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91156



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SUPERVISOR'S USE ONLY

Level 2 Biology, 2017

91156 Demonstrate understanding of life processes at the cellular level

2.00 p.m. Wednesday 22 November 2017
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of life processes at the cellular level.	Demonstrate in-depth understanding of life processes at the cellular level.	Demonstrate comprehensive understanding of life processes at the cellular level.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–11 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Merit

TOTAL

16

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QUESTION ONE: PHOTOSYNTHESIS

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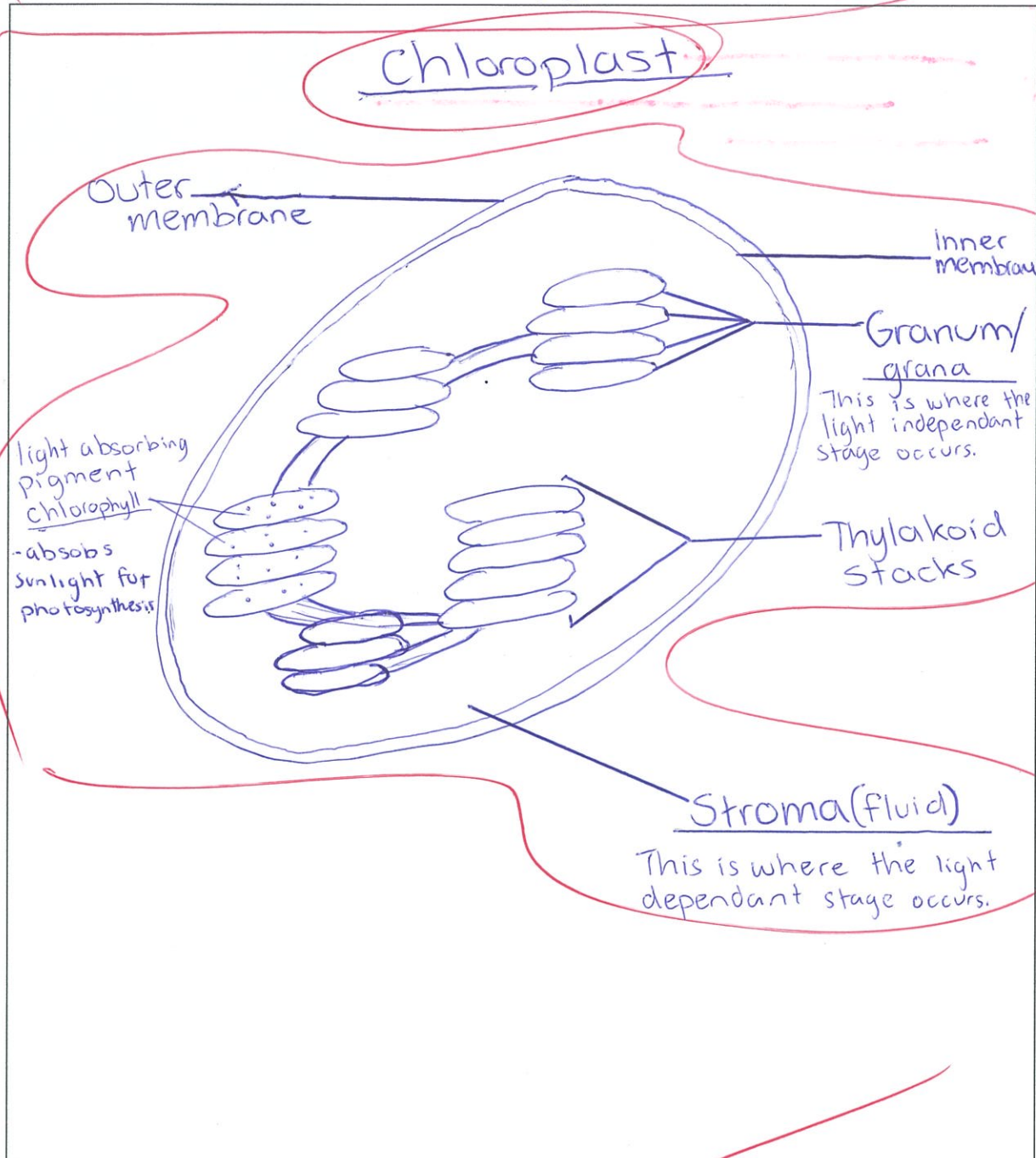
- (a) Describe osmosis AND explain how it occurs in root cells of a plant.

Osmosis is the diffusion of water molecules across a semi-permeable membrane from an area of high concentration to low concentration down the concentration gradient. The roots of a plant can go deep into the ground and when it rains the soil soaks up/absorbs the water down into the soil for the roots. The cells in the roots of plants diffuse the water across the cell semi-permeable membrane via Osmosis and absorb as much water as they need plus more to make the cells Turgid. Plant cells prefer turgid cells as opposed to isotonic cells in animals. Turgid cells in plants mean there is a higher percentage of the ^{water} molecule on the inside of the cell than out. ^{use} Turgid cells are hypertonic solutions. The plants (after root cells absorb the water) send the water up to the plant to carry out photosynthesis and then aerobic respiration which are both key life processes for a plant to survive.

