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2

91156



NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

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Level 2 Biology, 2015

91156 Demonstrate understanding of life processes at the cellular level

9.30 a.m. Monday 16 November 2015

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 2–12 in the correct order and that none of these pages is blank.

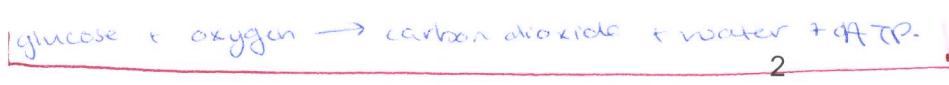
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Low
Achievement

TOTAL

8

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2

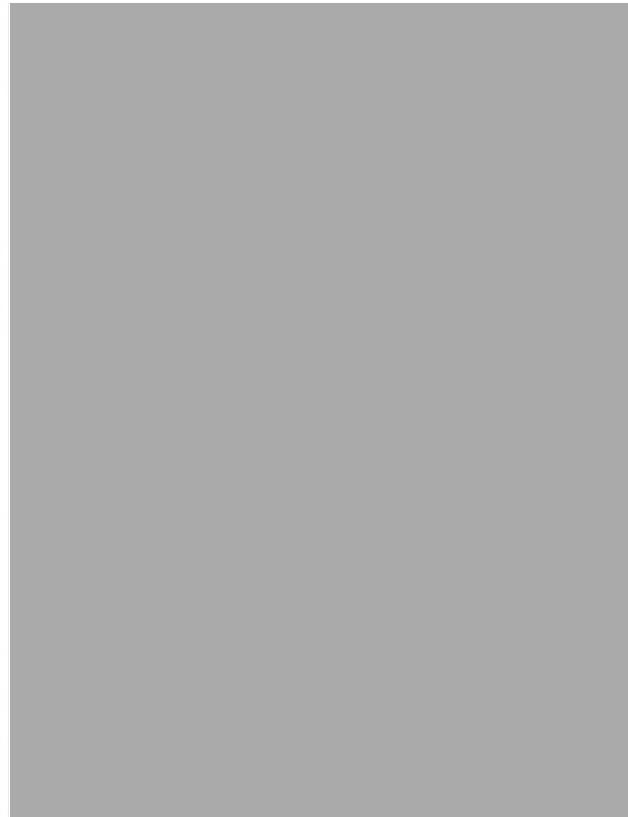
QUESTION ONE: RESPIRATION AND ENZYMES

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- (a) Describe the purpose of cellular respiration, AND where it occurs in the cell.

Cellular respiration occurs in the mitochondria of the cell and has the purpose of producing energy in the form of ATP.

- (b) The eastern oyster's (*Crassostrea virginica*) habitat is the rocky shore, which experiences large changes in environmental temperature and oxygen concentration. This habitat can also contain heavy metals, such as cadmium.



Eastern oyster (*Crassostrea virginica*)

<http://www.bily.com/pnwsc/web-content/Family%20Pages/Bivalves%20-%20Ostreidae,%20Anomiidae.html>

The eastern oyster's cellular respiration and enzyme activity are affected by environmental temperature, oxygen concentration, and cadmium.

Discuss how temperature, oxygen concentration, and cadmium can affect cellular respiration AND enzyme activity in the eastern oyster.

In your answer:

- describe the purpose of an enzyme
- explain how temperature and cadmium affect enzyme activity
- discuss how environmental temperature, oxygen concentration, and cadmium can affect the rate of cellular respiration in the eastern oyster.

You may use diagrams in your answer.

An enzyme is a biological catalyst with the purpose of speeding up reactions which otherwise may be very slow.

Temperature effects enzymes because they use heat energy and therefore are able to move faster and more efficiently, therefore the ~~enzyme~~ reaction will occur even faster due to the enzyme and ~~high~~ ~~at~~ temperature. Cadmium's pH level effects the enzyme activity and increases the rate of reaction.

As environmental temperature increases, the enzyme absorbs this heat energy and uses it to move more quickly and efficiently, increasing the rate of cellular respiration in the oyster until it reaches a plateau, where the other factors (~~top~~ oxygen concentration or pH level) are limited.



Increased oxygen concentration also increases the rate of ~~reaction~~ cellular respiration in the oyster because a higher concentration of oxygen molecules means that more successful reactions can occur. The ^{respiration} reaction will keep increasing until it reaches a plateau as factors like temperature or pH level becomes limiting.

There is more space for your answer to this question on the following page.

