Progress Check

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1. **What are the three important aspects about the overall chemical equation of respiration, pertaining to the following?**
   (i) Single or several steps
   (ii) Direct or enzyme-catalysed
   (iii) Forms of energy liberated

   Solution:

   Listed below are three important aspects:

   (i) The breakdown of glucose to water and carbon dioxide does not take place in a single step, but a series of chemical steps, which occur in two phases:
   - Glycolysis(cytoplasm)
   - Kreb's cycle(mitochondria)

   (ii) Every breakdown step if due to a particular enzyme.

   (iii) The energy that is liberated in the disintegration of the glucose molecule is not all in the form of heat but a large part of its converted into chemical energy in the form of ATP(adenosine triphosphate)

2. **List three ways in which respiration is different from burning.**

   Solution:

   The three differences are as follows:
   - Burning is a single step as opposed to respiration wherein a series of chemical steps take place.
   - Burning is carried out by heat whereas respiration is carried out by enzymes.
   - Burning is a physico-chemical process whereas respiration is a biochemical process.

3. **Name the three inlets of oxygen for respiration in plants.**

   Solution:

   Oxygen can be obtained from the atmosphere through three inlets:
   - Lenticels in stem
   - Stomata in leaves
   - General surface of the roots

Progress Check

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1. **Give the overall chemical equation for the two kinds of respiration in plants:**
   (i) Aerobic (ii) Anaerobic

   Solution:

   (i) The chemical equation for aerobic respiration is:

   $$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + 38\ ATP$$
   (energy/heat)

   (ii) The chemical equation for anaerobic respiration is:

   $$C_6H_{12}O_6 \longrightarrow 2\ C_2H_5OH + 2CO_2 + 2\ ATP$$
   Glucose Ethanol

2. **Mention any one difference other than those reflected in the two chemical equations given above.**

   Solution:

   One difference between aerobic and anaerobic respiration is that aerobic respiration takes place in the presence of oxygen whereas anaerobic can proceed without the use of oxygen.

3. **Certain organisms respire only anaerobically throughout their lives. Name any two such organisms.**

   Solution:

   Entities that respire anaerobically are as follows:

   - Some bacteria
   - Fungi
   - Germinating seeds(in lack of air)

Progress Check

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1. **In experiments on respiration, the seeds taken as control are boiled. Why?**

   Solution:

   The seeds are boiled with an antiseptic to avoid bacterial decay.

2. **What is the use of the following in the experiments on respiration?**

   (i) Soda lime (ii) Limewater

   Solution:

   (i) Soda Lime – To absorb any carbon dioxide released by the seeds

   (ii) Limewater – Change in the color of limewater to milky water indicates the presence of carbon dioxide, and its source being germinating seeds only.

3. **Suppose we conduct an experiment to demonstrate respiration in a green plant. What special precaution is required to be taken in it?**

   Solution:

   The following precaution can be considered:

   - Plant should be covered or kept in dark as the photosynthetic rate is higher in normal light than respiration. Hence the carbon dioxide that is generated by respiration would be used up by photosynthesis making it difficult to detect carbon dioxide. This is why photosynthesis is required to be stopped hence plants are kept in darkness.

4. **In experiment No.5 we are using mercury in the test-tube and the beaker. Why can't we use water instead?**

   Solution:

   Mercury is used instead of water because of the following properties of mercury, namely:

   - Mercury is a good conductor of heat and is the only metal that occurs in liquid state
   - It sticks to the capillary walls and provides accurate results
   - They can easily be obtained in its pure state
   - It has a low specific heat.

Progress Check

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1. **Fill in the blanks.**
   In anaerobic respiration in plants, the end product is _____ and _____ instead of lactic _____ in animals.
   Solution:
   Ethanol, ethyl alcohol, acid.

2. **The table below is intended to give certain differences between photosynthesis and respiration, but a few points are given wrongly. Strike out the wrong ones and write the correct words instead.**

	Photosynthesis		Respiration
(i)	Results in loss in weight	-	Results in gain in weight
(ii)	Sucrose is the product	-	Sucrose is broken down
(iii)	Occurs in green cells only	-	Occurs in all cells
(iv)	Uses water and oxygen	-	Uses glucose and oxygen

Solution:
The wrongly given differences are:
(i) Results in loss in weight - Results in gain in weight
Photosynthesis results in weight gain and respiration results in weight loss
(iv) Uses water and oxygen - Uses glucose and oxygen
Photosynthesis uses carbon dioxide and water, respiration uses oxygen and glucose.

