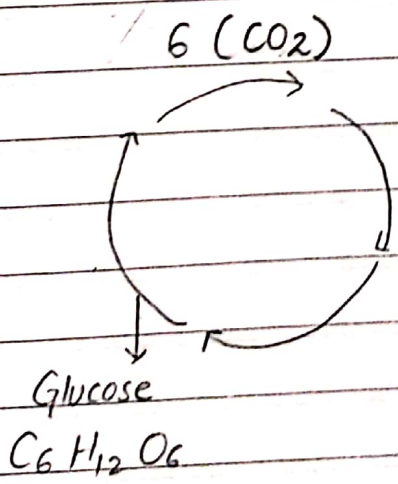
Photolysis of water

breakdown of water in presence of light

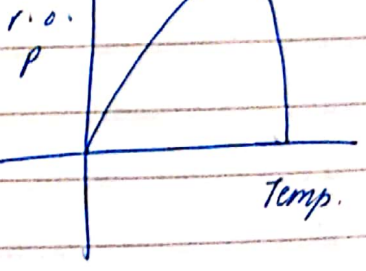
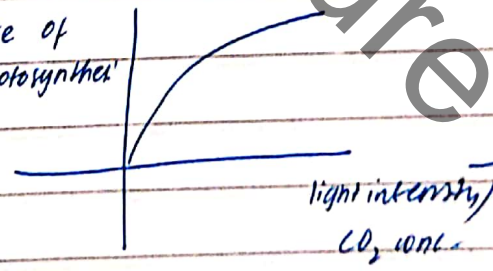


Mega Lecture

2. **Light Independent Phase** (Dark Reaction) (Carbon Fixation) (Calven Cycle)



rate of photosynthesis



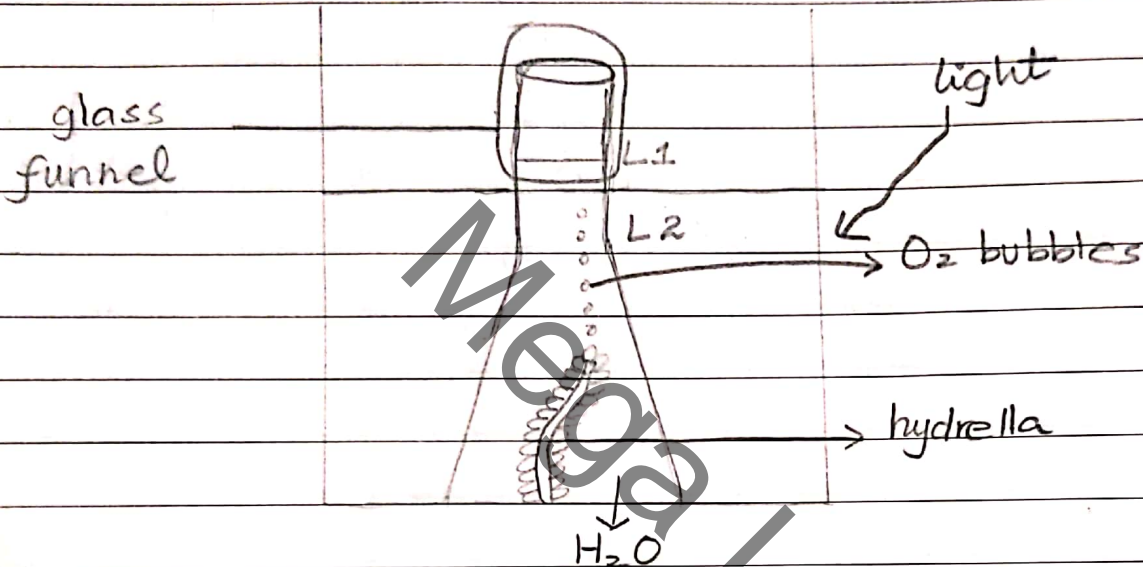
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Date:

→ starch confirms photosynthesis

OXYGEN

• only for aquatic plants



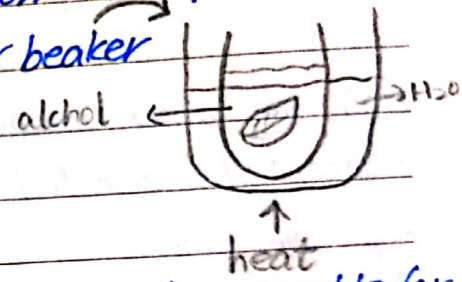
① to check for oxygen, add a burning matchstick which will produce a burning spinter.

