Assessment Schedule – 2025

Biology: Demonstrate understanding of life processes at the cellular level (91156)

Assessment Criteria

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate ***understanding*** involves: • defining, using annotated diagrams or models to describe, and describing characteristics of, or providing an account of, life processes at the cellular level.	*Demonstrate* ***in-depth understanding*** involves: • using biological ideas to give reasons how or why life processes occur at the cellular level.	*Demonstrate* ***comprehensive understanding*** involves: • linking biological ideas about life processes at the cellular level; discussion of ideas may involve justifying, relating, evaluating, comparing, and contrasting, analysing.

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0–6	7–12	13–18	19–24

Evidence

Question One

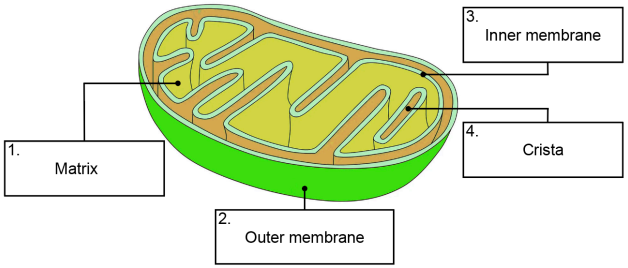
Expected Coverage	Achievement	Achievement with Merit	Achievement with Excellence
$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ or Carbon dioxide + water + light energy → oxygen + glucose **Photosynthesis** is the process by which plants convert light energy into chemical energy stored in glucose. It occurs in two main stages: the light-dependent reactions and the Calvin cycle (light-independent reactions): • Light-dependent phase: This occurs in the thylakoid membranes of the chloroplasts where chlorophyll absorbs light energy, which is used to split water molecules into oxygen, protons, and electrons. This process generates ATP, or adenosine triphosphate, and NADPH, or nicotinamide adenine dinucleotide phosphate, which go onto the next stage. • Light-independent phase: This occurs in the stroma of the chloroplasts, where ATP and NADPH produced in the light-dependent reactions are used to convert carbon dioxide into glucose through a series of enzyme-mediated steps. **Chlorophyll** is the green pigment in plants that captures light energy, which is essential for driving the light-dependent reactions. The **rate of photosynthesis** changes throughout the day, primarily due to variations in light intensity and temperature: • Light intensity: Photosynthesis rates increase with light intensity up to a certain point. At sunrise, light intensity is low, so the rate of photosynthesis is slow. As the sun rises, light intensity increases, peaking at midday, which maximises the rate of photosynthesis. In the afternoon, as light intensity decreases, the rate of photosynthesis also declines. • Temperature: Temperature affects the enzymes involved in photosynthesis. As the temperature rises in the morning, enzyme activity increases, enhancing the rate of photosynthesis. However, if the temperature becomes too high, enzyme activity can decrease, reducing the rate of photosynthesis.	Describes: • the process of photosynthesis (*accept non-balanced symbol equation / mixture of symbol and word equation*) • the light-dependent phase as occurring in the thylakoid / grana • the light-independent phase as occurring in the stroma • the difference / increase in light intensity during daylight hours • the difference / increase in temperature during daylight hours • why CO_2 is needed for photosynthesis • diffusion (of CO_2) in water / diffusion in air • what is meant by a limiting factor • the role of chlorophyll.	Explains: • the light-dependent phase of photosynthesis • the light-independent phase of photosynthesis • changes in rate of photosynthesis due to light intensity • changes in rate of photosynthesis due to temperature • why CO_2 is a limiting factor in aquatic plants but not in terrestrial plants.	Provides detailed discussion of: • the key phases of photosynthesis, locations, and linked to the context • changes in rate of photosynthesis due to a combination of factors • why limited CO_2 will result in a lower rate of photosynthesis.

