Q.1. For testing alkalinity for a water sample, first phenolphthalein indicator is added. The water remains colourless. However, when a few drops of methyl orange are added to the sample, the colour turns yellow. As per these observations, the correct choice is

(A) Absence of CO32– and/or HCO3– but the presence of OH– ions in the sample

(B) Presence of CO32– and/or HCO3– but the absence of OH– ions in the sample

(C) Absence of CO32–, HCO3– and OH– ions in the sample

(D) Presence of CO32–, HCO3– and OH– ions in the sample

Solution:

- **Colorless with Phenolphthalein**: This means there are no significant OH^- ions, or the pH is below 8.2.
- **Yellow with Methyl Orange**: This indicates the solution is alkaline but not strongly so (pH between 4.4 and around 8.2).

The presence of carbonate (CO_3^{2-}) or bicarbonate (HCO_3^-) ions could explain this behavior because:

- Bicarbonate ions (HCO_3^-) would not turn phenolphthalein pink but would make methyl orange yellow if the solution's pH is in the appropriate range.
- Carbonate ions (CO_3^{2-}) in the presence of water can form bicarbonate and OH^-, but if OH^- concentration isn't high enough, phenolphthalein might not change color, while methyl orange still would.

Therefore, the correct interpretation based on your observations is:

(B) **Presence of $CO3^{2-}$ and/or $HCO3^-$ but the absence of OH^- ions in the sample**

Q 2. Read the following statements

I. Photosynthesis takes place within the chloroplasts of the eukaryotes, whereas the breakdown of complex molecules to yield energy takes place in the cytoplasm and in the mitochondria.

II. Photosynthesis takes place within the chloroplasts of the prokaryotes, whereas the breakdown of complex molecules to yield energy takes place in the cytoplasm and in the mitochondria.

III. All living organisms retain the enzymatic machinery to partially oxidise glucose without the help of oxygen. This breakdown of glucose to pyruvic acid is called glycolysis.

IV. All living organisms retain the enzymatic machinery to completely oxidise glycerol without the help of oxygen. This breakdown of glycerol to citric acid is called glycolysis.

The correct choice is

(A) I and III are correct

(B) II and IV are correct

(C) I is correct whereas III is incorrect

(D) II is correct whereas IV is incorrect

Solution:

I. Photosynthesis takes place within the chloroplasts of the eukaryotes, whereas the breakdown of complex molecules to yield energy takes place in the cytoplasm and in the mitochondria.

- True. Photosynthesis indeed occurs in chloroplasts, which are organelles found in eukaryotic plant cells. The breakdown of complex molecules, primarily through cellular respiration, involves glycolysis in the cytoplasm and the Krebs cycle (citric acid cycle) along with oxidative phosphorylation in the mitochondria.

II. Photosynthesis takes place within the chloroplasts of the prokaryotes, whereas the breakdown of complex molecules to yield energy takes place in the cytoplasm and in the mitochondria.

- False. Prokaryotes do not have chloroplasts or mitochondria. Photosynthesis in prokaryotes like cyanobacteria occurs in structures called thylakoids, which are not enclosed by chloroplasts. Energy production in prokaryotes happens in the cytoplasm and sometimes involves membrane-bound processes, but not in mitochondria.

III. All living organisms retain the enzymatic machinery to partially oxidise glucose without the help of oxygen. This breakdown of glucose to pyruvic acid is called glycolysis.

- **True**. Glycolysis is a universal pathway in all living organisms, where glucose is partially oxidized to pyruvate in the cytoplasm, not requiring oxygen.

IV. All living organisms retain the enzymatic machinery to completely oxidise glycerol without the help of oxygen. This breakdown of glycerol to citric acid is called glycolysis.

- **False**. Glycolysis specifically refers to the breakdown of glucose, not glycerol. Glycerol can enter metabolic pathways, but it does not directly undergo glycolysis. Furthermore, complete oxidation of any molecule to CO_2 and H_2O typically requires oxygen (aerobic conditions), which is not what this statement implies.

I and III are both true statements.

