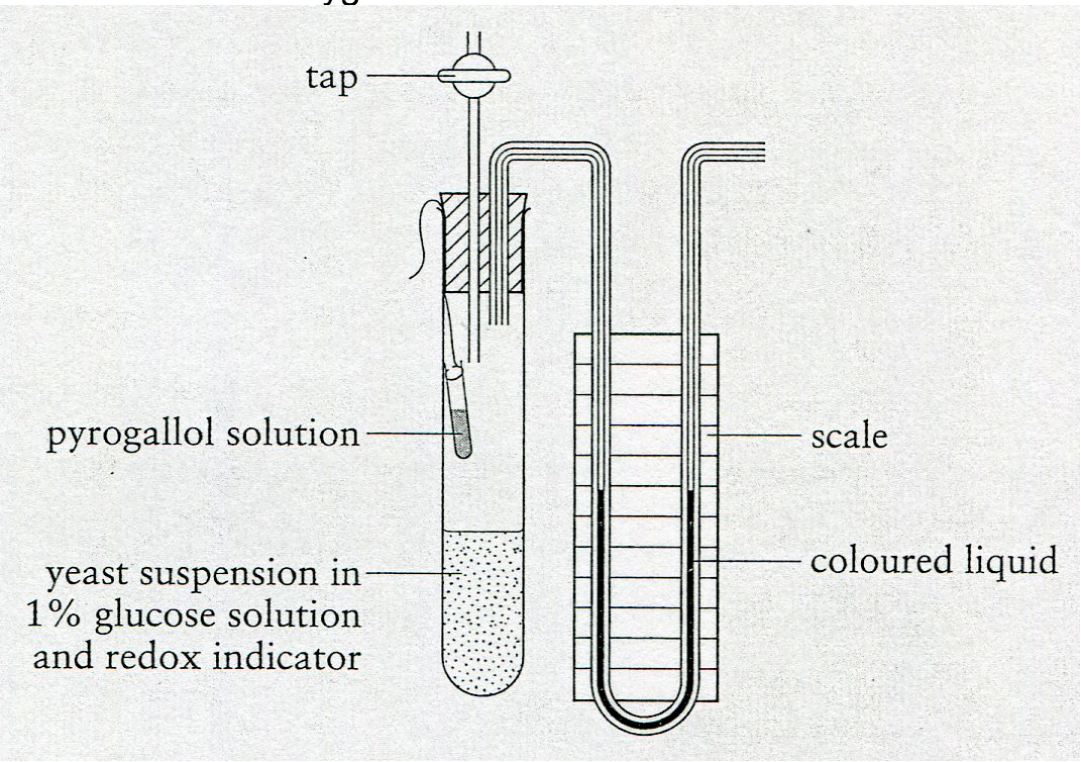
1. The diagram below shows apparatus that can be used to measure the rate of anaerobic respiration in yeast cells. The tube contains a yeast suspension in 1% glucose solution and a redox indicator. The pyrogallol solution absorbs oxygen.