Expected Coverage	Achievement	Achievement with Merit	Achievement with Excellence
CO_2 is often a limiting factor for photosynthesis in aquatic plants, compared to terrestrial plants, due to differences in availability and diffusion between water and air. The limitations are: • Availability: In terrestrial environments, CO_2 is readily available in the atmosphere. Plants can easily absorb CO_2 through their stomata. In aquatic environments, CO_2 is less available because it dissolves in water to form bicarbonate ions, which are less accessible to plants. • Diffusion: CO_2 diffuses much more slowly in water than in air. This slower diffusion rate means that aquatic plants may not receive sufficient CO_2 for optimal photosynthesis, especially in stagnant or deep water where CO_2 levels can be even lower. • Insufficient or reduced carbon: There is less raw material for making the glucose / carbon-rich sugars.			

N1	N2	A3	A4	M5	M6	E7	E8
ONE evidence point at Achievement.	TWO evidence points at Achievement.	THREE evidence points at Achievement.	FOUR evidence points at Achievement.	TWO evidence points at Merit.	THREE evidence points at Merit.	ONE evidence point at Excellence.	TWO evidence points at Excellence.

N0 = No response; no relevant evidence.

Question Two

Expected Coverage	Achievement	Achievement with Merit	Achievement with Excellence
(a)  **(b)** **Anaerobic respiration:** This occurs in the cytoplasm of the cheetah's cells when oxygen is scarce, such as during intense bursts of activity like sprinting. It involves the breakdown of glucose into lactic acid, producing a small amount of adenosine triphosphate (ATP) quickly but inefficiently. **Aerobic respiration:** This occurs in the mitochondria of the cheetah's cells when oxygen is available. It involves the complete breakdown of glucose into carbon dioxide and water, efficiently producing a large amount of ATP. $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ (+ ATP) Glucose + oxygen → carbon dioxide + water (+ATP) **Why the cheetah can carry out anaerobic respiration for short periods of time only:** Anaerobic respiration leads to the accumulation of lactic acid in the muscles, which can cause fatigue and muscle cramps. The cheetah can sustain this high-intensity activity for only short periods (about 20–30 seconds) before it needs to rest and allow lactic acid to be cleared and oxygen levels to be restored.	Labelled at (a): • at least three structures labelled correctly. **Describes:** • the process of aerobic respiration (*accept non-balanced symbol equation / mixture of symbol and word equation*) • the process of anaerobic respiration (*accept non-balanced symbol equation / mixture of symbol and word equation*) • aerobic occurring in the mitochondria • anaerobic occurring in the cytoplasm • anaerobic being used during intense bursts of activity • aerobic being used when oxygen is available and for longer periods of activity • an advantage of aerobic OR anaerobic (e.g. anaerobic respiration produces ATP quickly) • a disadvantage of aerobic OR anaerobic (e.g. anaerobic respiration produces toxic lactic acid).	Explains: • aerobic respiration and its advantage(s) and disadvantage(s) • anaerobic respiration and its advantage(s) and disadvantage(s) • an advantage of each type of respiration OR a disadvantage of each type of respiration (if neither of the first two explanations made) • the process of anaerobic respiration / glycolysis including its location • the process of aerobic respiration including its location • functions of the various parts of the mitochondria (e.g. the Kreb's cycle occurs on the matrix).	Provides detailed discussion of: • anaerobic respiration and how the advantages and disadvantages directly relate to the cheetah • aerobic respiration and how the advantages and disadvantages directly relate to the cheetah • why the cheetah needs BOTH systems to function effectively in its lifestyle.

Expected Coverage	Achievement	Achievement with Merit	Achievement with Excellence
Advantages and disadvantages of anaerobic and aerobic respiration: Advantages: • Anaerobic respiration allows the cheetah to generate ATP quickly for short bursts of high-speed activity, crucial for catching prey. • Aerobic respiration provides a more efficient and sustainable way to produce ATP for longer periods of activity and recovery. Disadvantages: • Anaerobic respiration produces less ATP per glucose molecule and leads to lactic acid build-up, causing fatigue. • Aerobic respiration requires a continuous supply of oxygen, which may not be available during intense activity.			