Review Questions

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A. Multiple Choice Type

1. Glycolysis is a process
(a) In which glycogen is broken down into glucose
(b) Which occurs in mitochondria
(c) In which glucose is broken down into pyruvate
(d) That occurs next to Krebs cycle.
Solution:
(c) In which glucose is broken down into pyruvate
Glycolysis occurs in the cytoplasm.

2. One same common function is performed by?
(a) Stomata and veins
(b) Stomata and lenticels
(c) Lenticels and sepals
(d) Lenticels and hydathodes
Solution:
(b) Stomata and lenticels
Oxygen is obtained from the atmosphere through three inlets, two of which are stomata and lenticels.

3. Anaerobic respiration normally occurs in
(a) Grass
(b) Cactus
(c) Coconut
(d) Baker's yeast
Solution:
(d) Baker's yeast
Anaerobic respiration can be carried out in the absence of oxygen.

B. Very Short Answer Type

1. Do the plants respire all day and all night or only at night? _____
Solution:
Plants are living entities performing all the living characteristics, one of which is respiration. Hence to survive, plants like us respire all day and night.

2. Name the following:
(a) Energy currency of cell.
(b) Oxidative breakdown of carbohydrates to release energy.
(c) An organism which respires throughout life anaerobically.
(d) A common phase in both aerobic and anaerobic respiration.
(e) Aerobic respiration requires _____

(f) A chemical which removes CO_2 from the air.

Solution:

(a) ATP(adenosine triphosphate)
(b) Respiration
(c) Fungus
(d) Glycolysis
(e) Oxygen
(f) Soda lime

3. Mention if the following statements are true or false. If false, rewrite them correctly.

(a) Aerobic respiration of one mole of glucose yields 138 ATP T/F
(b) Anaerobic respiration in plants yields lactic acid T/F
(c) Carbon dioxide readily dissolves in lime water T/F
(d) All leaves of a green plant normally respire anaerobically at night. T/F

Solution:

(a) The statement is false. One mole of glucose in aerobic respiration yields 38 ATP.
(b) The statement is false. Anaerobic respiration in plants yields ethanol.
(c) The statement is true.
(d) The statement is false. All leaves of a green plant normally respire aerobically at night.

C. Short Answer Type

1. What happens to the energy liberated in respiration?

Solution:

The energy liberated in the process of respiration is stored in the cells in the form of ATP. Some other part of it is lost in the form of heat to the ambient surroundings.

2. Why is it usually difficult to demonstrate respiration in green plants?

Solution:

Both respiration and photosynthesis at the day time occurs in green plants. To demonstrate the respiration in living entities, evolution of carbon dioxide can be taken as an indicator. In plants, during respiration, the carbon dioxide that is liberated gets used up hence there is not evolution of carbon dioxide. Consequently, it becomes difficult to demonstrate respiration in green plants as there in no evolution of carbon dioxide during day time.

3. Explain why respiration is said to be the reverse of photosynthesis.

Solution:

It is because of the reasons listed below:

- The organic food in respiration is disintegrated into its inorganic compounds, namely – carbon dioxide and water. In photosynthesis, the organic food is manufactured from its inorganic components, namely - carbon dioxide and water.

- Carbon dioxide is released during respiration while carbon dioxide is consumed in photosynthesis
- Oxygen is consumed during respiration while oxygen is evolved in photosynthesis
- Energy is liberated in respiration while in photosynthesis, energy is absorbed.

4. How is the tilting of the soil useful for the crops growing in it?

Solution:

The act of tilting causes the soil to get light/airy and porous. The parts of the plant present below the ground receive adequate oxygen supply to respire. This way tilting facilitates faster crop growth.

5. Write the full form of ATP and ADP.

Solution:

The full form is as follows:

ATP – Adenosine triphosphate

ADP – Adenosine diphosphate

6. Can cell respiration occur in any organism at a temperature of about 65°C? Give reason.

Solution:

No, cell respiration cannot take place in any organism at the mentioned temperature as the enzymes that participate in respiration become inactivated at relatively higher temperatures.

7. Fill in the blanks:

(a) _____ are the openings found on older stems.

