2

SUPERVISOR'S USE ONLY

91156

911560

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

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.

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

Low Merit

TOTAL 14

ASSESSOR'S USE ONLY

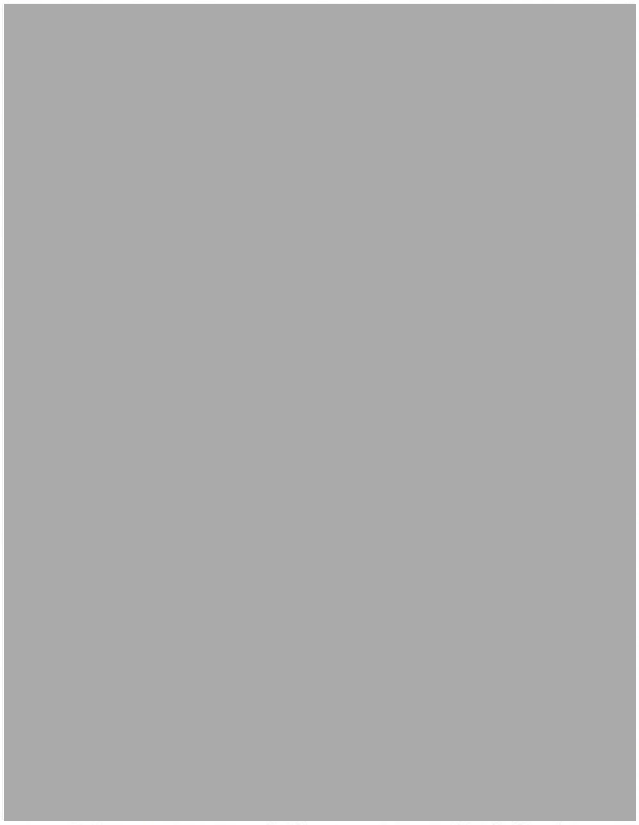
QUESTION ONE: RESPIRATION AND ENZYMES

ASSESSOR'S USE ONLY

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

Cellular respiration is the production of energy in the form of ATP, it allows organisms to carry out essential life processes that wouldnt be possible without energy. Cellular respiration 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

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.

ASSESSOR'S USE ONLY

Plan: purpose enzyme to catalyse reactions - anabolic (making) or catabolic (breaking) of substrates. Explain temp and enzyme poisons - temp changes active site shape bec. enzymes are proteins. Cadmium can kill enzymes when present. temp incr. to a point speeds up reactions - more collisions bec. faster moving particles. low temp slow parti - less colis. Too high temp denatures enzymes. ← Discuss in terms of oyster → talk about oxygen concentr. - how its required for respiration to occur $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ in terms of oyster.

The purpose of an enzyme is to catalyse reactions (speed them up) by joining substrates (anabolic reaction) or breaking down substrates (catabolic reaction). Enzymes work best in specific conditions depending on their location in an organism, however all enzymes can be effected by temperature and enzyme poisons. Temperature can either slow down enzyme activity in cold temperatures because when an enzyme gets cold, it moves slower meaning less collisions take place. In low temperature extremes, the rate of enzyme activity can slow down greatly or enzymes can even stop catalysing reactions at all. Most animal cell enzymes are most comfortable at temperatures between 30-35°C - this is when enzymes are working most efficiently because they are moving around lots and lots of collisions with substrates can happen therefore enzyme activity increases in warm temperatures. In high temperatures however, enzyme activity can slow and even come to a stop because as enzymes are proteins, they change shape in high temperatures, this means that the active site of an enzyme changes shape and can no longer catalyse reactions when temperatures get too hot - this is called denaturing. The presence of cadmium can affect enzyme activity because heavy metals are poisonous to enzymes (they are called enzyme poisons) therefore the presence of cadminum will slow enzyme activity if there is only

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

ASSESSOR'S USE ONLY

small amounts, or if their is enough cadmium present, it can stop enzyme activity all together. Enzyme poisons bind to the enzyme and stops it from being able to catalyse reactions. Environmental temperature, oxygen concentration and cadmium can affect the rate of cellular respiration in the eastern oyster because in order for respiration to occur, enzymes need to be functioning in the oyster, so if temperatures are too high or too low, the rate of respiration will be slower or stop, likewise with the presence of cadmium as an enzyme poison, if it kills all the enzymes respiration will not be possible but if it kills some of the enzymes, the cellular respiration rate will be slow. As organisms such as the eastern oyster require oxygen in order to respirate, ($C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$) a low oxygen concentration will result in low respiration rates because without oxygen the mitochondria would not be able to produce ATP. The rate of respiration will increase as the oxygen concentration increases because cellular respiration will be able to happen without waiting for oxygen molecules, however once respiration gets to its optimum speed, increased oxygen concentration will no longer speed up respiration because there would be something else limiting the speed of respiration (such as substrate concentration, temperature or enzyme poisons). Therefore the rate of cellular respiration in the eastern oyster will be faster when it has high concentrations of oxygen, no cadmium present and comfortable temperatures for the enzymes.

