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91156



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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.

Excellence

TOTAL

20

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QUESTION ONE: PHOTOSYNTHESISASSESSOR'S
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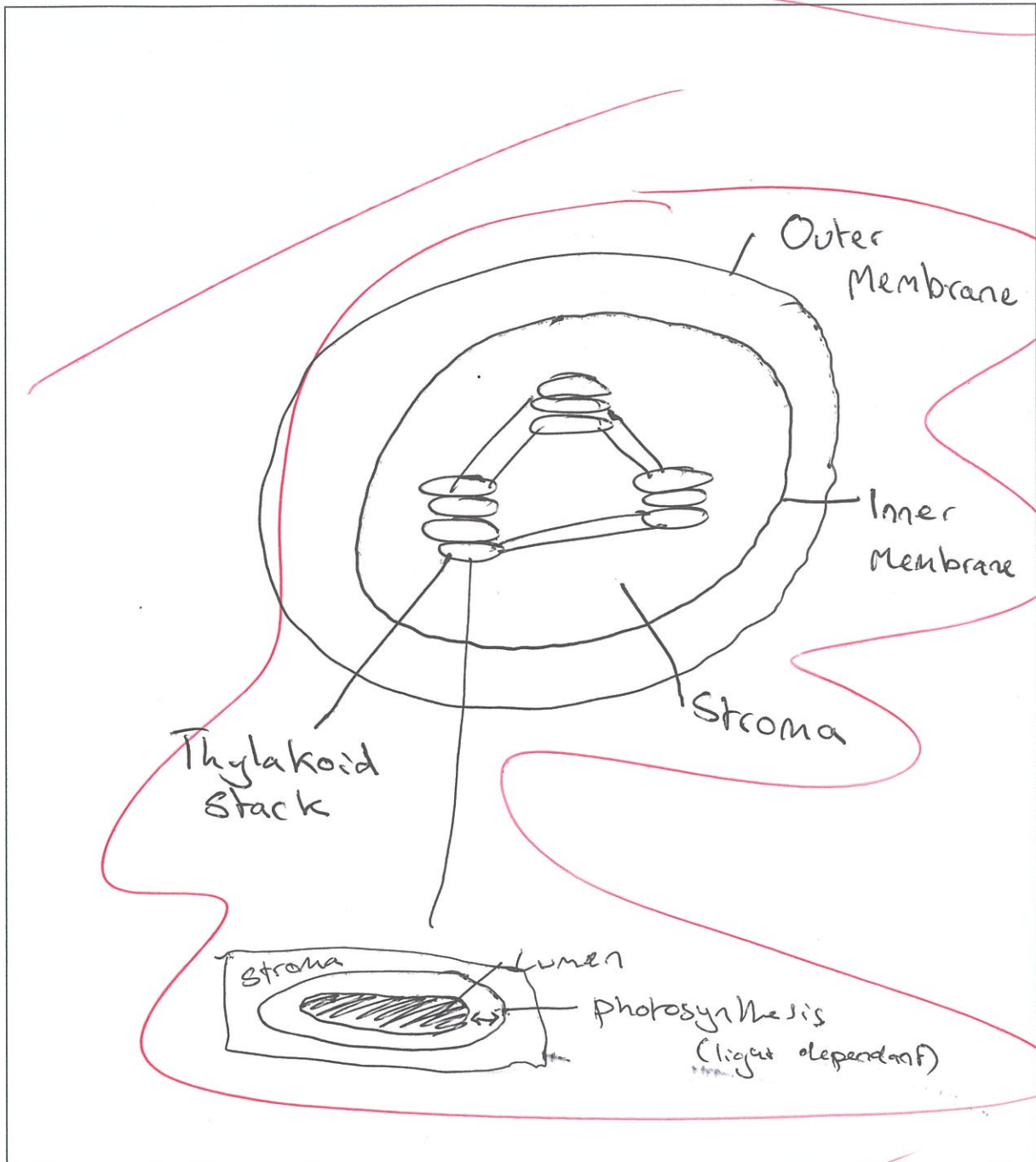
- (a) Describe osmosis AND explain how it occurs in root cells of a plant.

Osmosis is the movement of water from an area of high concentration to low concentration through a semi permeable membrane. It occurs down a concentration gradient and will cease if the distribution of water becomes equal. ~~It is passive & requires no energy.~~ ~~In a plant osmosis is used~~ energy. In a plant osmosis is used to transport water from ~~the~~ in the ground into the root cells of the plant. ~~At~~ the ends of the roots when they become very thin water diffuses through osmosis into the cells which have a lower concentration of water than the soil around them. The accumulation of water through osmosis in the roots of plants is necessary as it is one of the key reactants in the photosynthesis reaction plants use to gain energy ~~from~~ ^{and} ~~make~~ synthesis in order to complete life processes - such as growth.