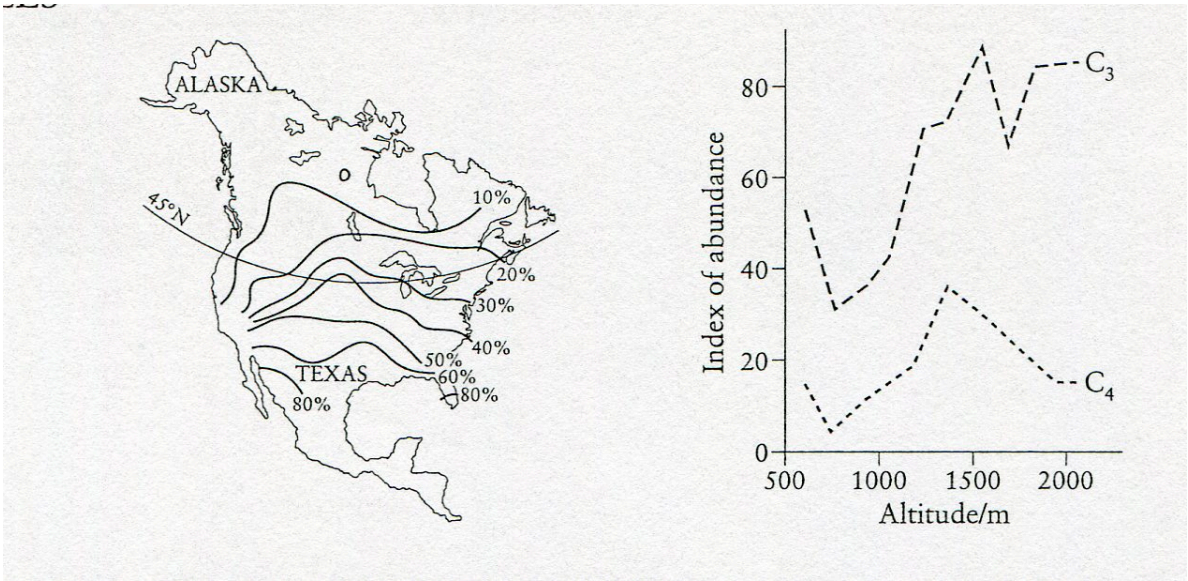


(a) (i) Name one suitable redox indicator which could be used in this experiment.

(ii) Give one change you would expect to observe during the experiment as the yeast respires and give a reason for your answer.

(b) Describe how you could use the apparatus to investigate the effect of temperature on anaerobic respiration of glucose by yeast.

2. The map below shows the distribution of grasses using the C4 mechanism in different parts of North America. Each line shows the percentage of C4 grasses compared with the total number of grasses in the region.



(a) Suggest a reason for the distribution of C4 grasses in the figure below.

The graph below shows the distribution of C3 and C4 plants at different altitudes in Texas.

(b) (i) Examine the graph and find the approximate optimum altitude in meters for each type of plant.

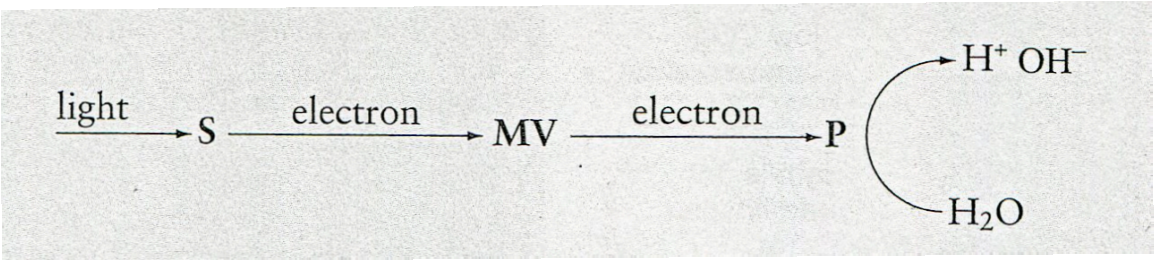
(ii) Suggest reasons for the trends in distribution of each type of plant.

3. If you keep a C3 plant and a C4 plant of comparable size in an air-tight glass container with water and provide them with adequate sun light, you would expect the C4 plant to:

a. grow better than the C3 plant after one year in that condition;
b. grow slower than the C3 plant after one year in that condition;
c. be able to survive longer than the C3 plant, but ultimately die;
d. be able to survive not as long as the C3 plant.

These plants continue to live for decades if the initial conditions were favorable. Argue for or against.

4. In one approach to harnessing the Sun's energy, chemists mimic the photosynthetic process. A sensitizer(*S*) absorbs a photon of light and becomes excited. An electron passes from the excited sensitizer to and 'electron relay', methyl viologen (*MV)* This passes on an electron to a colloidal platinum catalyst(*P*). Here water is split to produce hydrogen and hydroxyl ions.