M5

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:

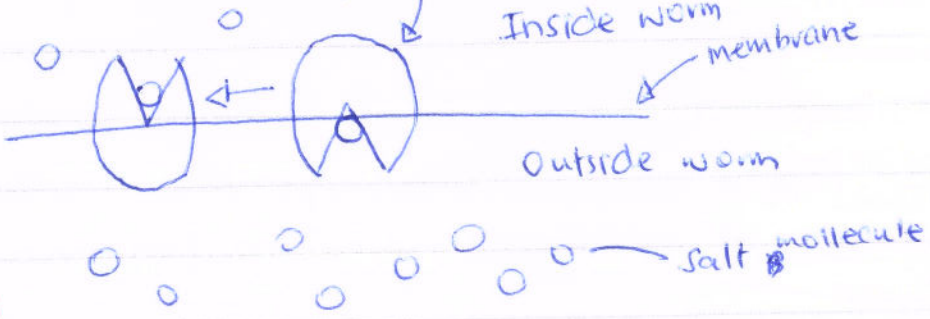
- describe diffusion, osmosis, and active transport
- explain how salt water moves across the cell membrane in a lugworm via osmosis and facilitated diffusion
- explain how salt water moves across the cell membrane in a hogchoker via osmosis and active transport
- discuss why oxygen consumption remains 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.

ASSESSOR'S USE ONLY

Plan: Diffusion - the net movement of particles from an area of high concentration to an area of low concentration. Osmosis - the diffusion of water across a semi permiable membrane. Active transport - the movement of materials across a membrane through ____'s against conc. grad. Lungworm: Osmosis from high solute concentration to low solute concentration, facilitated diffusion moving salt particles into the worm. Hogchocker: Osmosis from high solute to low solute conc., Active transport brings molecules across membrane through ( ) - these things against conc. grad. Lungworm doesn't require ATP therefore no extra oxygen required, Hogchocker does require extra ATP because active transpot requires energy therefore move oxygen to compensate. - link to resp.

Diffusion is the net movement of particles from an area of ~~low~~ high concentration to an area of ~~high~~ low concentration. Osmosis is the diffusion of water across a semi-permiable membrane. ~~from an area of high~~ Active transport is the movement of materials against the concentration gradient, it requires ATP because it is moving against the gradient. In the lungworm, ~~salt~~ water moves across the cell membrane through Osmosis as the water is moving from the ~~high~~ low solute concentration to the ~~low~~ high solute concentration and facilitated diffusion is moving the salt ~~par~~ molecules across the membrane through small things in the membrane which allow the larger molecules through, See diagram



In the Hogchocker Osmosis is occuring from the water with the ~~high~~ low solute concentration to the high solute concentration inside the fish, Active transport is bringing the salt molecules across the membrane against the concentration gradient

ASSESSOR'S USE ONLY

Because active transport is moving molecules against the concentration gradient, it requires energy in the form of ATP. In order to produce extra energy through cellular respiration, the Hagcheeker needs to have more oxygen in order for respiration to work because respiration requires oxygen. Therefore the Hagcheeker must consume more oxygen. In the lugworms case, neither osmosis or diffusion are active processes so it does not need to increase its oxygen consumption for more ATP to be produced because it doesn't need any extra ATP.