Date:

STARCH

(the leaf will become permeable + soft)

- leaf of a potted plant is placed in boiling water for about 2-3 minutes
- place it into alcohol boiling alcohol for next 5-10 minutes } decolourise
- alcohol will dissolve chlorophyll because both are organic
- it will take it out of the leaves and the leaf would become lighter
- * alcohol will turn green during the 5-10 minutes from transparent
- give indirect heat to alcohol in a water bath / water beaker
- alcohol will make the leaf brittle



- dip the leaf for another 2-3 minutes to make it soft and permeable for iodine
- add iodine solution on our leaf
- (appearance of blue black colour on the parts of leaf that performs p.s)

∴ destarch the leaf and place it in dark for minimum 48 hours

STOMATA: (space b/w two guard cells)

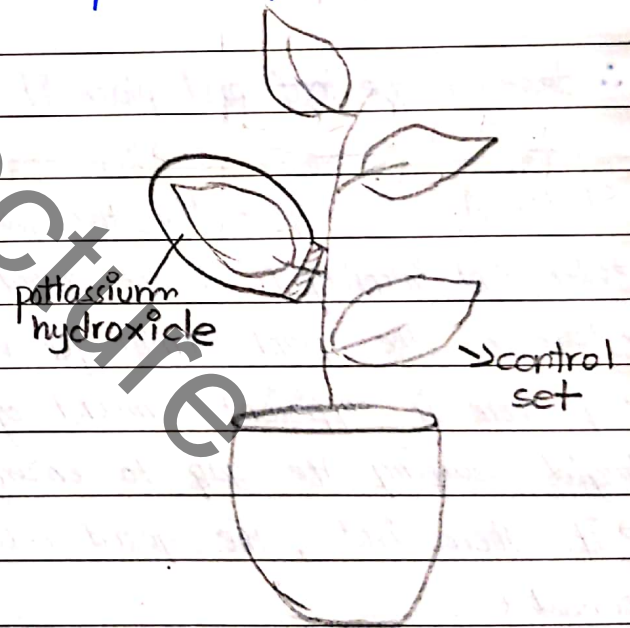
- when light intensity is ↑ the guard cells open to allow CO_2 to diffuse in
- however, the plant worries for water loss
- if there is sufficient amount of water present, the guard cells become turgid causing the gap to enlarge
- if there isn't, the guard cells ~~close~~ become flaccid & close the stomata
- guard cells are also sensitive to light intensity - close at night when photosynthesis isn't taking place

DALMATIAN

Date:

3. CARBON DIOXIDE

- a normal potted plant is destarched.
placing it in dark for 2-3 days
- select a leaf
- place it in a funnel with a cork to make it air-tight
- the funnel has presence of potassium hydroxide
to absorb CO_2
- all the other leaves are provided with light, water } control set
- except the selected one
- do the colour test (on back page) using iodine
- black spots on leaf ~~are~~ that is the control set.
- no blue black spots on leaf with funnel
- tells us that all leaves require CO_2 to produce food.

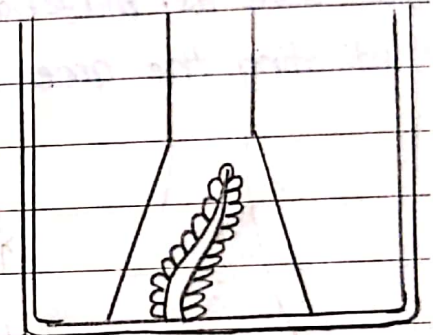
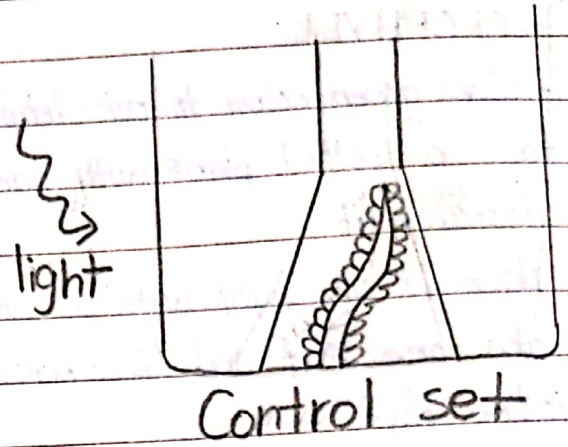