(b) Glycolysis occurs in the _____ of the cells.

(c) _____ is a respiratory substance.

(d) Rate of _____ is more than the rate of _____ in the daytime in the case of green plants.

(e) _____ is a chemical substance which absorbs oxygen of the air.

(f) _____ is used to create vacuum to show anaerobic respiration.

Solution:

(a) Lenticels

(b) Cytoplasm

(c) Glucose

(d) Photosynthesis, respiration

(e) Pyrogallate of potash

(f) Caustic potash (KOH)

D. Long Answer Type

1. **What is respiration? How are respiration and burning similar and how are they different?**

Solution:

Respiration is the oxidation of organic food specifically carbohydrates in living cells for the liberation of energy.

Similarities between burning and respiration are:

- Oxygen is required by both
- Energy is released by both
- The outcome of both is water and carbon dioxide.

Differences between burning and respiration:

Respiration	Burning
Occurs in a series of chemical steps	Occurs in a single step
Performed by enzymes	Carried out by heat
Biochemical process	Physico-chemical process
Energy released as ATP and heat	Energy released as heat and light
Light energy is not produced	Light energy is produced
Cellular process	Non-cellular process
Takes place at body temperature	Takes place at high temperature

2. How are aerobic and anaerobic respirations different in plants?

Solution:

The differences between aerobic and anaerobic respiration in different plants are listed below:

Attributes	Aerobic respiration	Anaerobic respiration
Also referred as	Oxybiotic respiration	Anoxybiotic respiration
Oxygen	required	Not required
Site of occurrence	Mitochondria	Cytoplasm
Breakdown of glucose	Complete	Incomplete
End-products	Carbon dioxide and water	Carbon dioxide and ethyl alcohol
Energy liberated from one mole of glucose	Large quantity (38ATP)	Small quantity(2 ATP)

3. Describe one experiment each you would perform to demonstrate the following phenomena:

The germinating seeds

(a) Produce heat,

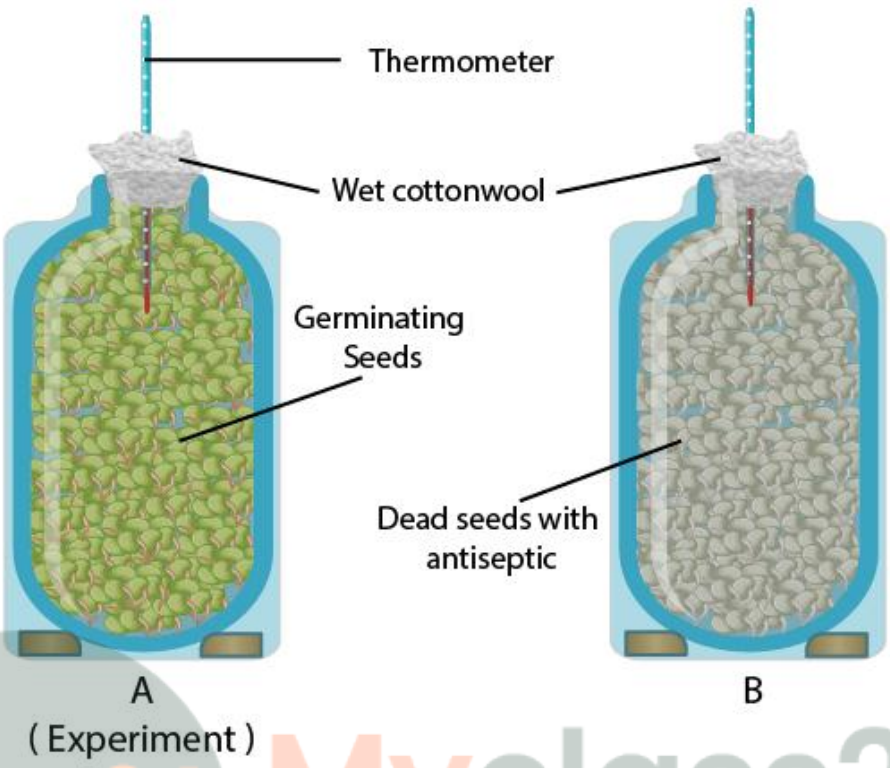
(b) Give out carbon dioxide,

(c) Can respire even in total absence of air.