Respiration: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$

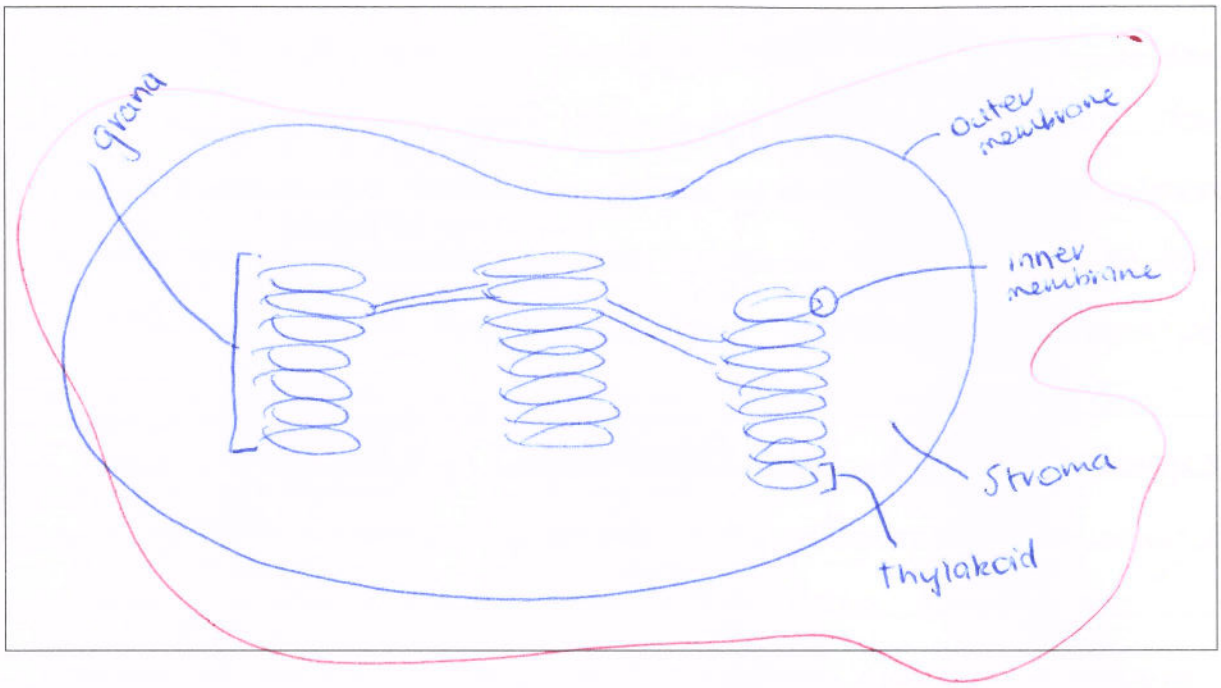
MS

QUESTION THREE: PHOTOSYNTHESIS

ASSESSOR'S USE ONLY

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.

ASSESSOR'S USE ONLY

Photosynthesis is the production of energy in the form of glucose in a plant with green pigment called chlorophyll. Photosynthesis occurs in the organelle called the chloroplast, the chloroplast is a long, flat oval shaped organelle with stacks of thylakoids providing it with lots of surface area for photosynthesis to occur across. The green pigment of the chlorophyll found in the stroma of the chloroplast traps light and uses it to split the water ~~from the~~ into a hydrogen atom and two oxygen atoms - the oxygen being the waste product gets diffused from the cell and the hydrogen gets pushed through ATP synthase to produce ~~AT~~ ATP which then gets broken up in a series of reactions which occur in the Krebbs cycle. These reactions ~~produce~~ remove one of the phosphate molecules from the ATP making it ADP, this ~~means~~ is then made into glucose which plants either use for energy or store as fat. Chloroplasts move within a cell due to light availability because in order for photosynthesis to occur it requires light and the more light a chloroplast gets, the faster photosynthesis can occur. Plants found in shady areas have

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

ASSESSOR'S USE ONLY

Bigger chloroplasts ~~because~~ than plants found in non shady areas because plants found in shady areas have less light available to them so need chloroplasts with a bigger surface area in order to trap more light and continue the process of photosynthesis. Plants in areas that get lots of light dont have to work as hard to get their sunlight so do not need their chloroplasts to have larger surface areas. By moving towards the source of light chloroplasts are able to get more light faster and photosynthesise faster.

Photosynthesis : $C_6H_{12}O_6 \rightarrow 6C$

$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

Carbon dioxide + water and sunlight and chlorophyl ⟶ glucose + oxygen

A4

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

91156

91156

911560

2

SUPERVISOR'S USE ONLY

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

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.

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

High Merit

TOTAL 16

ASSESSOR'S USE ONLY

QUESTION ONE: RESPIRATION AND ENZYMES

ASSESSOR'S USE ONLY

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

Cellular respiration is an enzyme controlled reaction of the breakdown of glucose into a useable form of energy for cellular processes & 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

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.