- (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 $\xrightarrow{\text{Light}}$ Glucose + Oxygen + ATP



- (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 by which plants synthesise (make) food using sunlight. This ~~occurs~~ occurs in the chloroplasts of the cells. ~~The light dependant reaction~~ Light is needed twice in the process of photosynthesis and the ^{overall} reaction for ~~the~~ the light dependant process is $6H_2O + 6CO_2 \xrightarrow{\text{light}} C_6H_{12}O_6 + 6O_2 + \text{ATP}$. Light dependant reactions in ~~the plant~~ ^{sunlight} are reactions which require light to function, whereas light-independent reactions do not.

Water can effect the rate of photosynthesis because it is a reactant of the reaction. Plants require ~~water~~ H_2O molecules from the ground in order to split - and bind hydrogen with carbon dioxide, and release O_2 - ~~and~~ and thus form the ~~sugar~~ glucose (food) & energy they require. If there is abundant light & Carbon dioxide but no water the reaction cannot take place. Water is often the most limiting factor in a photosynthesis reaction, thus limiting the rate

of ATP energy production & thus the energy needed for life process. Water abundance can heavily influence the photosynthesis reaction as it is necessary - without it the plant cannot perform the reaction & will die.

Another factor affecting the rate of photosynthesis is ~~light intensity~~ ^{temperature} ~~enzymes~~ are necessary in carrying out the reaction, and enzymes have a specific set of conditions they can function in - outside of which they will cease to. One key aspect of this is temperature, and light intensity will raise the temperature. As the temperature rises & the number of collisions between enzymes and substrate will also rise increasing the rate of photosynthesis - in a colder ~~at lower~~ ^{temperatures} the collision rate, and thus photosynthesis rate will also fall. There will be an optimum temperature for the enzymes in the plant will function, optimising the rate of photosynthesis. Past this point the enzyme will denature, unravelling the proteins and distorting the active site rendering the enzyme unable to bond to substrate and react. If this occurs the rate of photosynthesis will slow, and likely come to a stop altogether.

M6
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QUESTION TWO: CELL RESPIRATION

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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.

Cellular respiration is the process by which cells release energy from food in order to maintain their cellular processes such as growth & repair. This respiration can either be anaerobic or aerobic. Anaerobic respiration is respiration which does not require oxygen to complete. This process occurs in the cytoplasm of the cell where in glycolysis glucose is broken down into two pyruvate and a small amount of ATP is produced. From this point the products undergo reactions which convert them into a different substance and waste products such as lactic acid. ethanol often in ~~organisms~~ ^{organisms}. A disadvantage of the process of anaerobic respiration is that it creates

far less ATP - the essential usable energy cells require to complete life processes. It produces ~~only~~ far less than the (roughly) 36 ATP one glucose molecule produces in aerobic respiration, and is thus a far less efficient process in terms of maintaining the energy levels the organism - such as the blue Mussel needs to live. As such it is often a back up method - such as in the blue mussel, used when oxygen is unavailable. Aerobic respiration requires oxygen to perform. It again begins with glycolysis in the cytoplasm of the cell, however - this process then moves inside the mitochondria where the Krebs cycle occurs in the enzyme filled matrix, and the electron transport chain occurs on the cristae - inner membrane of the organelle. $6O_2 + C_6H_{12}O_6 \rightarrow 6H_2O + 6CO_2 + ATP$. This method is more efficient as it produces more ATP - roughly 36, which is the overall ~~total~~ ^{purpose} of respiration. A disadvantage of aerobic respiration is its reliance on the presence of oxygen, as without it the reaction will not work. Oxygen is often the most limiting factor of the respiration reaction, thus slowing the rate of ^{aerobic} respiration and in the case of the blue mussel rendering it useless at low-tide. *

An advantage of this method however is that when oxygen is readily available & not limited, the rate of respiration in the organism - such as the mussel, is very high & fast, allowing the cells to complete processes & such as growth & repair efficiently - far more efficiently than amongst anaerobic respiration.