DALMATIAN

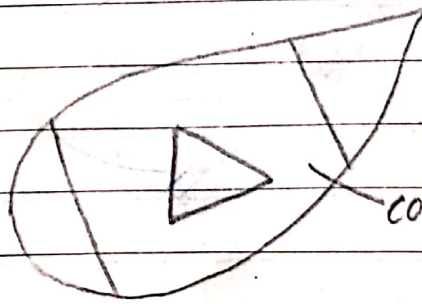
Date:

LIGHT

- oxygen bubbles will be released indicating presence of photosynthesis
- in apparatus 2 no oxygen bubbles will be released



- Potted plant is destarched
- select one leaf
- cover both sides with dark paper with a pattern. 
- decolourize the specific leaf and then iodine test
- specific leaf will give blue black spots only in areas where light is available
- other areas don't
- whole leaf will be covered



- one placed in dark
- one in light

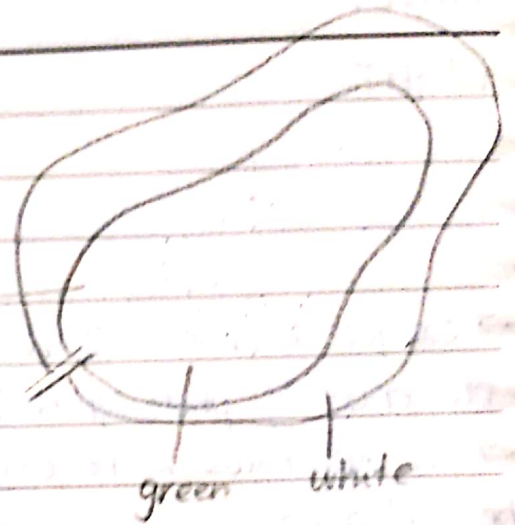
DALMATIAN

Date:

CHLOROPHYLL

- it gives green colour to our leaves
- take a potted plant with variegated leaves
- destarch it
- place it in light with all conditions
- take one leaf and decolourize
- iodine test
- the part of the leaf which was originally green will give us blue/black colour
- indicating the green part conducts the photosynthesis only

blue
black
spots



Variegated leaf

Date: _____

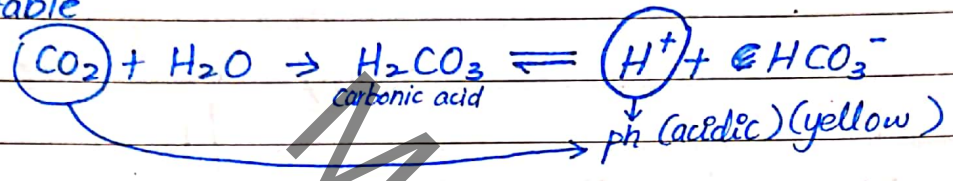
CARBON DIOXIDE & OXYGEN

→ Indicator: Hydrogen Carbonate (Red) (Ph 7) (neutral)