ASSESSOR'S USE ONLY

An enzyme is a biological catalyst that speeds up chemical reactions such as respiration without being used up themselves. Temperature effects enzyme activity because enzymes work at an optimum temperature. If the temperature becomes too hot the enzyme will denature which means that it permenantly changes shape so can no longer function. If the temperature becomes cooler than optimum temperature the enzyme activity slows but doesn't denature which means that if the temperature was to increase back to optimum the enzymes would function. Cadium is a heavy metal which acts as an inhibitor to enzymes. If the inhibitor is in the active site this means that the substrate cannot bind to the active site so the reaction cannot take place. A non-competitive inhibitor binds to the enzyme away from the active site which ~~stops~~ stops the substrate from joining the active site as enzymes are specific so the change in shape means that enzymes no longer function. Environmental temperature, oxygen concentration & cadum can effect the rate of cellular respiration. Temperature can effect the rate of cellular respiration as the temperature increases, the rate of cellular respiration does up until a certain point where the enzyme denatures as cellular respiration is controlled by enzymes. Oxygen concentration has a huge impact on cellular respiration as it

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

ASSESSOR'S USE ONLY

is split into 3 stages - Glycolysis, Krebs cycle & electron transport chain. If there is no oxygen present only one stage of cellular respiration can be carried out - Glycolysis as it carries out anaerobic respiration which means it ~~only~~ doesn't need oxygen but only produces 2 units of ATP. The more oxygen the more ATP will be produced as all stages can be carried out. Cadium can effect the rate of cellular respiration as respiration is enzyme controlled and cadium is an inhibitor which means that the active site cannot bond to the substrate so the reaction cannot take place as the active site has changed shape due to the inhibitor and enzymes are specific so respiration would not take place.

~~Aerobic~~ Respiration equation is:

$6O_2 + C_6H_{12}O_6 \rightarrow 6CO_2 + 6H_2O + ATP$

~~Anaero~~

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.

ASSESSOR'S USE ONLY

Diffusion is the movement of materials down the concentration gradient from an area of high concentration to low concentration. Osmosis is the movement of water molecules across a semi-permeable membrane from an area of high concentration to low concentration down a concentration gradient. Active transport is the movement of materials against the concentration gradient through a semi-permeable membrane from an area of low concentration to high concentration. Facilitated diffusion is the movement of materials down the concentration gradient through the use of channel & carrier proteins. The lugworm moves salt water through the semi-permeable membranes passivly via osmosis as they are water molecules going from an area of high concentration (sea) to an area of low concentration (inside the lugworm). Seeing as it is ~~water~~ water molecules it has to be carried out via facilitated diffusion due to the plasma membrane & the ~~phosph~~ prospolipid bilayer. The heads on this bilayer don't mind water but the tails dislike water so the lugworm has to carry out facilitated diffusion for # osmosis to occur. The hogcholer moves salt water via osmosis & active transport. Osmosis moves the salt water from the sea into the hogcholer due to it being part of passive transport which moves water molecules down the concentration gradient. When in high levels of salt water the hogcholer using active transport such as ~~endocytosis & pin~~

ASSESSOR'S USE ONLY

~~to regulate~~ ion pumps to go against the concentration gradient decreasing the ~~salt~~ salty water concentration further in the hogchoker. Active transport requires energy which is why the hogchokers oxygen intake increases to produce more energy for active transport compared to the lugworm which carries out passive transport so doesn't require energy. Respiration produces energy in a useable form so the hogchoker can use it for ~~respiration~~ active transport. By using active transport the hogchoker has a higher energy requirement than the lugworm which means the hogchoker needs more oxygen to carry out more respiration to produce more energy

