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91156



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## Level 2 Biology, 2016

### 91156 Demonstrate understanding of life processes at the cellular level

9.30 a.m. Friday 18 November 2016  
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.**

TOTAL

Merit

17

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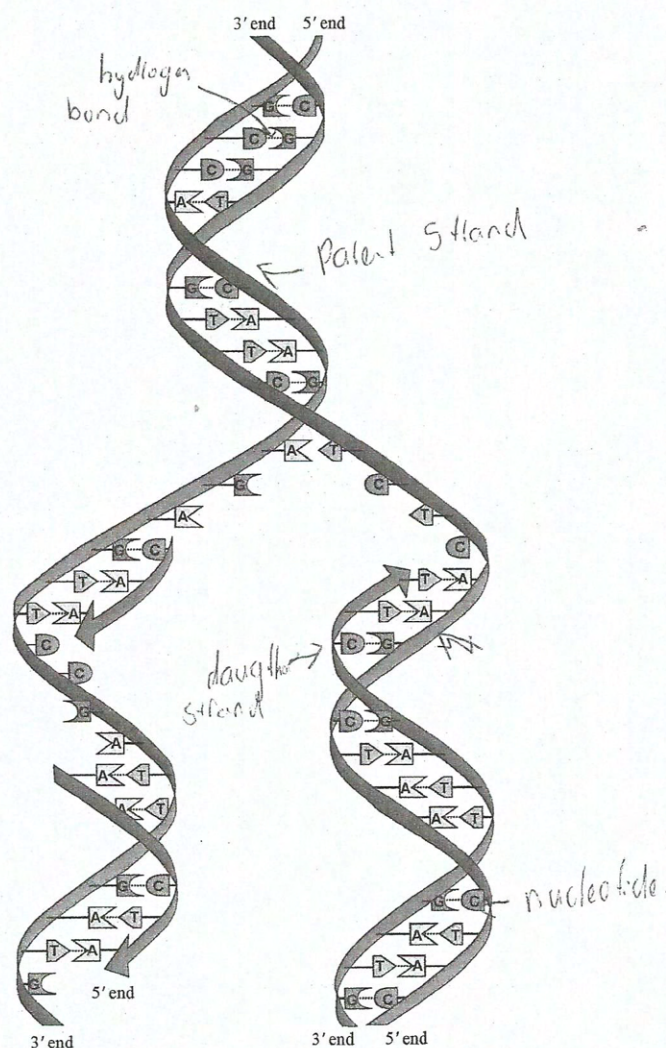
## QUESTION ONE: DNA REPLICATION

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(a) The model below shows DNA replication.

Label the following on the diagram:

- nucleotide
- nitrogen base
- hydrogen bond
- parent strand
- daughter strand
- sugar-phosphate backbone.



(b) Explain the purpose of DNA replication.

DNA replication occurs so mitosis can occur, for mitosis to occur (cells to divide) each new cell must have a complete set of DNA. DNA replicates for this to occur.



(c) Enzymes are needed for DNA replication.

Discuss the function of enzymes in DNA replication and the factors that affect them.

In your answer include:

- a description of the structure of an enzyme
- an explanation of how enzymes function in DNA replication
- a discussion of at least three factors that affect enzymes during DNA replication.

You may use diagrams in your answer.

An Enzyme is a catalyst in chemical reaction, it speeds up the rate of reaction by providing an alternative pathway for the reaction to occur which requires a lower amount of activation energy. Enzymes are specific so only bind with specific substrates and work best, highest activity rate in optimum conditions. Enzyme has a specific shaped active site and ~~collide~~ <sup>collide</sup> with which binds with a substrate. The enzyme and substrate must collide with sufficient force for the collision to be successful and for substrate to bind with Active Site / Enzyme.

DNA replication is a series of enzyme controlled reactions. Enzymes unwind a parental strand of DNA, breaking the weak hydrogen bonds. Enzymes then bond new bases to parent bases according to base pairing rules. They then bond bases to leading strand.