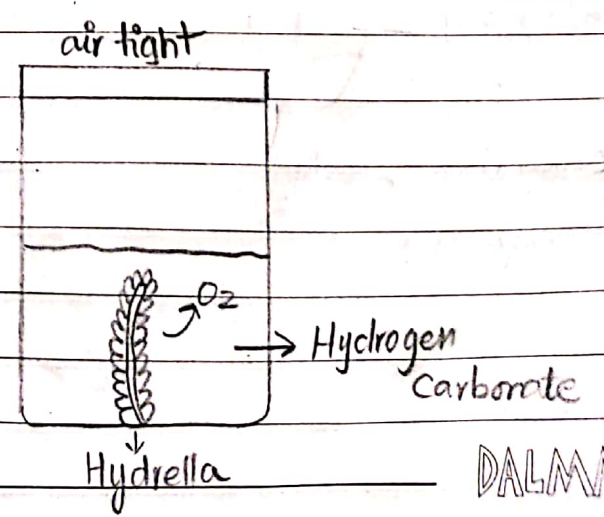
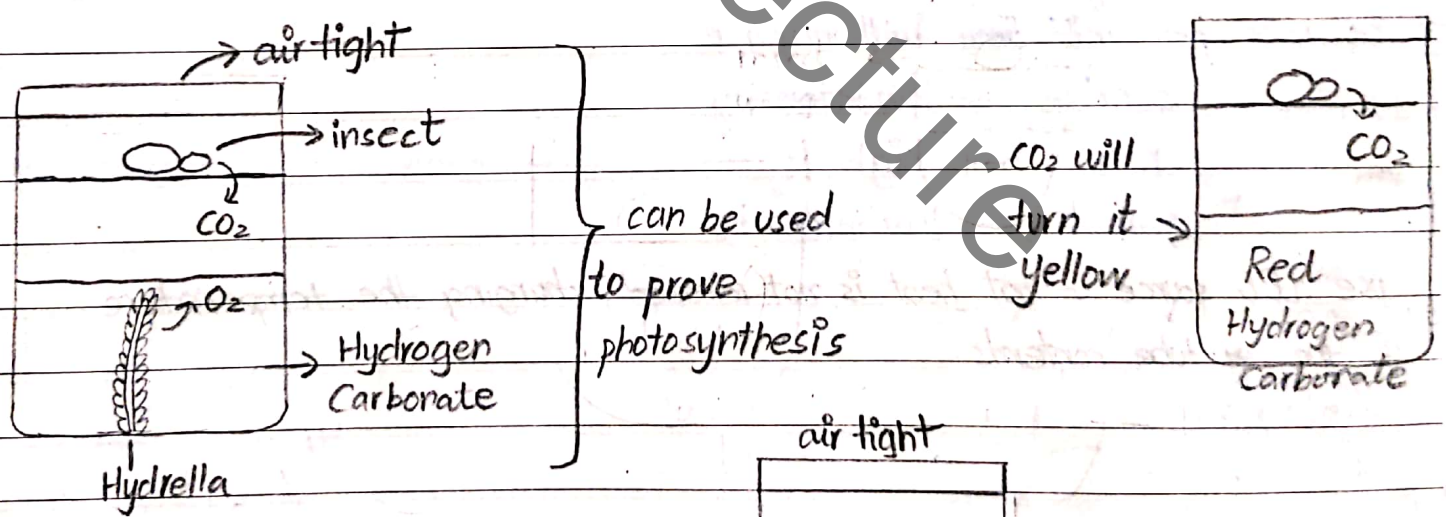
↓
declines to acidic conditions 1-3 (Yellow)

↓
when becomes basic 8-11 (Purple)