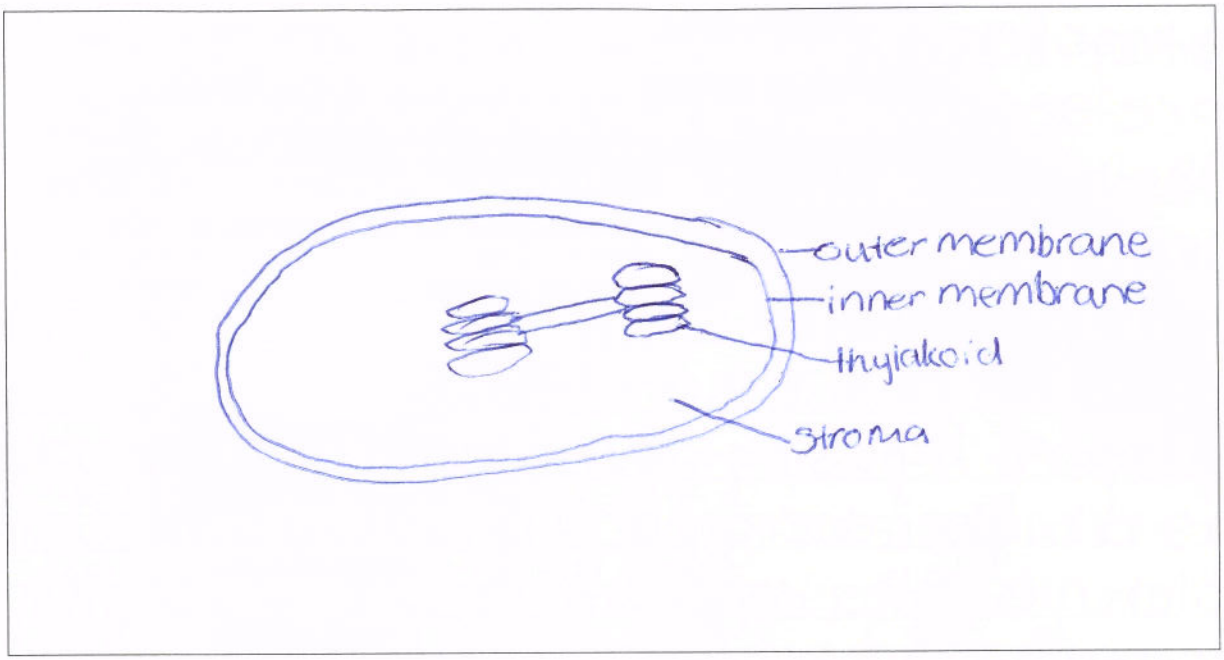
1/5

QUESTION THREE: PHOTOSYNTHESIS

ASSESS USE O

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

ASSESSOR'S USE ONLY

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.

~~$6CO_2 + C_6H_{12}O_6$ sunlight~~

$6CO_2 + 6H_2O \xrightarrow{\text{sunlight}} 6O_2 + C_6H_{12}O_6$

Photosynthesis is an enzyme controlled reaction that uses carbon dioxide, water & sunlight to create glucose & oxygen. Chloroplasts move within a cell due to light availability as for the whole of photosynthesis to occur light is needed, so move to access light. Plants found in shady areas have bigger chloroplasts as it increases surface area which means that more sunlight can be absorbed for those plants in the shady area which will help to increase the rate of photosynthesis, producing more glucose and oxygen for other cellular processes. Plants found in non-shady areas have smaller chloroplasts than those in shady areas as they have excess light and the chloroplasts become saturated before the light would run out, which means that those in the sun will be running always at the maximum rate of photosynthesis. When there is adlib sunlight the chloroplasts are spread even so they all absorb sunlight, but

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

When~~is~~ in shady areas they bunch to try and keep the photosynthesis rate as high as possible & absorb the maximum ~~amount~~ amount of sunlight possible.

ASSESS
USE O

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

91156

Low M - score of 14

Question	Commentary
1	The candidate is awarded M5 as they fully explain the effect of temperature on enzyme activity and the effect of oxygen concentration on respiration. An M6 would have been awarded if the candidate had provided further explanation as to how or why denaturing takes place and affects the enzyme action or how or why cadmium causes the enzyme action to decrease / stop.
2	The candidate is awarded M5 as they have explained the movement of substances across the lugworm and have explained the role of respiration in cell membrane transport. They could have gained an M6 or higher by giving a more detailed explanation of transport across the Hogchoker's membrane and/or explaining why the O2 consumption increased in higher salt concentrations.
3	The candidate has incorrectly labeled the inner membrane in part (a). The candidate is awarded A4 as they have described the process and given reasons why chloroplasts move around and are larger in shaded plants. They have explained why they are larger but this is their only explanation. To gain an M5 or better they would need to explain the process in terms of H2 and CO2 forming glucose and/or explained the movement of Chloroplasts with regard to how or why they get more light.

High M - score of 16

Question	Commentary
1	A score of M6 is awarded because the candidate explains the effect of Cadmium on an enzyme and also explains how cadmium can change the shape of the active site / denature the enzyme. They explain the effect of oxygen and relate this clearly to the rate of respiration. An E7 may have been awarded if the candidate had comprehensively explained the effects of temperature and adequately related this, or the role of cadmium, to the rate of respiration.
2	An M5 was awarded as the candidate has explained the transport occurring in the Hogchoker and has also explained the role of respiration in terms of providing energy for active transport. This candidate could have gained an M6 or better by providing a more accurate explanation of transport in the lugworm or by linking the increase O2 consumption to increased salt levels in the Hogchokers environment.
3	The candidate has gained an M5 as they have explained why shaded plants have larger chloroplasts and why non-shaded plants do not need larger chloroplasts. They may have been awarded an M6 or better if they had also explained the movement of chloroplasts or the process of photosynthesis or provided clearer justification as to why the chloroplasts are bigger.