The cadmium metal would change the pH level of the oyster meaning the enzymes controlling the rated reaction for cellular respiration may change shape and become non-functioning. This would decrease the rate of reaction dramatically as the enzymes would not be able to catalyse the reaction. //

QUESTION TWO: MOVEMENT OF MATERIALS

The lugworm (*Arenicola marine*) lives on sandy shores where the salt water concentration can fluctuate slightly. To survive in this habitat, the lugworm **passively** adjusts the salt water concentration of its body to match the surrounding seawater. Oxygen consumption remains constant during this process.



<http://marinebio.org/species.asp?id=57>

The hogchoker (*Trinectes maculates*) lives in estuaries, where salt water concentration changes regularly. However, the hogchoker **actively** adjusts the salt water concentration of its body when in high salt concentration water. As salt concentration increases, oxygen consumption also increases.



http://www.okeefes.org/Photo_Journal/Summer_2013/Summer_2013.htm

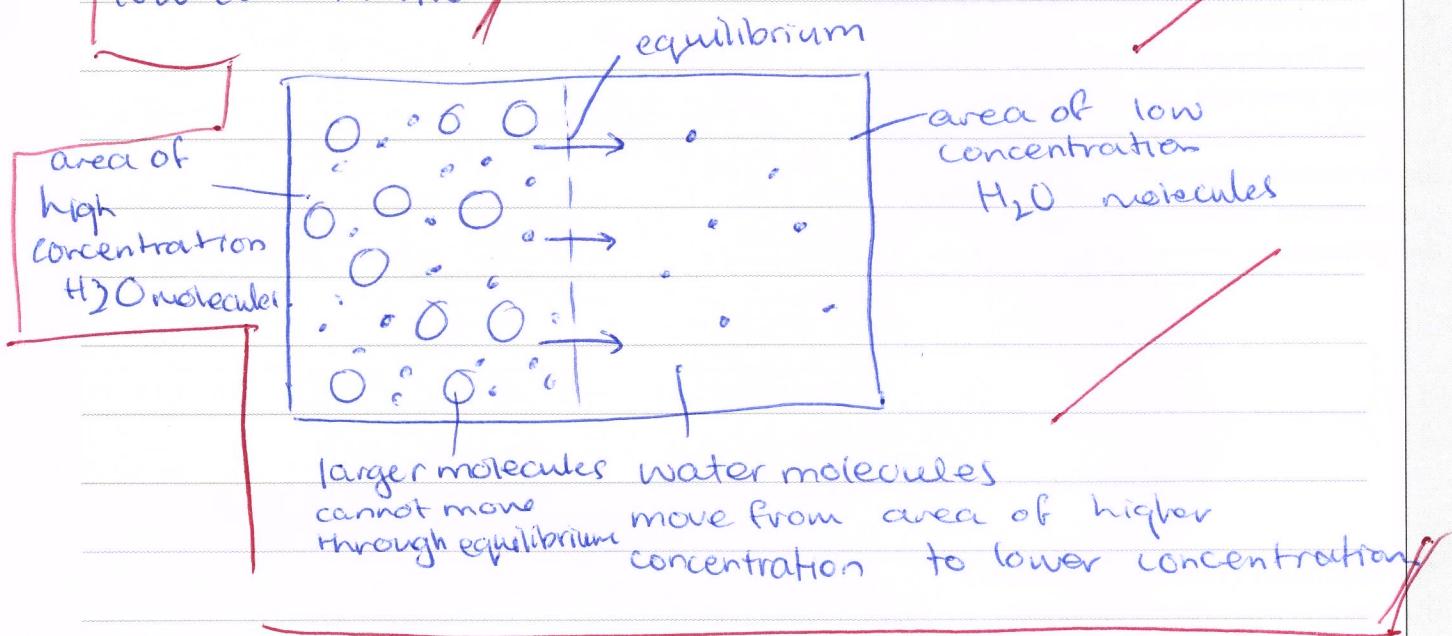
Discuss the movement of materials in the lugworm and hogchoker cells, and how oxygen consumption affects these processes.