- (b) Write the word equation for photosynthesis AND draw a labelled diagram of a chloroplast showing the inner membrane, outer membrane, stroma, and thylakoid stacks.

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Water + Carbon dioxide $\xrightarrow{\text{Sunlight}}$ Glucose (sugar) + Oxygen



- (c) Discuss how photosynthesis occurs, and the factors that affect it.

In your answer:

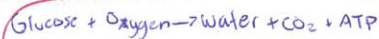
- ✓ • explain light-independent AND light-dependent reactions
- ✓ • indicate on your chloroplast drawing (previous page) where these reactions occur
- ~ • discuss how water AND one other factor can affect the rate of photosynthesis.

Photosynthesis is the process in which a plant splits water and produces food (glucose) for the plant to then use to grow and carry out other key life processes like cellular/aerobic respiration. Photosynthesis is carried out in plants with the two reactants Carbon dioxide and Water. With the use of sunlight in the 'light dependant phase' the plant produces Glucose and then in the 'light independant phase' it also produces the second product of Oxygen. The first stage (light dependant phase) happens in the Stroma of a chloroplast when Water, Carbon dioxide and sunlight react. The water is split and the product of Glucose begins ^{to form}. In the second stage (light independant phase) which happens in the Grana/granum in the chloroplast is where the remaining Oxygen molecules left over from the water splitting turns to Oxygen (O_2) and Glucose ($C_6H_{12}O_6$) is also formed. Water is a key reactant in the process of

www.behance.net/gallery/13665729/Corn-Plant-Root-Systems

photosynthesis, without water which is a key nutrient to the plant, photosynthesis could not occur. ~~the~~ Water can affect the rate of photosynthesis if there is none of it. No water for a plant means no photosynthesis and the plant will soon die. Another factor that can affect the rate of photosynthesis is temperature. Because photosynthesis like most chemical reactions is an enzyme controlled reaction, factors that affect enzymes will affect the process of photosynthesis. As temperature increases so does the rate of enzyme activity. The faster the enzymes are moving due to the heat means more successful collisions with substrates and an overall quicker reaction. But if the temperature continues to increase past the enzymes maximum rate then the heat can break their ^{hydrogen} bonds and cause enzymes to denature. If these photosynthesis specific enzymes denature then the reaction will stop and/or not be completely carried out to produce glucose and Oxygen. When all factors are working at optimal rate, ~~the~~ (temperature, nutrient availability, pH level etc) the the rate of photosynthesis will be working at an optimal rate producing glucose and Oxygen.

MS



QUESTION TWO: CELL RESPIRATION

6

aerobic = Uses energy. Does cellular respiration ~~with energy~~. Uses oxygen
anaerobic = Does cellular respiration when no oxygen/energy is available

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<http://taputeranga.org.nz/the-marine-life/molluscs/why-are-mussels-absent-from-the-wellington-south-coast/>

<http://naturewatch.org.nz/taxa/117650-Mytilus-edulis>

Intertidal animals such as the **blue mussel**, *Mytilus edulis*, rely on seawater to get dissolved oxygen for aerobic respiration. At low tide the mussels are exposed to the air and tightly close their shells to prevent desiccation (drying out). During low tide they rely on anaerobic respiration to maintain essential life processes.

Compare and contrast anaerobic and aerobic respiration in intertidal blue mussels.

In your answer include:

- an explanation of anaerobic respiration that includes where it takes place in the cell, and the products formed
- an explanation of aerobic respiration that includes where it takes place in the cell, and the products formed
- a discussion of one advantage and one disadvantage for BOTH anaerobic AND aerobic respiration in blue mussels.

Blue mussels use aerobic respiration when they are submerged under sea-water by relying on the seawater to get them dissolved oxygen to carry out the process of aerobic respiration. Aerobic respiration is cellular respiration that requires and uses oxygen to create ATP and the waste products of H₂O and CO₂. The purpose of aerobic respiration is to produce ATP (energy) for the ~~Blue mussel~~ ^{Blue mussel}. Aerobic respiration occurs in the Mitochondria of a cell in the Cristae and the Matrix. The cristae is a wiggly inner membrane with a large

Surface area to create optimal ATP. The Matrix is the fluid inside the Cristae. The Blue Mussel uses Anaerobic respiration when there is no oxygen available for the cells inside the mussel because of the low tide and the survival mechanism of tightly closing their shells as not to dry out. When they tightly close their shell against a rock or surface, ^{in low tide} they are preventing their shell from drying out from the air, due to this there is no oxygen available for the mussel so must use Anaerobic respiration to produce ATP for itself. Anaerobic respiration is carried out in the cells when there is no oxygen available to be a reactant in the process so instead Anaerobic respiration is used to continue creating (not as much) ATP for the cell. An advantage of Anaerobic respiration in Blue mussels is that it allows them to continue creating ATP when there is no oxygen available. A disadvantage of Anaerobic respiration in Blue mussels is that it doesn't produce very much ATP energy so is not as efficient. An advantage of Aerobic respiration is that it produces lots of ATP (28-38) so is an efficient process. A disadvantage for aerobic respiration in Blue mussels is that it has to rely on the seawater dissolving the oxygen for it for the process, instead of it being readily available to use in the process.