* CO₂ whenever is present with H₂O immediately converts to an unstable



* O₂ produces Alkaline Oxides
↓
Basic conditions



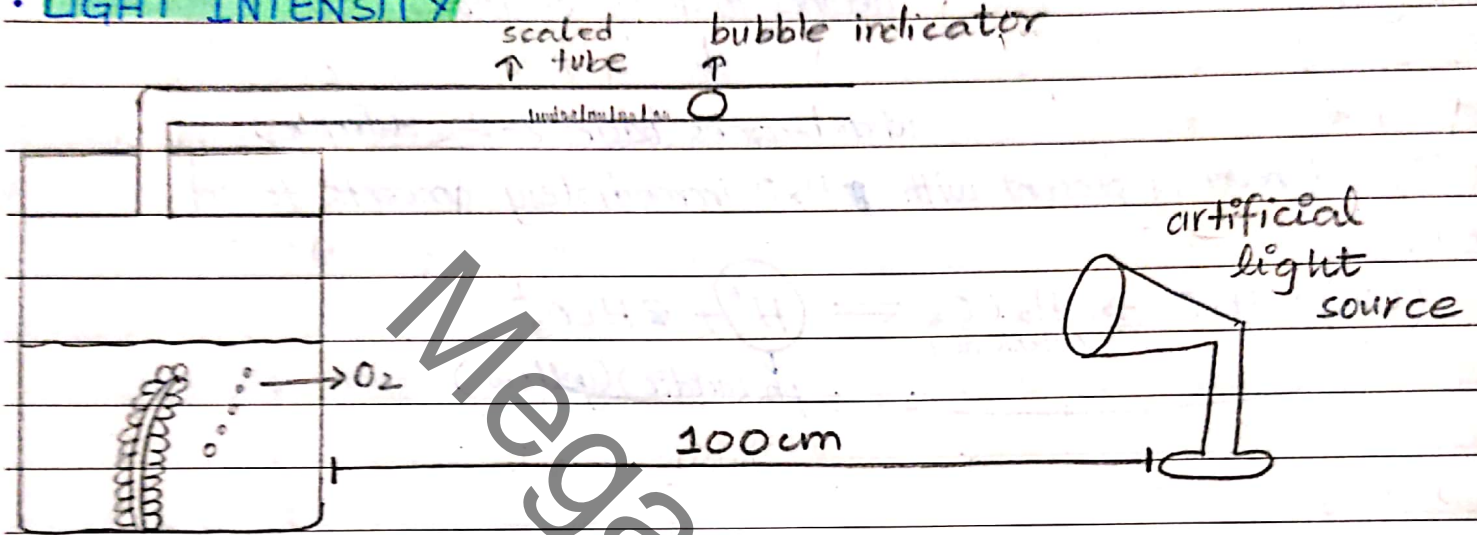
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Date:

FACTORS AFFECTING PHOTOSYNTHESIS

→ quantity affects photosynthesis

LIGHT INTENSITY



→ the bubble indicator will move right when O_2 is produced

→ move the lamp closer

→ the light intensity increases as the distance becomes less

→ the rate per unit time will increase

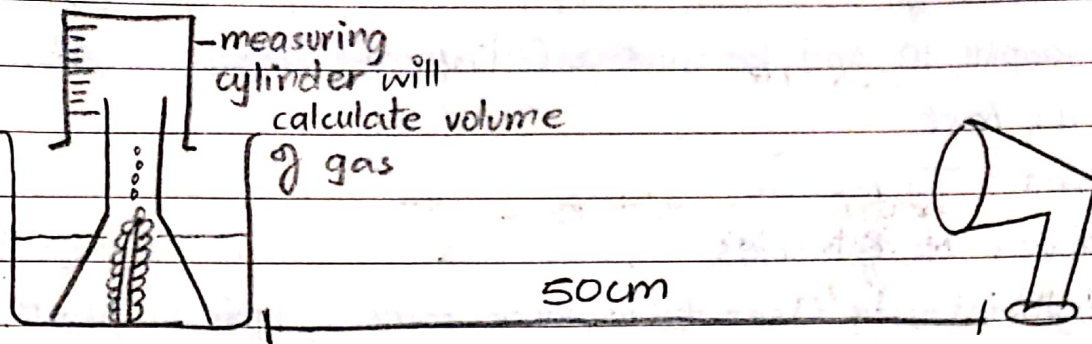
sunrise — low intensity

noon — high

sunset — low intensity

use LED source so that heat is not released, changing the temperature of the test tube contents.