Solution:

Following phenomena describes the experiments:

(a) Aim: Experiment demonstrating the fact that germinating seeds produce heat



(Experiment)

Experiment to show liberation of heat during germination

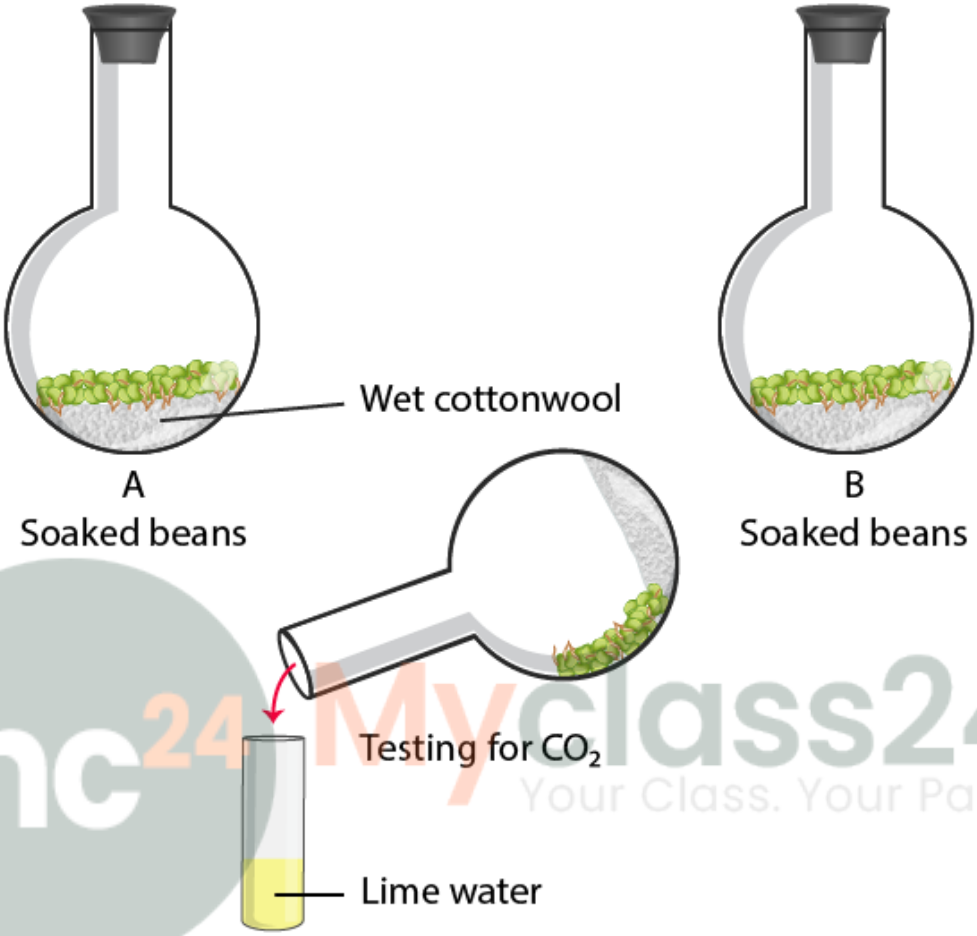
Procedure:

- Name two thermo flasks as 'A' and 'B', keep them aside
- Approximately 200 pea seeds or beans would be used in the experiment. Soak them in water for more than 24 hours.
- Split the seeds into two equal groups approximately
- One group of seeds are killed by boiling them and washing them with dilute formaline in order to restrict bacterial decay
- The live germinating seeds need to be placed in flask A and the boiled/killed seeds in flask B.
- Introduce a thermometer into each of the flasks and seal their mouths with cotton wool.
- Take note of the initial reading observed in the thermometer

Inference:

- A few hours later, thermometer in the flask A shows a higher reading depicting that the seeds that germinate generate heat.
- Flask B shows no rise in the temperature

(b) Aim: Experiment demonstrating the fact that germinating seeds produce carbon dioxide



Experiment to show the production of carbon dioxide in germinating seeds

Procedure:

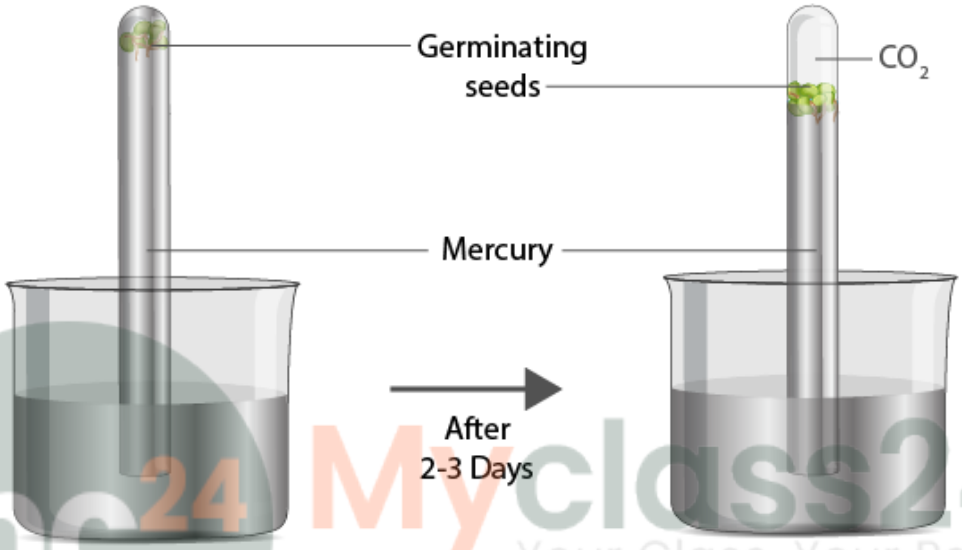
- Name two thermo flasks as ‘A’ and ‘B’, keep them aside
- At the base of both the flasks, place wet cotton wool
- In flask A, take a few soaked seeds of pea, simultaneously take equal quantity of boiled seeds in flask B
- To flask B, add some carbolic acid so as to inhibit bacterial growth on the dead seeds
- Seal the flasks with a cork, leave them undisturbed for a couple of days
- Observe the changes.

Inference:

- Post few days, germination of seeds in flask A is observed
- Flask B shows no signs of seed germination
- Cork is removed to test the gases in each of the flasks. The flask is toppled over a test tube which carries limewater. The test tube is then shaken up.

- Indication of carbon dioxide as expected in flask A is observed when lime water turns milky, thereby depicting that germinating seeds produce carbon dioxide.
- The gas in the flask B shows no effect upon coming in contact with limewater, indicating absence of carbon dioxide.

(c) Aim: Experiment demonstrating the fact that seed germination undergo respiration even in complete absence of air



Procedure & Inference:

- Fill a test tube with mercury that is inverted into a beaker of mercury.
- Into this tube, push some soaked and peeled off pea seeds before inverting into the mercury beaker
- You will observe that seeds will float up and are entirely girdled by mercury
- A few days later, few changes are observed. Mercury level drops, presence of some gases are detected in the tube
- Pour in some KOH into the tube
- Gas in the tube is absorbed, mercury level rises again, depicting that the gas was carbon dioxide
- Consequently it is proved that the germinating seeds undergo respiration even in the total absence of air.

4. How do the following structures help in respiration in plants?

(a) Lenticels _____

(b) Stomata _____

(c) Root hairs _____

Solution:

Listed below are the ways in which the following structures help in plant respiration:

(a) Lenticels: They assist the stem to take part in respiration

(b) Stomata: They assist the leaves to take part in respiration
(c) Root hairs: They assist the roots to take part in respiration

E. Structured/Application/Skill Type

1. **The following two chemical reactions are supposed to indicate a certain process occurring in the green plants under two different conditions:**
   (a) $C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 +$ _____ $+ 38ATP$
   (b) $C_6H_{12}O_6$ ® _____ $+ 2CO_2 + 2ATP$
   (i) Fill in the blanks of each reaction
   (ii) Name the process represented by the two chemical equations
   (iii) What are the conditions under which the two reactions (a) and (b) are occurring?