Q. 3.

Read the following statements

i. Aerobic heterotrophic bacteria uses organic matter for carbon source and energy source.

ii. Aerobic heterotrophic bacteria uses carbon dioxide for carbon source and energy source.

iii. Aerobic autotrophic bacteria uses carbon dioxide for carbon source and reduced substances for energy source.

iv. Aerobic autotrophic bacteria uses organic matter for getting energy.

The correct choice is

(A) (i) is correct; (iii) is correct

(B) (iv) is correct; (i) is incorrect

(C) (i) is correct; (iv) is correct

(D) (ii) is correct; (iv) is incorrect

Solution:

Let's break down each statement and then determine the correct choice:

Understanding the Terms

- **Aerobic:** Requires oxygen for survival and metabolism.
- **Heterotrophic:** Obtains carbon from organic compounds (like sugars, proteins, etc.).
- **Autotrophic:** Obtains carbon from inorganic sources (primarily carbon dioxide).

Analyzing the Statements

- **i. Aerobic heterotrophic bacteria uses organic matter for carbon source and energy source.**
    - This is **correct**. Heterotrophs get both their carbon and energy from breaking down organic matter.
- **ii. Aerobic heterotrophic bacteria uses carbon dioxide for carbon source and energy source.**
    - This is **incorrect**. Heterotrophs use organic matter, not carbon dioxide, for their carbon source.
- **iii. Aerobic autotrophic bacteria uses carbon dioxide for carbon source and reduced substances for energy source.**
    - This is **correct**. Autotrophs use carbon dioxide as their carbon source. They get energy from oxidizing reduced inorganic substances (like hydrogen sulfide or ferrous iron) or through photosynthesis (using light energy).
- **iv. Aerobic autotrophic bacteria uses organic matter for getting energy.**
    - This is **incorrect**. Autotrophs do not use organic matter for energy; they use inorganic sources or light.

Correct Answer is **(A) (i) is correct; (iii) is correct**

Q. 4

A student wants to decide electron acceptor for aerobic, facultative and anaerobic bacteria. In this context, read the following statements

i. Dissolved Oxygen (DO) can act as electron acceptor for aerobic bacteria.

ii. Nitrite can act as electron acceptor for aerobic bacteria.

iii. Dissolved Oxygen (DO) can act as electron acceptor for anaerobic bacteria.

iv. Nitrite can act as electron acceptor for facultative bacteria.

The correct choice is

(A) (i) is correct; (iv) is correct

(B) (ii) is correct; (iii) is incorrect

(C) (ii) is correct; (iii) is correct

(D) (i) is correct; (ii) is correct

Solution:

- **Aerobic bacteria:** Bacteria that require oxygen for their metabolic processes.
- **Facultative bacteria:** Bacteria that can thrive in both the presence and absence of oxygen.
- **Anaerobic bacteria:** Bacteria that cannot survive in the presence of oxygen.

Analyzing the Statements

- **i. Dissolved Oxygen (DO) can act as electron acceptor for aerobic bacteria.**
  - This is **correct**. Aerobic bacteria utilize dissolved oxygen (DO) as the final electron acceptor in their respiratory chain.
- **ii. Nitrite can act as electron acceptor for aerobic bacteria.**
  - This is **incorrect**. While some bacteria can use nitrite as an electron acceptor, this process is typically associated with *anaerobic* conditions (denitrification). Aerobic bacteria primarily use oxygen.
- **iii. Dissolved Oxygen (DO) can act as electron acceptor for anaerobic bacteria.**
  - This is **incorrect**. Anaerobic bacteria are poisoned by oxygen and cannot utilize it as an electron acceptor. They use other molecules like sulfate, nitrate, or even carbon dioxide.
- **iv. Nitrite can act as electron acceptor for facultative bacteria.**

- This is **correct**. Facultative bacteria can switch their metabolic pathways depending on the availability of oxygen. In the absence of oxygen, they can use nitrite as an electron acceptor (denitrification).

Correct Answer is **(A) (i) is correct; (iv) is correct**