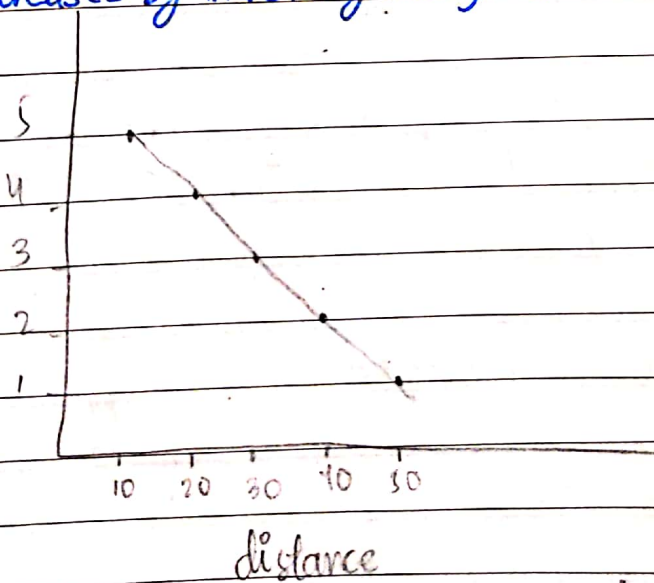
Date:



- allow sometime to the plant to
- count no. of bubbles (O_2) per 5 minutes
- move the lamp closer to the apparatus

Distance (independent)	Oxygen bubbles/min	Rate per minute
50	5	1
40	10	2
30	15	3
20	20	4
10	25	5

rate increases by increasing the light intensity



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Date:

TEMPERATURE

→ take temperature above 10 and below 50 (فوق 10 و تحت 50) (photosynthesis) (البناء الضوئي)

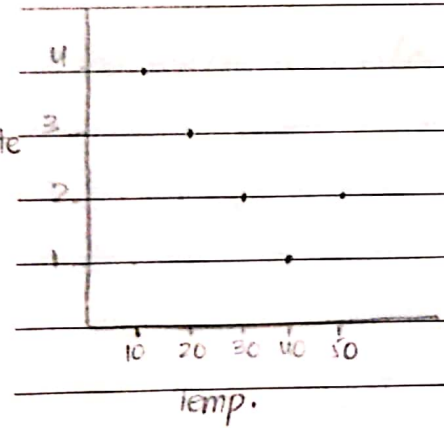
→ same apparatus as last

* Independent variable: Temperature

* Dependent variable: No. of bubbles

* Constant variable: light intensity (keep the distance same), type of plant

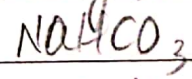
Temperature	No. of bubbles/min	Rate per minute
40	5	1
30	10	2
20	15	3
10	20	4



Hence, the metabolic reaction

* the enzymes will work fast upto 40° and then denature.

effect of different CO₂ concentrations on the rate of photosynthesis



Sodium Hydrogen Carbonate

vary the concentration in air - 0.3% of air

Date:

* Photosynthesis is a chemical reaction controlled by limiting factors:
temperature, light intensity ~~energy~~, CO_2 , Chlorophyll

MINERALS:

• **Magnesium** is must for plants because it is used to make chlorophyll. (Mg)
→ lack gives us less chlorophyll, yellowish appearance of our leaves — chlorosis

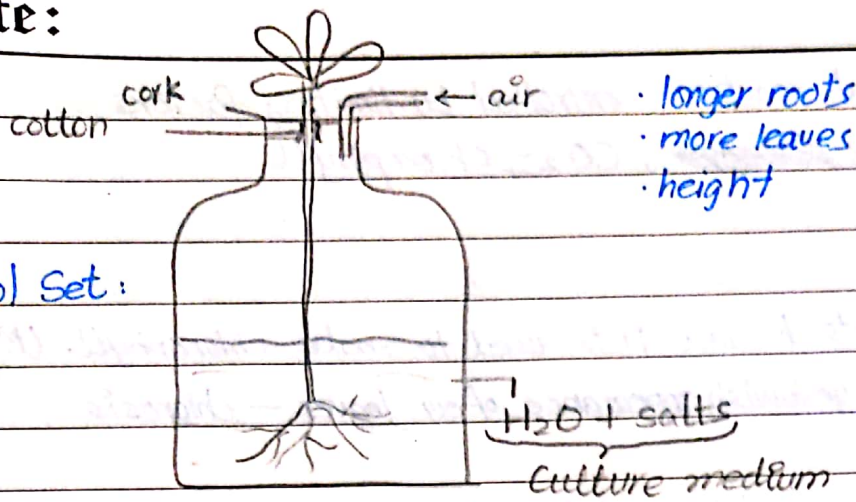
• **Nitrogen** is part of amino acids — proteins and is used for growth. From the soil plants use it as nitrates or nitrites ($\text{NO}_3^- + \text{NO}_2^-$)
→ lack will result in retarded growth