Temperature is a factor that affects enzymes during DNA replication. Enzymes work best in their optimum temperature, in the human body this is about  $37^{\circ}\text{C}$ , at the optimum temperature there will be the most successful collisions between an Enzyme's active site and substrate ~~resulting~~ <sup>resulting</sup> per second resulting in the highest enzyme activity and highest rate of DNA replication. At temperature too low, enzymes will move slower and have less kinetic energy, resulting in less

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

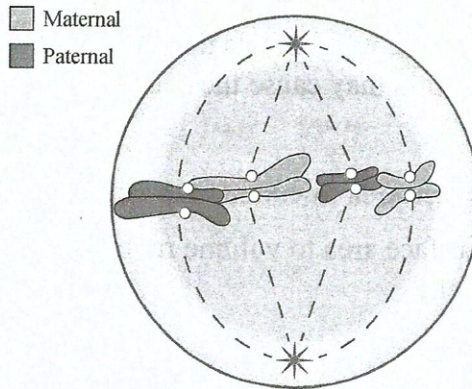


Successful collision, with enough force to overcome activation energy between enzyme and substrate therefore there is less enzyme activity and a lower rate of DNA replication. At temperatures too high it can cause the enzyme to denature. This causes the active site to change shape so it can no longer bind with the substrate. Therefore there will be less successful collisions between enzyme and substrate resulting in lower enzyme activity. If all enzymes become denatured, there will be no more successful collisions and no enzyme activity, thus DNA replication not occurring. Enzyme poisons can also affect enzymes in DNA replication. An enzyme poison causes an enzyme's active site to become blocked, this means the substrate is no longer able to bind with the enzyme resulting in less successful collisions and lower enzyme activity. If the poison blocks all enzymes' active sites there will be no more successful collisions resulting in no enzyme activity and DNA replication. Enzyme concentration is another factor which affects enzymes in DNA replication. ~~What~~ (on spare paper)



## QUESTION TWO: MITOSIS AND MOVEMENT OF MATERIALS

ASSESSOR  
USE ONLY



adapted from: <https://www.bio.purdue.edu/BCBLab/?p=1093>

- (a) Describe what is happening in the diagram above during mitosis.

Chromosomes have lined up randomly at cell equator and a spindle network has formed. The chromatids are then being pulled apart and pulled towards the cell poles where a nuclear membrane will form around them.

- (b) Explain the purpose of mitosis, and how this type of cell division occurs.

Mitosis produce two genetically identical cells for cell growth and repair. It occurs in 5 Phases

1. Interphase - where occurs before Mitosis, where DNA is replicated.

2. Prophase - DNA is condensed and super coiled forming chromosomes.

3. Metaphase - Chromosomes line up randomly at cell equator, spindle network forms.

4. Anaphase - Chromosomes get torn apart and into two chromatids which get pulled towards cell poles.

5. Telophase - nuclear membrane forms around chromatids resulting in two daughter cells.



- (c) Most cells in the human body grow to a limited size then divide. The new cells grow, but also divide when they have reached a certain size.

Discuss how the surface area to volume ratio affects the process of diffusion, and why the changes in surface area to volume ratio may cause the cell to divide.

In your answer include:

- \* a description of how the surface area to volume ratio changes as the cell grows
- \* an explanation of how the surface area to volume ratio affects the movement of materials into and out of a cell
- \* an explanation of diffusion
- \* a discussion of how the surface area to volume ratio can affect diffusion and cell division.

Cells divide when the distance between to cells get to large. they divide to keep the surface area to volume ratio high. When the surface area to volume ratio decreases so when a cell grows to a certain point and the dist ratio becomes to low the cell will divide.

Diffusion is the random movement of particles along a concentration gradient, from an area of high concentration to low concentration. Diffusion is passive transport and requires no energy.

~~When cells are dividing and growing materials move into and out of cells at a higher rate so materials needed for energy/growth can be received therefore when there is a low~~

When there is a high surface area to volume ratio materials can move into and out of the cell at a faster rate, this is because the high surface area provides a large amount of space where materials can move into and out of cell.

When the surface area to volume ratio is high diffusion can occur at a faster rate because the high surface



area provides a large area for particles to diffuse. This can increase cell division because for cell division to occur the cell requires energy. And when particles can diffuse at higher rates energy can be produced longer as the oxygen and glucose required to produce energy can diffuse into cell faster (because of high surface area) resulting in more energy being produced thus cells can divide faster.

Also the high surface area allows components required for photosynthesis to diffuse faster thus more glucose being produced further increasing respiration leading to higher cell division.