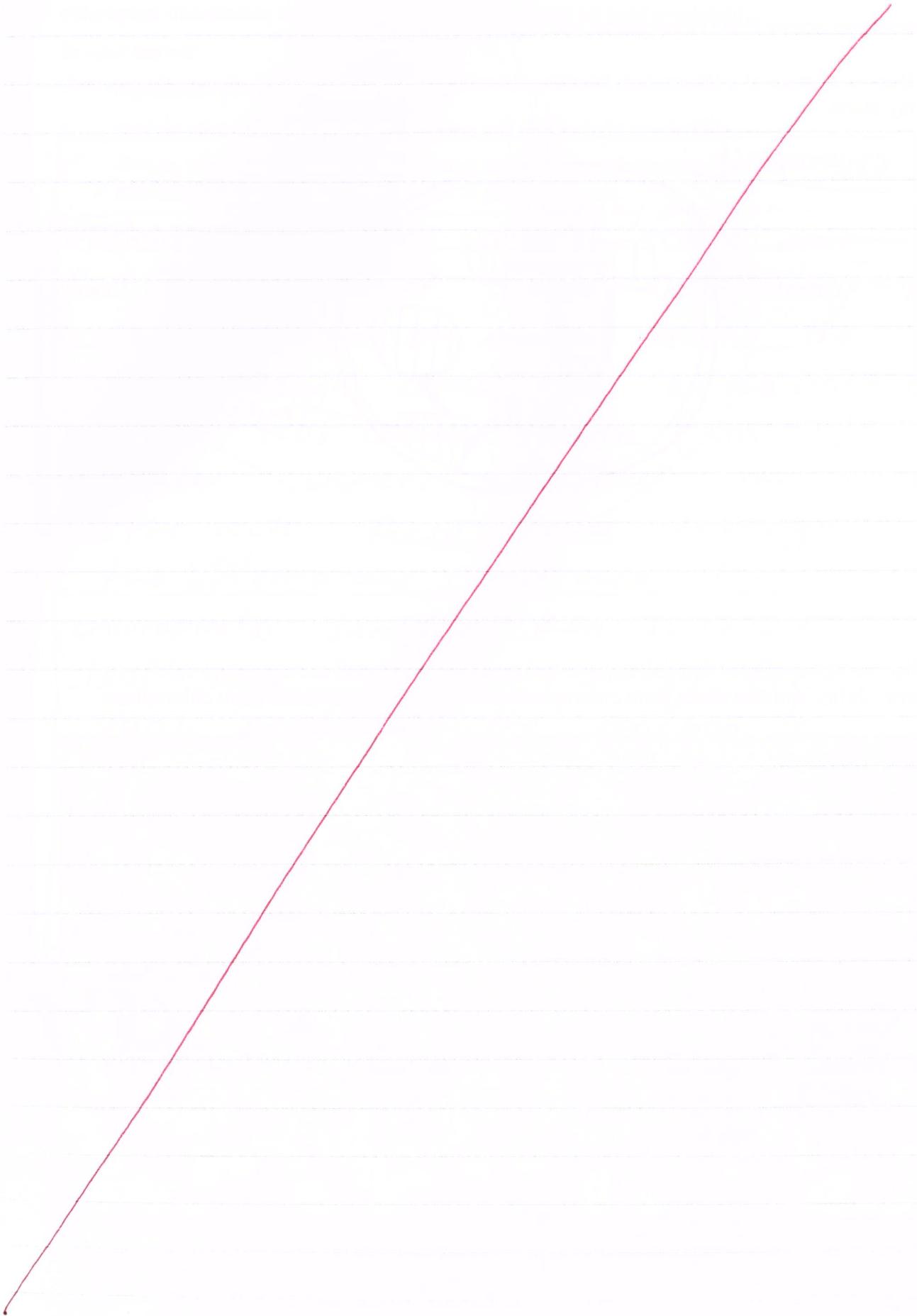
In your answer:

- describe diffusion, osmosis, and active transport
- explain how salt water moves across the cell membrane in a lugworm via osmosis and facilitated diffusion
- explain how salt water moves across the cell membrane in a hogchoker via osmosis and active transport
- discuss why oxygen consumption remains constant in the lugworm, whereas oxygen consumption increases in the hogchoker as salt water concentration increases, and link this to the life process of cellular respiration.

You may use diagrams in your answer.

osmosis is the movement of water particles from an area of high concentration to an area of low concentration.