N1	N2	A3	A4	M5	M6	E7	E8
ONE evidence point at Achievement.	TWO evidence points at Achievement.	THREE evidence points at Achievement.	FOUR evidence points at Achievement.	TWO evidence points at Merit.	THREE evidence points at Merit.	ONE evidence point at Excellence.	TWO evidence points at Excellence.

N0 = No response; no relevant evidence.

Question Three

Expected Coverage	Achievement	Achievement with Merit	Achievement with Excellence
Enzymes are proteins made up of long chains of amino acids that fold into a specific three-dimensional shape. This shape includes an active site where substrate molecules bind. *(Accept a labelled diagram showing the enzyme structure, active site, and substrate, and how it may become denatured.)* **The role of enzymes in biological processes:** Enzymes act as biological catalysts, speeding up chemical reactions in cells without being consumed in the process. They are essential for various metabolic processes, including respiration, DNA replication, and photosynthesis. Enzymes ensure that these reactions occur quickly and efficiently, maintaining the organism's overall metabolic rate. Without enzymes, many of the biological processes would take too long to be effective. **The mechanism by which enzymes function:** Enzymes work by lowering the activation energy required for a reaction to occur. When a substrate binds to the enzyme's active site, it forms an enzyme-substrate complex. This interaction stabilises the transition state and facilitates the conversion of substrates into products. After the reaction, the products are released, and the enzyme is free to catalyse another reaction. **Why temperature variations have different effects on enzyme activity:** Optimal temperature: Each enzyme has an optimal temperature at which it functions most efficiently. This is typically around the normal body temperature of the organism. Increased temperature: As temperature rises, enzyme activity increases because molecules move faster, leading to more frequent collisions between enzymes and substrates. However, if the temperature exceeds the optimal range, the enzyme's structure can become unstable, leading to denaturation. Denaturation involves the unfolding of the enzyme's three-dimensional structure, rendering the active site non-functional. Decreased temperature: Lower temperatures reduce the kinetic energy of molecules, resulting in fewer collisions between enzymes and substrates. This slows down the rate of enzyme-	Describes: • structure of enzymes (e.g. simple diagram or description of the active site) • function of enzymes (e.g. catalysts: can speed up biological reactions / processes within an organism; lower activation energy; catalyse biochemical reactions) • tolerance limit(s) of enzymes (*accept a graph*) • enzymes denaturing at high temperatures • optimal temperature described • reduced reaction rate at low temperature • the lock and key model OR the induced-fit model.	Explains: • how the structure of enzymes enables them to work: – the lock and key model (active site of enzyme matches substrate shape model implication of change in substrate) (*accept diagram*) *OR* – induced fit (the active site is flexible (enzyme / active site) changes slightly when combined with the substrate / (implication of) change in substrate) (*accept diagram or explanation*) • why high **or** low temperature affects the rate of activity of enzymes (e.g. less enzyme activity at lower temperatures / damage to active site / denaturing at higher temperatures / optimum temperature is most activity) • the formation of enzyme-substrate complex • the role of enzymes in a biological process.	Provides detailed discussion of: • the **function** of enzymes related to their **structure** and why temperature affects them • the effects of **high and low temperature** on the **rate of activity of enzymes** (i.e. low collision rate at lower temperatures because particles are moving more slowly / with less energy; optimum temperature at which enzyme works fastest / rate of reaction is highest; damage to active site / denaturing at higher temperatures; why reaction cannot occur at high temperatures, e.g. substrate can't bind to active site) • the impact of enzyme activity on the rate of **cellular activity** in an organism.

Expected Coverage	Achievement	Achievement with Merit	Achievement with Excellence
catalysed reactions. While enzymes do not denature at low temperatures, their activity is significantly reduced.			

N1	N2	A3	A4	M5	M6	E7	E8
ONE evidence point at Achievement.	TWO evidence points at Achievement.	THREE evidence points at Achievement.	FOUR evidence points at Achievement.	TWO evidence points at Merit.	THREE evidence points at Merit.	ONE evidence point at Excellence.	TWO evidence points at Excellence.

N0 = No response; no relevant evidence.