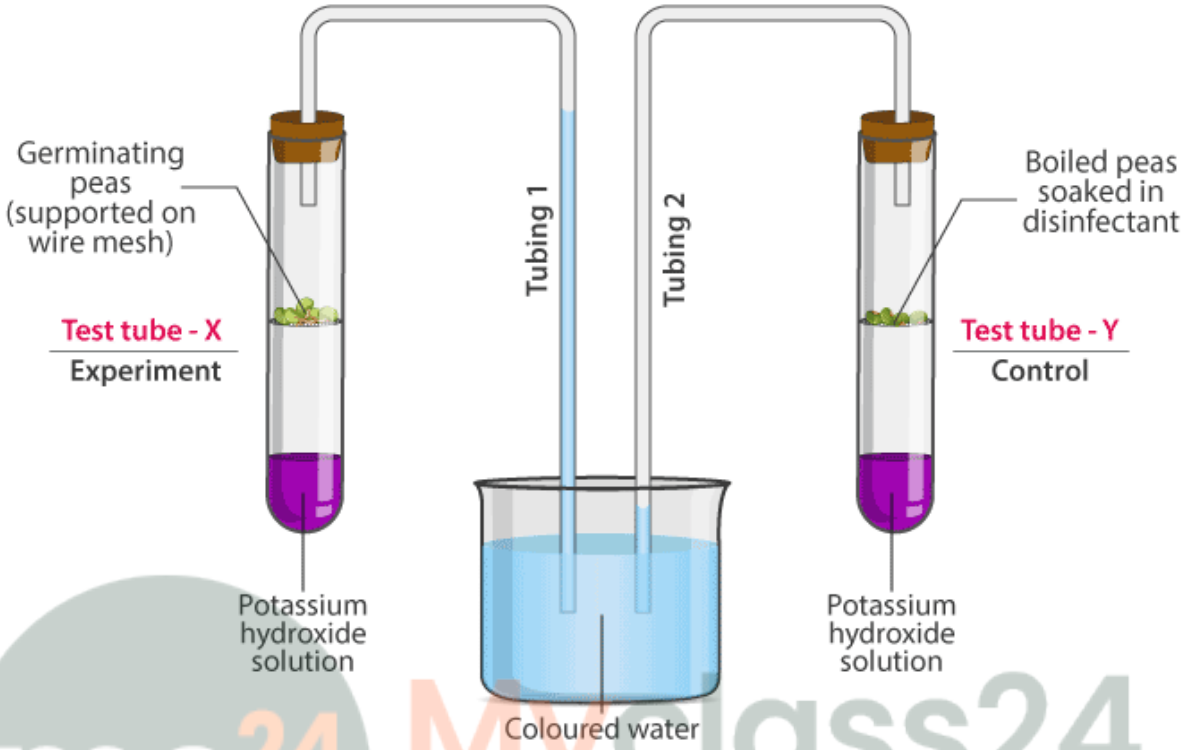
   Solution:

   (i) **(a)** $6H_2O$ **(b)** C_2H_5OH

   (ii) **(a)** The process observed in the chemical reaction here in aerobic respiration
   (b) The process observed in this chemical reaction is anaerobic respiration

   (iii) The reaction occurring in (a) can take place only in the presence of oxygen as it is aerobic respiration. The reaction occurring in (b) can take place even in the absence of oxygen as it is anaerobic respiration.

2. **The following diagram refers to an apparatus which is used to demonstrate a physiological process:**
   (a) What is the purpose of keeping potassium hydroxide solution in the test tubes X and Y?
   (b) Why has the coloured water risen in tubing 1?
   (c) What is the purpose of keeping boiled peas soaked in a disinfectant in test tube Y?
   (d) Name the biological process which causes the above rise.
   (e) Define the biological process shown in the experiment.



Solution:

(a) To check the presence of carbon dioxide, potassium hydroxide is placed in the test tubes X and Y. Potassium hydroxide has a special property of absorbing carbon dioxide if produced.

(b) In the test tube X, when the process of respiration takes place, the oxygen is consumed that is present in the test tube. Due to respiration, carbon dioxide that is produced is absorbed by the KOH in the test tube. Due to consumption of oxygen, a space is developed causing the colored water to rise in the tubing 1.

(c) It is because the seeds die once they are boiled and hence cannot undergo respiration. This is why respiration does not take place in test tube Y.

(d) The biological process that causes a rise is respiration

(e) It is respiration. It is a catabolic process wherein energy is liberated from simple sugars to be able to carry out life processes.

