

## ***Life Sciences, Grade 11, Cellular Respiration***

### **Written questions**

#### **Question 1: Introduction to Cellular Respiration**

1.1 **Cellular Respiration (CR)** is a series of chemical reactions within cells that break down a fuel molecule (usually glucose) in the presence of oxygen (or without), to form carbon dioxide and water (or other products), capturing energy in ATP molecules. Its primary purpose is to **release energy** from fuel molecules and make it available for all the life activities performed by organisms.

1.2 **Aerobic Respiration** is cellular respiration that occurs **in the presence of oxygen**. **Anaerobic Respiration** (also known as Fermentation) is cellular respiration that occurs **without oxygen**.

1.3 The energy currency molecule produced during cellular respiration is **ATP (Adenosine Triphosphate)**. Organisms need energy for all activities performed by cells, tissues, organs, and systems, such as building complex molecules (anabolism), breaking down molecules (catabolism), active transport, nerve impulses, muscle contraction, and maintaining body temperature.

#### **Question 2: Stages of Aerobic Respiration and Energy Yield**

2.1 **Glycolysis** is the first stage of both aerobic and anaerobic respiration. During glycolysis, glucose (a 6-carbon sugar) is broken down into two molecules of pyruvic acid (3-carbon molecules), producing 2 ATP molecules. It occurs in the **cytoplasm** of the cell.

2.2 The **Krebs Cycle (Citric Acid Cycle)** is the second stage of aerobic respiration, occurring in the **mitochondrial matrix**. It involves a series of reactions that further break down pyruvic acid, producing ATP, carbon dioxide (CO<sub>2</sub>), and hydrogen (H). **Oxidative Phosphorylation / Electron Transport Chain** is the third and final stage of aerobic respiration, occurring on the **inner mitochondrial membrane**. It produces the most ATP (approximately 34 ATP molecules) and water as a by-product.

2.3 The overall chemical equation for aerobic respiration is: **Glucose + Oxygen → Carbon Dioxide + Water + Energy (ATP)** Reactants: Glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>) and Oxygen (O<sub>2</sub>). Products: Carbon Dioxide (CO<sub>2</sub>), Water (H<sub>2</sub>O), and Energy (ATP).

### Question 3: Anaerobic Respiration and Experimental Investigations

3.1 **Alcoholic Fermentation** occurs in organisms like **yeast** when oxygen is absent; pyruvic acid is converted into **ethanol (alcohol) and carbon dioxide (CO<sub>2</sub>)**. **Lactic Acid Fermentation** occurs in **muscle cells** during strenuous exercise when oxygen is scarce; pyruvic acid is converted into **lactic acid**.

3.2 **Oxygen Debt** is the extra oxygen needed to get rid of lactic acid build-up after strenuous exercise. It occurs when muscle cells switch from aerobic to anaerobic respiration due to insufficient oxygen supply, leading to the accumulation of lactic acid, which needs oxygen for its breakdown.

3.3 **Aim:** To investigate whether carbon dioxide is released during anaerobic respiration. **Key Variable:** Presence/absence of CO<sub>2</sub>. (Alternatively, presence/absence of oxygen, or type of sugar/oil). **Expected result:** If limewater is used, it will turn cloudy (milky), indicating the presence and release of carbon dioxide.

3.4 The conclusion drawn from an experiment designed to investigate whether germinating seeds release heat energy is that **heat energy is released by germinating seeds**. This heat is a product of cellular respiration occurring within the living, active seeds.