MS

QUESTION THREE: MITOSIS

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The table below shows how mitosis occurs at different rates in different types of human cells.

Cell Type	Mitosis Rate (How often cells are replaced)
Skin cell	2 weeks - Not crucial to the
Liver cell	300 - 500 days
Intestinal - internal lining	4 - 5 days - Constantly material cells, must replace regularly
Intestinal - muscle and other tissues	16 years - large muscle?

Survival of human
to be replaced regularly
passing through, detaching

Discuss why the rate of mitosis varies in different human cells, using examples from the table above.

In your answer:

- explain the purpose of mitosis AND how it occurs
- provide reasons why the rate of mitosis varies in different types of human cells
- compare and contrast ALL the different types of cells in the table AND justify the mitosis rate in terms of cell function.

You may use diagrams in your answer.

Mitosis is the process of growth and repair in cells by creating ~~identical~~ ^{identical} copies (daughter cells) of the parent cells to replace them (growth & repair). Mitosis occurs in four main stages, Prophase, Metaphase, Anaphase and Telophase (P.M.A.T). For Mitosis to occur, Interphase must happen first to prepare the cells with new sets of DNA and organelles. Interphase consists of 3 main stages, G1, S and G2. In stage S the DNA in parent cells is replicated for Mitosis so the new cells created have an identical set of DNA to the parent cells, without DNA cells would be useless. Once Interphase is complete the cells can carry out Mitosis where ~~the~~ ^{two} chromosomes unravel and uncoil to form ^{two} chromatids joined at a centromere. The membrane enclosing the chromosomes disappears from view and the chromosomes line up at

the cell equator (the middle) and connect to spindle network fibers ^{one side of} at ~~V~~ each ~~side~~ chromatid. The spindle network fibres pull the chromosomes apart and to the opposite poles. As part of Cytokinesis the one cell then splits into two ^{daughter cells} with chromatids at each end. A nuclear membrane forms around the chromatids as now separate ^{daughter} cells and then coil and unravel into a complex shape out of view. The end result is two new daughter cells with identical copies of the original parent cells DNA. The rate of Mitosis varies in different types of human cells due to the factor of the stage of life they are in. For example cells that are ^{going through} ~~part of~~ infancy or Puberty will be growing and renewing faster than a liver cell for example which takes 300-500 days to carry out the process due to not needing to renew themselves often. Skin cells need replacing reasonably often due to the damage skin cells get being exposed to bacteria, the sunlight and other conditions. Because the skin and skin cells protect our body it's important the cells stay in reasonably good condition and go through the process of Mitosis often (2 weeks). The intestinal internal lining is replaced every 4-5 days due to materials like food and waste products passing through the intestine.

MB

Extra paper if required.

Write the question number(s) if applicable.

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NUMBER

Q3. regularly and detaching the inner ^{lining} cells. Therefore the intestinal internal lining cells need to be replaced more regularly ~~more~~ so the function of the ~~intestinus~~ is working well. The intestinal muscle and other tissue cells compared to the intestinal internal lining won't do Mitosis as often (16 years) because there won't be as much, if any, material coming into contact with these cells so won't get damaged or detached in need of the growth and repair of Mitosis. The rate of Mitosis varies in different types of human cells due to a few factors. The first one being the previously stated stage of life that the cell is at. Another being the availability of nutrients, so Mitosis can be carried out. And another factor being conditions like Temperature, pH level and inhibitors to the enzymes responsible for catalysing the Mitosis process. Because Mitosis is an enzyme controlled chemical reaction, the factors that affect the rate of enzyme activity will affect the rate of Mitosis.

Seen

Subject:	Biology	Standard:	91156	Total score:	16
Q	Grade score	Annotation			
1	M5	This is a low M5. The student has demonstrated knowledge of osmosis and of the chloroplast. There is some confusion with the light dependent and independent phases. The explanation of how temperature affects the rate is clear with the explanation of how water effects the rate being weaved through the entire answer.			
2	M5	This is a high M5. The student has clearly demonstrated knowledge of the different between the two processes and knows when they occur. There is some understanding about energy gains, although this is not comprehensive. Explanation on the benefit of aerobic respiration as well as the explanation of respiration ensured a Merit grade here.			
3	M6	A comprehensive answer is not provided for the process of, and need for mitosis. However a strong Merit is gained as this student shows clear knowledge of mitosis and its place in the cell cycle. They have linked the role of meiosis to the need for identical daughter cells. There are a couple of good points linking the rate of cell renewal to function. For example there is a good explanation of damage to the skin cells and growth needed more identical cells.			