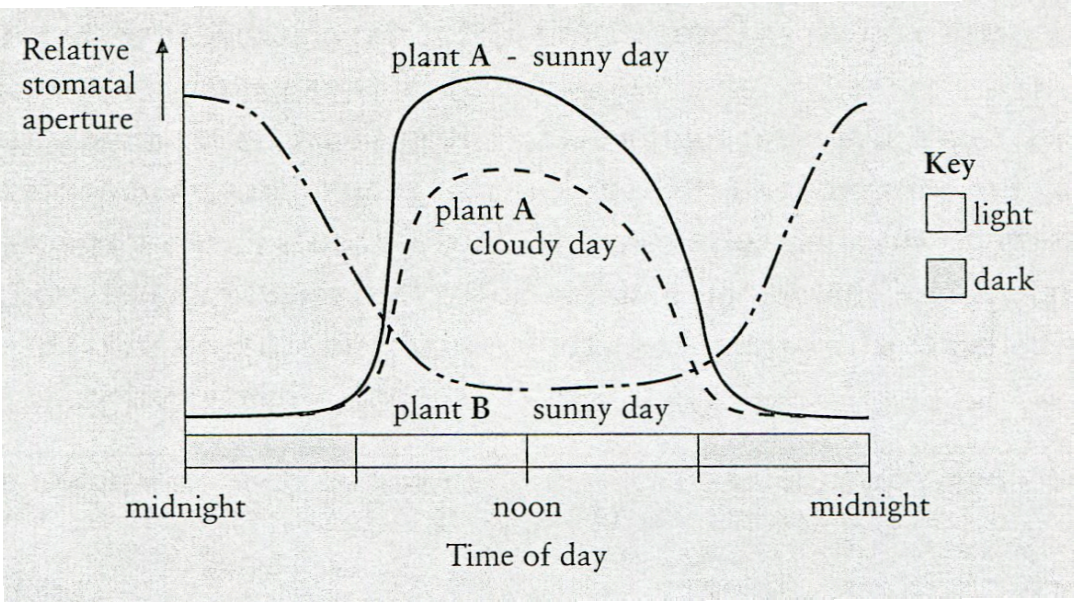


(a) A State three ways in which this chemical system resembles a photosynthesis.

Methyl viologen(MV) is better known as the weedkiller, paraquat.

(b) Suggest how paraquat acts as a weedkiller.

5. The diagram shows the stomatal aperture changes in two plants, **A** and **B** in different conditions.



(a) Stomata open when guard cells absorb water because of a change in the water potential of their cell contents

Give **one** explanation for the mechanism that results in

(i) a change in water potential of the guard cells in plant **A** between 06.00 and noon.

(ii) the stomata of plant **A** not opening as widely on the cloudy day as on the sunny.

(b) Plant **B** is a succulent plant that lives in dry conditions.

(i) Give **one** advantage to plant **B** of the different behavior of its stomata.

(ii) Give one disadvantage to plant **B** of the different behavior of its stomata

6. Living cells contain the enzyme catalase, which catalyzes the breakdown of hydrogen peroxide to water:

$$2H_2O_2 \xrightarrow{\text{Catalase}} 2H_2O_2 + O_2$$

An experiment was carried out the investigate the effects of enzyme concentration and substrate concentration on rate of reaction. Some cabbage leaves were ground up with distilled water the resulting liquid was filtered to produce ‘cabbage extract’, and the residue on the filter paper discarded.