• **Phosphorus** is used as phosphate in the soil by plant. Important component of DNA and ATP. (PO_4^-)
→ lack will result in retarded growth of roots, purplish colour of the leaves

• **Potassium** is used for proper development of flowers
→ lack will give us less flowers and less rate of reproduction

- can only be absorbed by roots by a process known as active transport at the level of root hair cells
- are only present in form of salts

Date:



Control Set:

- (they absorb it)
- no microorganisms in culture medium hence we use airtight seal
 - roots should be submerged into water
 - between cork piece of cotton wool is placed for safety of root stems.
 - every one time skip one salt (for next apparatus)

★ known as culture method

Q. (pg. 35 Q#5 & 6)

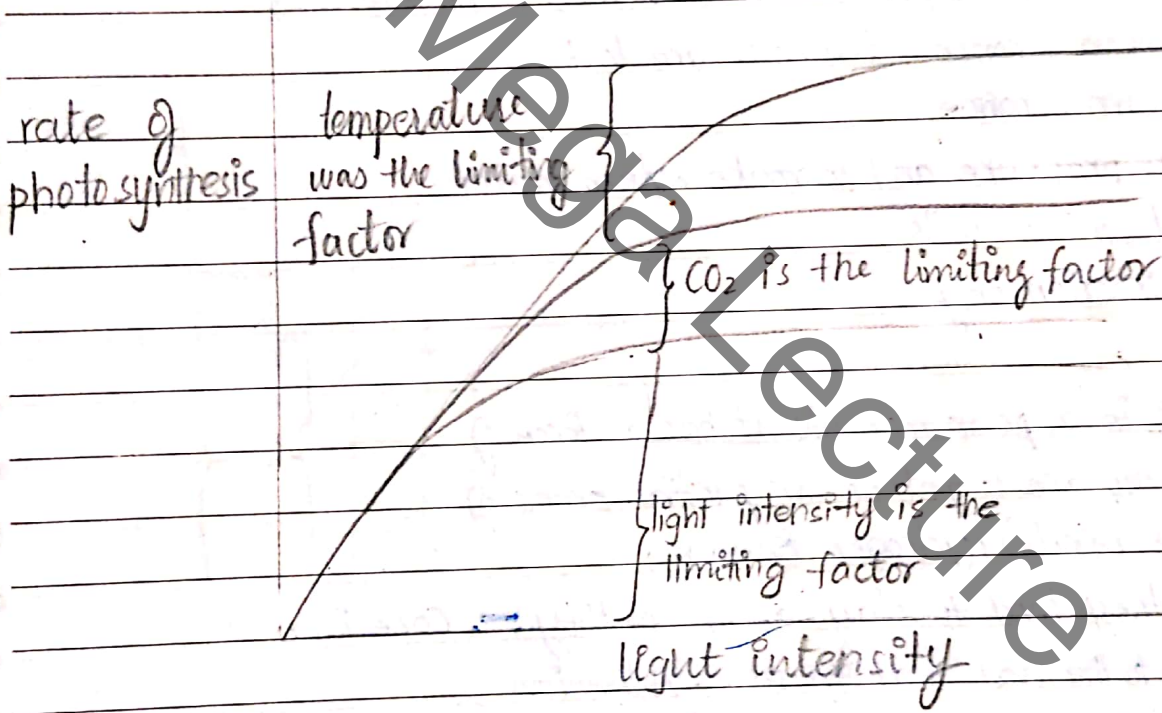
Q6. 2 leaves A & B had been put in different conditions in an experiment for photosynthesis. a disk from each test is cut. the disks were kept in boiling water for 2 min for starch test.

- Procedure for starch test and describe. Find stages as dishes A will be stained black and B will be brown. Describe your results.

Date:

LIMITING FACTORS

- The factor that limits the reaction rate in any physiological process governed by many variables.



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