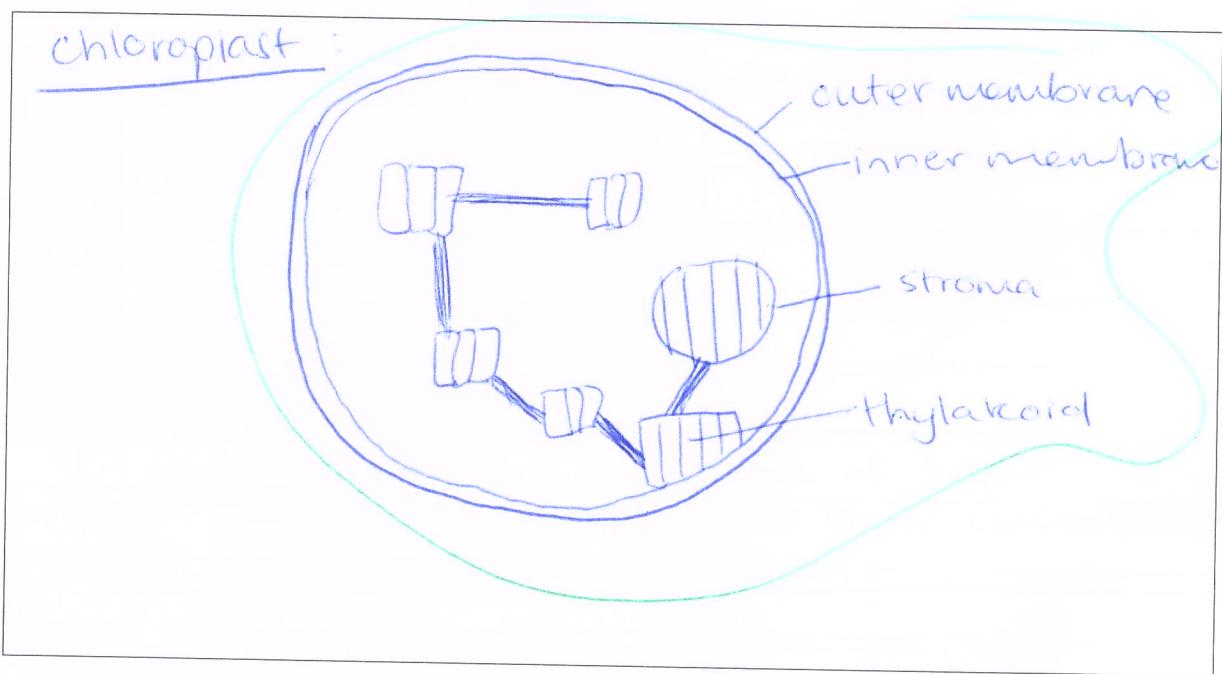


N1

QUESTION THREE: PHOTOSYNTHESIS

Photosynthesis occurs in the chloroplasts, and requires light energy.

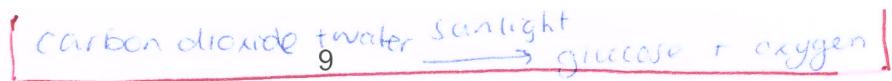
- (a) Draw a diagram of a chloroplast, labelling the outer membrane, inner membrane, stroma, and thylakoid.



- (b) Biologists have found that chloroplasts can move within the cell in response to light availability, and that shade plant chloroplasts are bigger than non-shade plant chloroplasts.



<http://www.shutterstock.com/video/clip-3943691-stock-footage-chloroplasts-in-the-living-plant-cells-under-microscope-magnification-x-phase-contrast.html>



Discuss why plants found in shady areas have bigger chloroplasts, and explain how chloroplast distribution within the cell can be influenced by light availability.

In your answer:

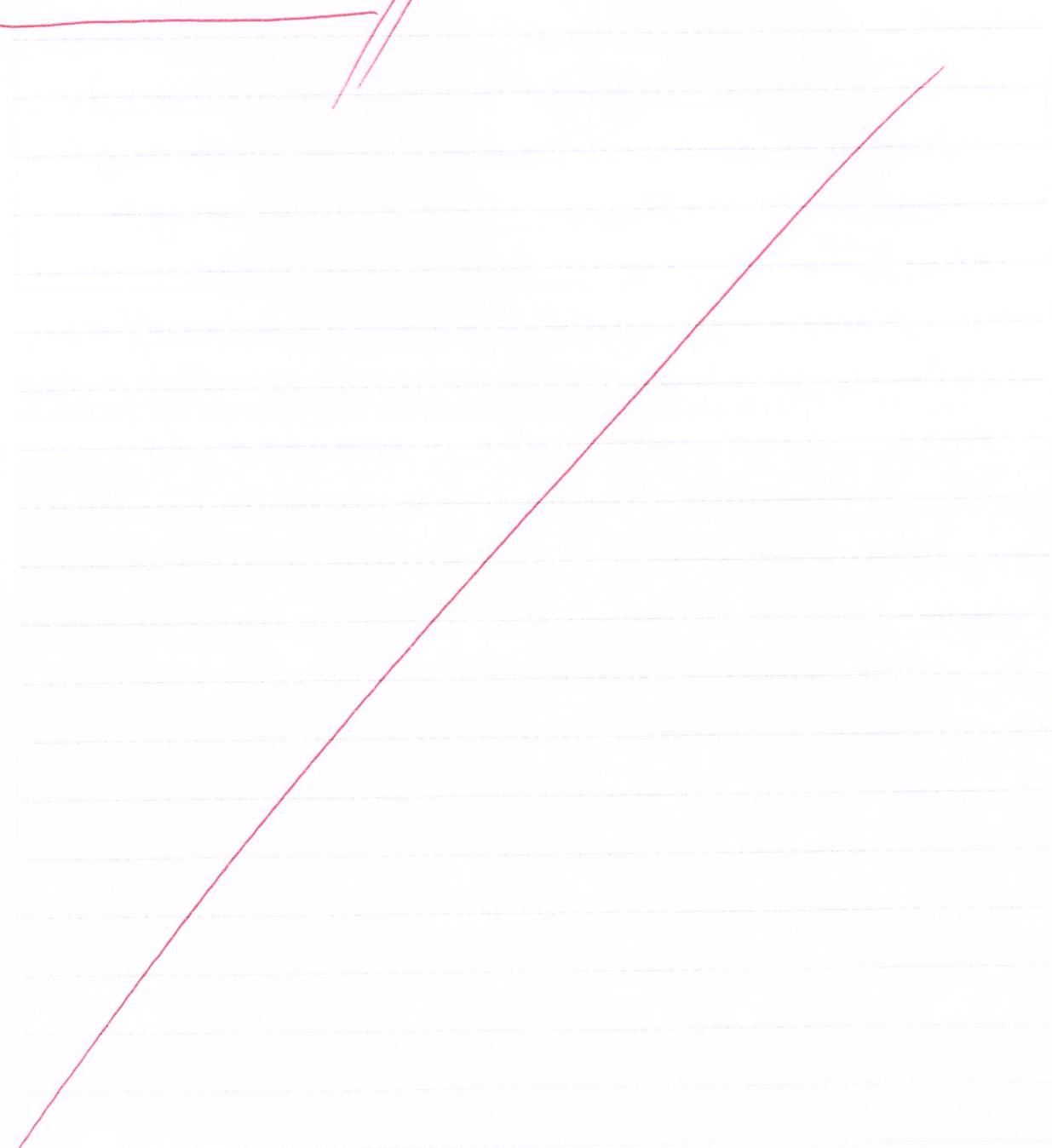
- explain the process of photosynthesis
- explain why chloroplasts move within a cell due to light availability
- discuss why plants found in shady areas have bigger chloroplasts than plants found in non-shady areas, and how this relates to photosynthesis.

Photosynthesis is the process of making energy food in the form of glucose. During photosynthesis carbon dioxide ~~is meet~~ enters the leaf through small holes on the underside of the leaf called stomata, (via air). Water enters the leaf through the roots. These travel through the ^{cell} membrane and into the chloroplasts. Sunlight then enters the leaf and the light energy from the sun is used in the reaction to form glucose. Oxygen is produced as a waste product and is released from the chloroplasts and travels through the cell membrane to ~~the~~ and out of the stroma.

Glucose is then used as energy in respiration or transferred into starch. Chloroplasts move within a cell due to light availability because light energy is needed for the photosynthesis process to occur. Therefore, plants found in shady areas have bigger chloroplasts in order to absorb as much light as possible.

There is more space for your answer to this question on the following page.

whereas plants in non-shady areas have a large amount of light readily available to them, and the light is more concentrated therefore ~~they~~ ^{the chloroplasts} do not need to become larger. To absorb more light as they already have the sufficient amount of light needed in order to produce enough heat energy for their photosynthesis.



A3

QUESTION
NUMBER

**Extra paper if required.
Write the question number(s) if applicable.**

ASSESSOR'S
USE ONLY

QUESTION
NUMBER

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ASSESSOR'S
USE ONLY**91156**

2

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High
Achievement

TOTAL

11

ASSESSOR'S USE ONLY



+
water
+
ATP

QUESTION ONE: RESPIRATION AND ENZYMES

- (a) Describe the purpose of cellular respiration, AND where it occurs in the cell.

Respiration is the process by which a cell gains energy. It involves the breakdown of glucose and oxygen to form carbon dioxide, water and ATP (energy). This occurs in the mitochondria.

- (b) The eastern oyster's (*Crassostrea virginica*) habitat is the rocky shore, which experiences large changes in environmental temperature and oxygen concentration. This habitat can also contain heavy metals, such as cadmium.

Eastern oyster (*Crassostrea virginica*)

<http://www.bily.com/pnwsc/web-content/Family%20Pages/Bivalves%20-%20Ostreidae,%20Anomiidae.html>

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Discuss how temperature, oxygen concentration, and cadmium can affect cellular respiration AND enzyme activity in the eastern oyster.

