

Life Sciences, Grade 11, Photosynthesis

Written questions

Question 1: Basics of Photosynthesis

1.1 Photosynthesis is a process that makes glucose (an energy-rich molecule) from carbon dioxide and water, requiring radiant energy trapped by chlorophyll, and releasing oxygen.

1.2 The light-dependent phase occurs in the **thylakoid membranes** of the chloroplast. The light-independent (dark) phase occurs in the **stroma** (fluid-filled space) within the chloroplast.

1.3 The process by which water molecules are split during the light-dependent phase is called **photolysis**. The oxygen produced during photolysis is released as a gaseous by-product.

Question 2: Energy Transfer and Limiting Factors

2.1 **ATP (Adenosine Triphosphate)** is an energy carrier molecule formed during photophosphorylation in the light-dependent phase, and its energy is used to power reactions in the dark (light-independent) phase. **NADPH** is an energized hydrogen acceptor molecule formed in the light-dependent phase, which carries hydrogen atoms to the dark phase where they are utilized.

2.2 A **Limiting Factor** is a factor that restricts the rate of a process when it is in short supply. Three common limiting factors for photosynthesis are **carbon dioxide concentration, temperature, and light intensity**.

2.3 At low CO₂ concentrations, the rate of photosynthesis is low. As the CO₂ level increases, the rate of photosynthesis also increases up to a certain point. When the optimum amount of CO₂ is present, photosynthesis occurs most rapidly. If the CO₂ concentration is higher than the optimum amount, the rate of photosynthesis will remain constant, as other factors like light, water, and temperature become limiting.

Question 3: Environmental Effects on Photosynthesis

3.1 At low temperatures, the rate of photosynthesis is low. As temperature increases (e.g., 10-25°C), the rate of photosynthesis increases. However, if the temperature increases above the optimum (e.g., above 25°C), the rate decreases rapidly because

the enzymes involved in photosynthesis begin to **denature** (alter their natural shape and become ineffective), thus impairing the process.

3.2 At low light intensity, the rate of photosynthesis is low. As light intensity increases, the rate also increases, but only up to a certain optimum point. If light intensity increases past this optimum, the rate remains constant because other factors (like CO₂ and temperature) become the **limiting factors**.

3.3 At very high light intensities, plant stomata can shut. This happens to prevent excessive water loss through transpiration, but in doing so, it restricts the intake of carbon dioxide. Consequently, CO₂ becomes a **limiting factor** for photosynthesis, even if light intensity is high.