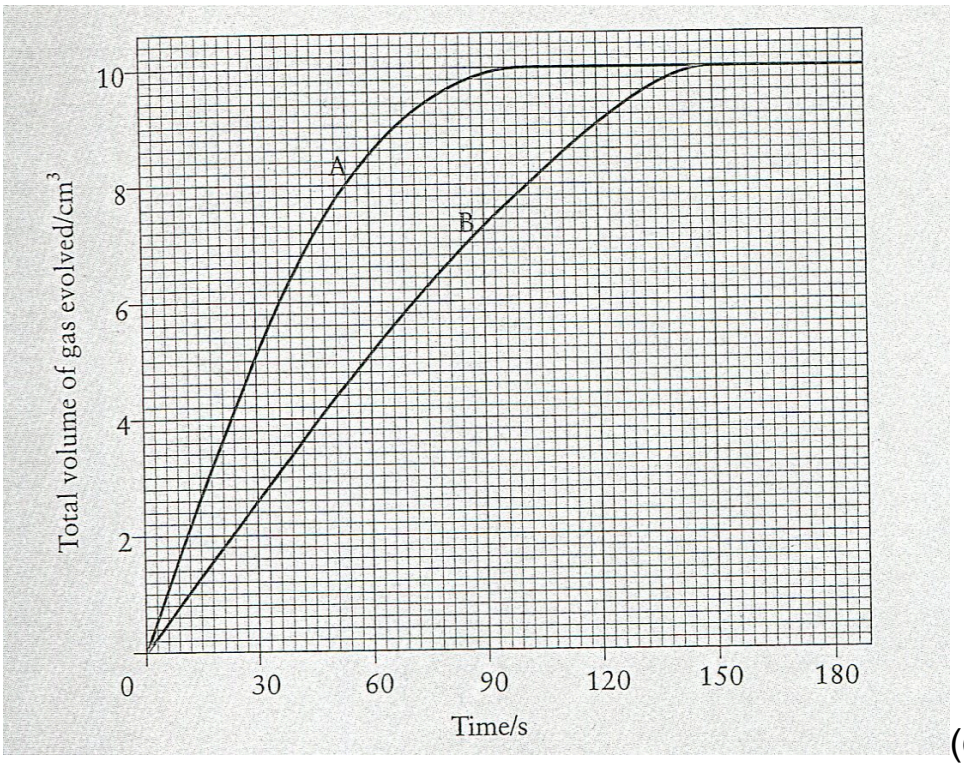
(a) Suggest why the processes of grinding the cabbage leaves with water, and filtration were carried out.

Cabbage extract was then added to hydrogen peroxide solution. This was don’t three times using the following quantities.

Experiment	Volume of cabbage extract/ cm^3	Volume of hydrogen peroxide/cm^3	Volume of distilled water/cm^3
A	5	5	0
B	2	5	3
C	5	2	3

(b) Explain why water was added to experiments **B** and **C**.

The volume of gas evolved was recorded over time for each experiment. The results for experiments A and B are shown in the graph below.



(c.)

(i) Explain the shape of the curve obtained for experiment A.

(ii) copy the graph and calculate the rate of reaction in the first 15 second for experiments A and B show your working.

(iii) Explain why this initial rate is different in the experiments A and B.

(iv) Explain why the total volume of gas released from 150 seconds onwards is the same in both experiments.

(v) On your copy of the graph, sketch the curve you would expect to obtain or the experiment C.

(d.)

A chemical X is thought to be a competitive inhibitor of catalase.

Suggest you could investigate this hypothesis.

7. The enzyme phenol oxidase is often released when plant cells are disrupted and leads to the oxidation of colorless phenols into colored products. Samples of an extract containing phenol oxidase were subjected to various treatments, then mixed with a solution of phenols buffered at pH7 and incubated at 35 degrees C for 10 minutes. The pre-treatment and results are shown in the table below.

TUBE	Pre-Treatment of enzyme extract	Color of extract after incubation with phenol
A	none	intense brown
B	incubated with protease for 10 minutes	colorless
C	mixed with trichloroacetic acid	colorless
D	mixed with mercuric chloride for 5 minutes	very light yellow

(a) Assuming these experiments were all appropriately standardized, what do you conclude from the results of each experiment?

(b) How would you have discovered

(i) if any non-enzymatic oxidation of phenols occurs in tube A?

(ii) if enzymatic oxidation of phenols occurs in tube D?

In some further experiments, samples of the enzyme extract were mixed with different substrate concentrations, with or without the presence of a standard amount of chemical, PTU (phenylthiourea). The results are shown in the table below.

Concentration of substrate/mmol dm^{-3}	Initial rate with PTU present/units	Initial rate without PTU present/units
0.5	2.4	4.2
1.0	4.1	6.3
1.5	5.1	7.1
2.0	5.5	7.6
2.5	5.5	7.6

(c) Plot these result

(d) Phenylthiourea (PTU) bind to copper atoms.

(i) Suggest a hypothesis which might reasonably explain how PTU inhibits the action of phenol oxides

(ii) Explain how, from the information provided, it is possible to determine that the inhibition caused by PTU is non-competitive rather than competitive