In your answer:

- describe the purpose of an enzyme
- explain how temperature and cadmium affect enzyme activity
- discuss how environmental temperature, oxygen concentration, and cadmium can affect the rate of cellular respiration in the eastern oyster.

You may use diagrams in your answer.

An enzyme is a protein that catalyses reactions (speeds them up) and helps to increase the rate of reaction, increasing product formed.

As temperature increases, the particles gain more kinetic energy and therefore move faster.

Because particles are moving at an increased speed, ^{there} is an increase in ~~wandering~~ and therefore an increase in ^{collisions} and an increase in reaction rate collisions in successful collisions! There is an optimal temperature which the enzyme works best at, reaction rate will be highest here. Above this temperature, the enzyme will begin to denature as its bonds begin to break! If temperature is low, reaction rate will ^{no product will be formed or very little.} be slow.

An increase in oxygen means an increase in reaction rate, and therefore increase cellular respiration due to there being more reactant.

There is more space for your answer to this question on the following page.

AKC

QUESTION TWO: MOVEMENT OF MATERIALS

The lugworm (*Arenicola marine*) lives on sandy shores where the salt water concentration can fluctuate slightly. To survive in this habitat, the lugworm **passively** adjusts the salt water concentration of its body to match the surrounding seawater. Oxygen consumption remains constant during this process.

Passive transport
high → low

<http://marinebio.org/species.asp?id=57>

The hogchoker (*Trinectes maculates*) lives in estuaries, where salt water concentration changes regularly. However, the hogchoker **actively** adjusts the salt water concentration of its body when in high salt concentration water. As salt concentration increases, oxygen consumption also increases.

Active transport
-energy required
low → high

http://www.okeefes.org/Photo_Journal/Summer_2013/Summer_2013.htm

Discuss the movement of materials in the lugworm and hogchoker cells, and how oxygen consumption affects these processes.

In your answer:

- describe diffusion, osmosis, and active transport
- explain how salt water moves across the cell membrane in a lugworm via osmosis and facilitated diffusion
- explain how salt water moves across the cell membrane in a hogchoker via osmosis and active transport
- discuss why oxygen consumption remains constant in the lugworm, whereas oxygen consumption increases in the hogchoker as salt water concentration increases, and link this to the life process of cellular respiration.

You may use diagrams in your answer.

Diffusion is the net movement of molecules from an area of high concentration to an area of low concentration. (This is with the concentration gradient so no energy is required).

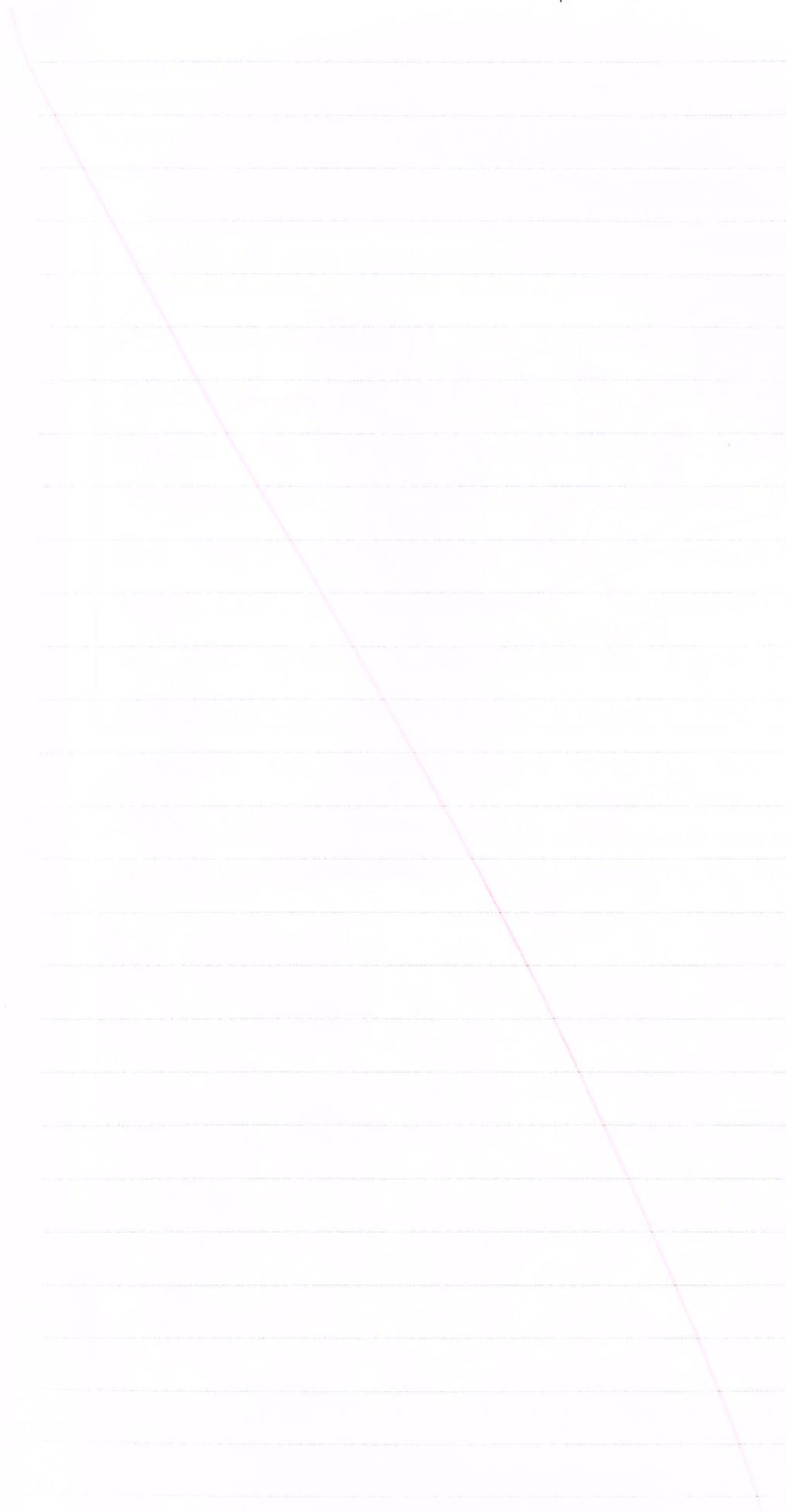
Osmosis is the net movement of water molecules from an area of high concentration to an area of low concentration through a semi-permeable membrane.