3. Given below is a set of six experimental set-ups (A-F), kept in this state for about 24 hours.

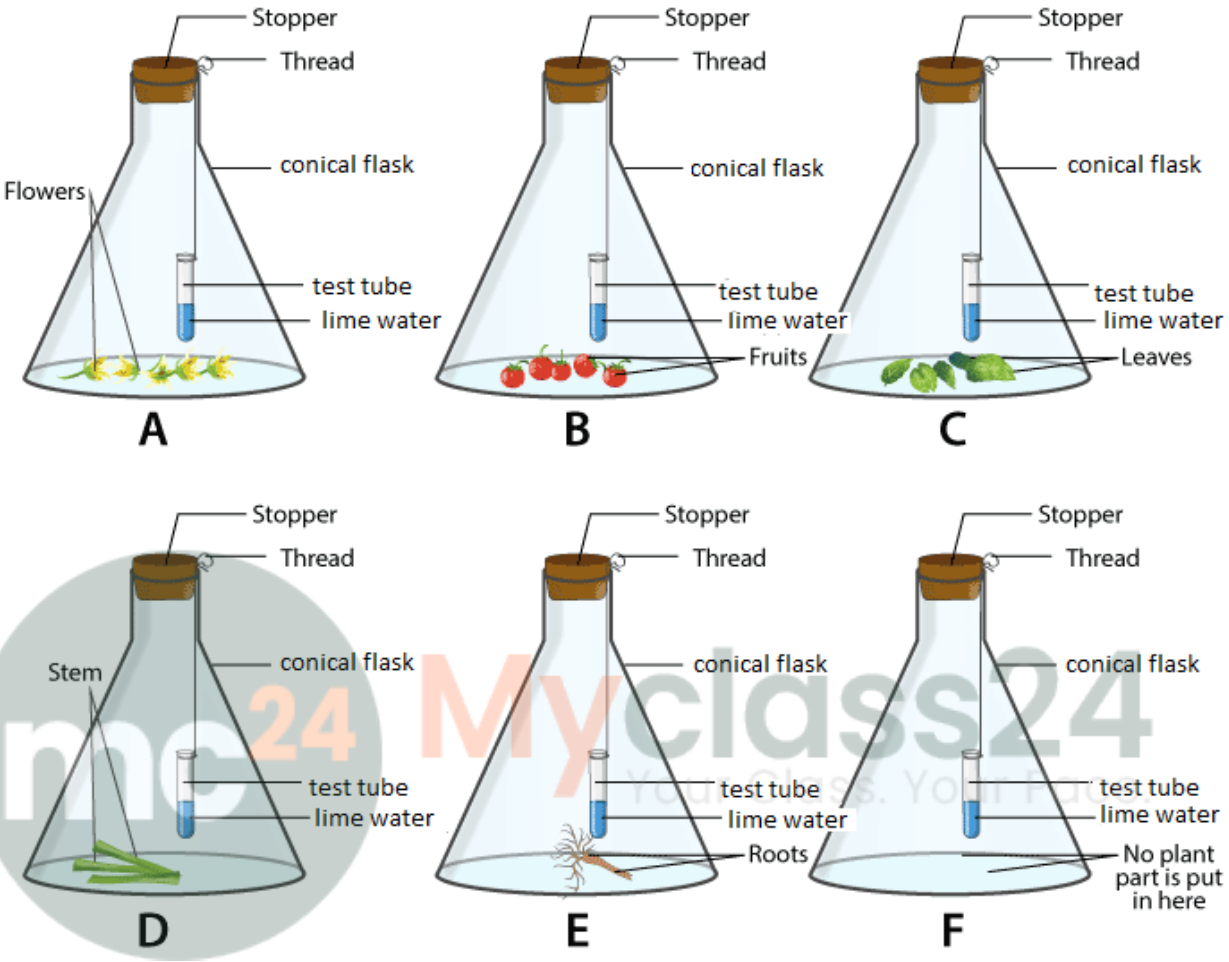
(a) In how many flasks, the different plant parts have been kept under observation?

(b) What is the purpose of keeping a test-tube containing limewater in each flask?

(c) In which tube/tubes the limewater will turn milky?

(d) What is the purpose of the set-up F?

(e) What conclusion can you draw from this experiment?



Solution:

(a) The different plant parts for observation have been placed in five flasks right from A-E flasks as observed in the diagram.