### QUESTION THREE: CELL PROCESSES

Photosynthesis and cell respiration are cell processes carried out within a plant.

Discuss the similarities and differences between photosynthesis and aerobic cell respiration in a plant.

In your answer include:

- ✖ a word equation of photosynthesis and aerobic cell respiration
- ✖ an explanation of how both aerobic cell respiration and photosynthesis are required to support the overall survival of the plant
- ✖ a discussion of the similarities and differences of the two processes.

[http://www.ecoagra.com/eA\\_BPP-HowItWorks.html](http://www.ecoagra.com/eA_BPP-HowItWorks.html)

Specific details of stages for each process are NOT required.

Aerobic respiration is the breakdown of glucose to form Energy in the form of ATP. It occurs in the ~~cytoplasm~~<sup>mitochondria</sup> of cells.

Glucose + Oxygen  $\rightarrow$  Energy (ATP) + Water + Carbon dioxide.

Photosynthesis is a ~~series~~ of the process of forming glucose from water and carbon dioxide in the presence of light Energy. it occurs in the ~~in~~ chloroplast of cell.

Water + Carbon dioxide  $\xrightarrow{\text{light energy}}$  Glucose + Oxygen.

Aerobic respiration occurs in both plants and animal cells, it is required for both to gain energy need to carrying out metabolic process, such as growth and repair. The energy is also need for the transport of materials required for the process such as photosynthesis. Without the energy ~~the~~ the plant would not be able to grow or survive.

Photosynthesis occurs in only plant cells, it is the plants way of forming food needed ~~to use to prod~~ (Glucose) in order to produce energy in ~~aerobic~~ respiration. The glucose produced allows plant to ~~the plant~~ carry out metabolic processes.

Differences.

- Photosynthesis occurs in the ~~mitochondria~~<sup>chloroplast</sup> of the cell,



Chloroplasts are adapted to have optimum conditions for photosynthesis. It contains a green pigment called chlorophyll which traps sunlight needed for it to occur. Whereas Aerobic respiration occurs in the mitochondria of cell. The mitochondria is also adapted to have conditions optimum for photosynthesis to occur. Depending on a plant's cells energy requirement it will have a different number of mitochondria. This is similar to photosynthesis depending on the light availability to plant it will have a different number of chloroplasts and different sizes of chloroplasts.

Photosynthesis occurs in <sup>only</sup> both plant & cells where respiration occurs in both plant and animal cells.

### Similarities

Both processes are required for a plant to survive. Photosynthesis is needed to produce glucose required for respiration to occur so the plant can produce energy required for metabolic processes.

Both processes require enzymes to occur. Respiration is a series of enzyme controlled reactions. Enzymes are needed to break glucose molecule to form pyruvate and in the Krebs cycle and electron

Photosynthesis uses enzymes to bond carbon dioxide with hydrogen to form glucose. As both processes require enzymes, the rate of photosynthesis and respiration are best when enzyme activity is high.



Extra paper if required.

Write the question number(s) if applicable.

QUESTION  
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USE C

1B. When the enzyme concentration is low there will be less successful collisions between enzyme and substrate as there are limited enzymes available to bind with substrate resulting in low enzyme activity. When enzyme concentration increases to optimum concentration, there will be the highest number of collisions between enzyme and substrate, resulting in highest enzyme activity and rate of replication. If the concentration of enzymes increases beyond this, the enzyme activity will not continue to increase as substrate concentration will become limited.



## Annotated Exemplar Template

Merit exemplar 2016

<b>Subject:</b>	<b>Biology</b>	<b>Standard:</b>	<b>AS91156</b>	<b>Total score:</b>	<b>17</b>
<b>Q</b>	<b>Grade score</b>	<b>Annotation</b>			
1	M5	a) Only three correct labels rather than the required five. b) Inadequate explanation. c) Two M points here – one for enzyme activity and the other for an explanation of how temperature affects enzyme activity.			
2	M5	a) Correct description. b) Growth and repair correctly stated as purposes but not that the maintenance of a high SA:Volume is needed. c) Correct explanations of diffusion and the movement of materials.			
3	E7	Correct word equations given for both processes and a concise account is given. Links made to both differences and similarities with respect to the need for energy.			