Active transport requires energy to occur as it is the process of moving ions or molecules against their concentration gradient - ^{area of} low conc. to an ~~an~~ area of high conc.

Salt water moves across the cell membrane in a hoghocker

~~Magnification~~ via osmosis and active transport.

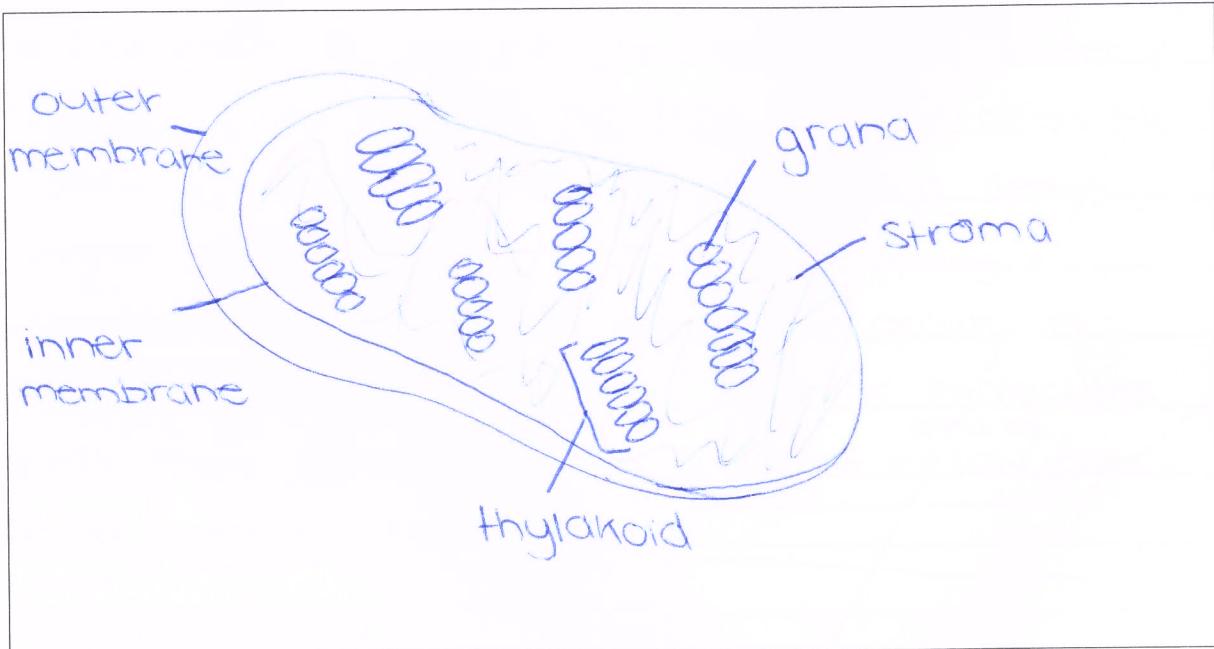
In active transport, energy is required as the molecules are being moved against their concentration gradient. An ion channel allows specific ions ~~and~~ to pass through. The carrier proteins embedded in the membrane bind themselves to the molecules, ^{change} ~~and~~ shape and deposit the molecule on the other side of the membrane before returning to its original position.