~~The downside being anaerobic~~ * This means ATP would not be produced & ^{necessary} cellular functions would be unable to continue - long term causing the death of the organism if this is its sole form of respiration. (see extras)

QUESTION THREE: MITOSIS

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
Liver cell	300 – 500 days
Intestinal – internal lining	4 – 5 days
Intestinal – muscle and other tissues	16 years

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 which occurs in cells after ^{DNA} cellular replication for growth, repair & regeneration. ~~then~~ Chromosomes align on the ^{equatorial} ~~equatorial~~ plane of the cell, before being pulled apart ^(at the centromere) to each end by spindle fibres. A nuclear membrane then forms around each set of chromosomes and the cell splits in two ^{daughter cells} – each identical to each other & the parent cell ~~the~~ due to the previous ~~cellular~~ DNA replication. The rate of mitosis varies in different types of cells due to cell type and function. Cells with high ~~the~~ requirements of growth and regeneration will have higher rates of mitosis due to their need – skin cells fall under this category. As humans grow and change, particularly in adolescence skin cells ^{must} ~~then~~ divide rapidly through mitosis in order to fit the need. Skin cells being on the outside of the body also sustain more damage through ~~the~~ injuries such as sunburn, cuts & grazes which require

them to regenerate and regrow damaged tissue. This is different to cells such as liver and intestinal ^{muscle} inside the body as they are less exposed and as such have less requirement for regeneration (through mitosis). This is why skin cells have the ^{second} highest rate of mitosis - due to their function in keeping up with growth & change, and exposure resulting in regeneration. ~~live cells~~ They ~~do~~ not require mitosis as frequently as intestinal lining cells however due to a different type of exposure. Intestinal lining cells are faced with damage more frequently than skin cells due to their function in enclosing ~~it~~ & being exposed to all food & matter which passes through the intestines. The exposure to this results in a high mitosis rate as regeneration is needed in order to maintain the lining and ensure it is not damaged or rubbed off as this would be extremely dangerous for the individual - the intestinal lining is in constant exposure 24/7 to potentially harmful matter & rubbing which in turn means it divides more than skin cells which ^{are} only exposed to circumstances requiring regeneration sometimes, and liver & intestinal body cells which are not in as demanding a circumstance. Liver cells, being an essential internal organ which processes ~~the~~ possible toxins such as alcohol is (although vital) not in a position as demanding as the skin or the intestinal lining. As liver cells process they wear out, requiring replacement when they are no longer working to the capacity at which the body requires

E7

Extra paper if required.

Write the question number(s) if applicable.

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Question 2. The advantage of anaerobic respiration is its reliability, as it does not have a limiting factor such as oxygen for aerobic. The blue ~~muscle~~ ^{muscle} can use anaerobic respiration to get the energy for its ^{essential} life processes at low tide when their shells are tightly closed. Without this process the muscle would die without the ATP energy ^{it needs} to live.

Seen

Question 3.

To complete its internal functions and stay healthy. The liver does not require as much growth as the skin, or as much regeneration due to constant contact as the intestinal lining and as such its function (although vital) does not have as higher demand for mitosis as those previously mentioned. It still however has a higher rate than the intestinal muscle & other tissues as it has a more active role in the functioning of the body ^{demand in the sense of processing & exposure to outside material} which does result in the need for replacement. Intestinal muscle & other cells have the lowest rate of mitosis on the chart due to their function in the body. These cells are not exposed to outside forces & as such are unlikely to be ~~exposed~~ damaged ~~the~~ and

Seen

Extra paper if required.

Write the question number(s) if applicable.

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inhibit their ~~var~~ ability - unlike the cells of the skin, liver & intestinal lining. As such they have a division through mitosis rate far lower than the other cells. Intestinal muscle (etc) cells act within the body to aid other cells - and would likely only be replaced through mitosis when they are eventually worn down and their ability inhibited, which would take ~~atong~~ a long time assuming the person didn't sustain injuries which caused the cells the need to regenerate. ~~Because~~ Although the skin, liver & intestinal cells would also divide for this reason, ~~the fact~~ it would be far less common as they divide for other reasons first. As such intestinal muscle cells have the ~~longest~~ slowest rate of mitosis out of the skin, liver, and intestinal lining.

Subject:		Biology	Standard:	91156	Total score:	20
Q	Grade score	Annotation				
1	M6	The fundamentals of the transport of water as well as the reactants and products have been clearly stated. The light dependent and independent reactions have been explained and link to the correct areas. The explanation of the impact of water availability was completed weakly as well alongside the effect of changing temperature which was done well.				
2	E7	A comprehensive answer is provided showing sound understanding of the nature of both anaerobic respiration and aerobic respiration. Unlike the majority of students this answer clearly showed when and where each process took place alongside an advantage and disadvantage of each. To gain E8 more explanation of the use of dissolved oxygen during the high tides of the day would be necessary.				
3	E7	A comprehensive answer is provided showing sound understanding of mitosis with the need for replication prior and the link to why many different named tissue types would require new cells at different rates. Mitosis was described and clearly linked to its occurrence times being when cells are damaged. Damage types were explained for each of the four cell types.				