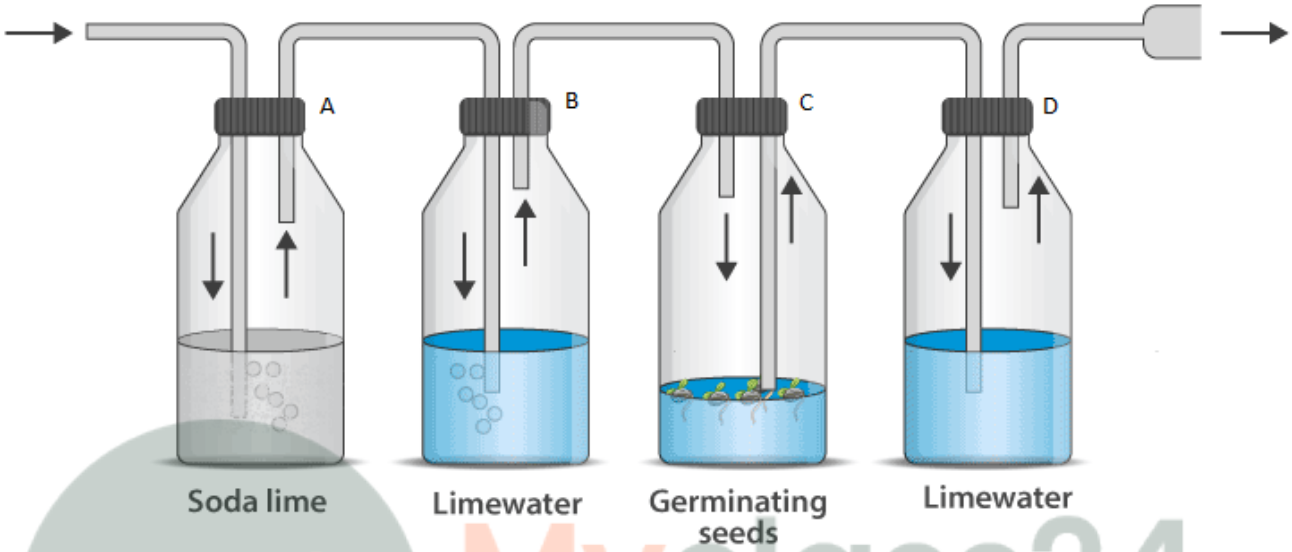
(b) It is the property of limewater to absorb carbon dioxide. Hence it is placed in the flask, so as to absorb carbon dioxide and turn milky in the presence of any carbon dioxide.

(c) Limewater turns milky in the presence of carbon dioxide. All five flasks from A to E have plant parts; hence respiration takes place in all five parts causing the limewater to turn milky. In flask F, respiration does not take place as there is no plant part, hence no change is observed

(d) In the experiment, the set-up F depicts the experiment control, wherein all conditions are maintained in the same way except for the plant part that is absent in flask F.

(e) The experiment clearly shows that carbon dioxide is produced during the process of respiration.

4. In order to study and prove a particular physiological process in plants, the following experiment was set up. Study the same and then answer the questions that follow:



(a) Name the physiological process being studied.
(b) What is the function of soda lime in the bottle 'A' and why is limewater placed in bottle 'B'?
(c) What change would you expect to observe in bottle 'D'?
(d) Represent the physiological process named in (a) above in the form of a chemical equation.
(e) In order to obtain accurate results, the bottle 'C' should be covered with a piece of black cloth. Why?
(f) If bottle 'C' was fitted with a 3-holed rubber stopper and a thermometer were introduced in such a way that its bulb reaches close to the germinating seeds, what would you observe? Why?

Solution:

(a) The experiment demonstrates that carbon dioxide is produced during the process of respiration in germinating seeds.

(b) Soda lime is placed in bottle 'A' as it indicates the passage/presence of carbon dioxide in bottle A. Another property of soda lime is that is absorbs carbon dioxide that is present in the air. The clear limewater in bottle B indicates that the air that enters the flask C is free from carbon dioxide.

(c) The bottle D holding limewater should indicate that carbon dioxide is produced as a result of respiration occurring in bottle 'C' possessing the germinating seeds. As carbon dioxide is produced in the bottle C, limewater turns milky that enters the bottle 'D'.

(d) The chemical reaction is as written below:

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6C_2O + 6H_2O + 38ATP$ (energy)

(e) The bottle 'C' is covered with a black cloth in order to restrict any chance of photosynthesis so as to make sure the process of respiration only is carried out and observed.

(f) A thermometer is inserted in bottle C to observe the changes in temperature. Respiration causes the temperature to rise, if there is no respiration, the temperature will not rise.