QUESTION THREE: PHOTOSYNTHESIS

Photosynthesis occurs in the chloroplasts, and requires light energy.

- (a) Draw a diagram of a chloroplast, labelling the outer membrane, inner membrane, stroma, and thylakoid.



- (b) Biologists have found that chloroplasts can move within the cell in response to light availability, and that shade plant chloroplasts are bigger than non-shade plant chloroplasts.

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Discuss why plants found in shady areas have bigger chloroplasts, and explain how chloroplast distribution within the cell can be influenced by light availability.

In your answer:

- explain the process of photosynthesis
- explain why chloroplasts move within a cell due to light availability
- discuss why plants found in shady areas have bigger chloroplasts than plants found in non-shady areas, and how this relates to photosynthesis.

Photosynthesis is the process which produces glucose and ^(ATP) by using energy from light. $\text{Carbon dioxide} + \text{water} \rightarrow \text{glucose} + \text{oxygen}$

Thylakoids are stacked because it increases the ~~max~~ surface area and therefore ~~max~~ maximum light can be absorbed. Chlorophyll is found in the grana and absorbs light energy.

Chlorophyll will move within the cell to absorb as much light energy as they can as this light energy will ^{eventually} be converted into glucose and ATP which is the ultimate purpose behind photosynthesis.

Photosynthesis is affected by the light intensity a plant will receive. In non-shady areas, the plants will be able to absorb lots of light energy as it is directly hitting them. This means the chloroplast does not need to do much work in order to absorb the light energy, and therefore has no need to be big. Shady areas mean~~s~~ plants will have difficulty absorbing light as part of it is blocked out. In order for the chloroplast to be able to function and produce glucose and ATP, it needs light energy.

There is more space for your answer to this question on the following page.

10

The chloroplast ~~would~~ therefore be bigger in order to increase its surface area, and chlorophyll present. Because the chloroplast is bigger, it is able to absorb more lighting so it can continue functioning.

Therefore, non-shade chloroplasts will be smaller than shade chloroplasts as it does not need to ~~work~~ harder and increase its size in order to absorb maximum light energy.

AG

**Extra paper if required.
Write the question number(s) if applicable.**

QUESTION
NUMBER

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QUESTION
NUMBER

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91156

Low A - Score of 08

Question	Commentary
1	The candidate received a score of A4 by showing a clear understanding of respiration in terms of its purpose, location and the word equation. The candidate also adequately described the generic role of enzymes and temperature. In order to gain a higher score, the candidate needed to make clearer links between the factors listed in the question and the rate of enzyme action – explaining how or why temperature changed the rate for example.
2	This response only provides evidence towards understanding of Osmosis. As this definition was incomplete only an N1 could be awarded. More explicitly incorporating the idea of a semi permeable membrane would have allowed N2 to be awarded.
3	The response for part (a) has the stroma labeled incorrectly. The candidate provides a correct word equation for photosynthesis and links larger chloroplasts to the concept of getting more light for the process. This provided sufficient evidence to gain an A3. An A4 could have been awarded had the candidate described why the chloroplasts move or correctly labeled their diagram in part (a).

High A - score of 11

Question	Commentary
1	The candidate was awarded an A4 because they have shown very good recall of the process, its purpose and location. They have provided a word equation and also know the function of enzymes. They have related temperature to enzyme action at the merit level. They may have been awarded an M5 if they had provided an explanation of Denaturing, Explained the role of Cadmium or made a more detailed link between oxygen levels and either enzyme action or respiration.
2	The candidate was awarded A3 as they provided definitions for three processes at the appropriate level. A higher score could have been awarded had they shown evidence of linking these processes to the two organisms given in the question or provided a greater explanation as to why O ₂ consumption levels varied between the two.
3	The candidate has incorrectly labeled Thylakoid and Grana in part (a). They have been awarded an A4 as they have described the process of photosynthesis and have given unexplained reasons why the chloroplasts move and are larger in shaded plants. They have begun to explain why chloroplasts are larger in shaded plants but would have required another explanation in order to gain M5.