



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2017

Centre Number

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Candidate Number

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Biology

Assessment Unit AS 1

assessing

Molecules and Cells

**[SBY11]**

SBY11

THURSDAY 25 MAY, AFTERNOON**TIME**

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.**Do not write outside the boxed area on each page or on blank pages.**Complete in black ink only. **Do not write with a gel pen.**Answer **all eight** questions.**INFORMATION FOR CANDIDATES**

The total mark for this paper is 75.

Section A carries 60 marks. Section B carries 15 marks.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

You are reminded of the need for good English and clear presentation in your answers.

Use accurate scientific terminology in all answers.

You should spend approximately **20 minutes** on Section B.

You are expected to answer Section B in continuous prose.

Quality of written communication will be assessed in Section B.

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Section A

- 1 (a) Cells can be categorised as prokaryotic or eukaryotic.

Complete the following table by inserting a ✓ if the component is present and a ✗ if it is absent. (All boxes must be completed.)

Component	Prokaryotic cell	Eukaryotic cell
Endoplasmic reticulum		
DNA		
Histone protein		
Ribosome		
Golgi apparatus		
Plasmid		

[3]

- (b) State **one** structure that contains microtubules in a eukaryotic cell.

[1]

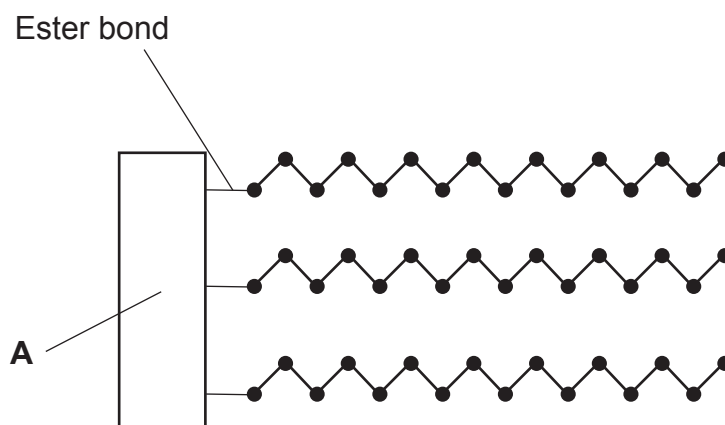


2 Fatty acids can be saturated or unsaturated. Palmitic acid is a saturated fatty acid ($C_{15}H_{31}COOH$) and α -linolenic acid is an unsaturated fatty acid ($C_{17}H_{29}COOH$).

(a) Define the term 'unsaturated'. _____

_____ [1]

(b) The diagram below represents a triglyceride containing three palmitic acid chains.



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(i) Identify the part of the triglyceride labelled A.

A _____ [1]

(ii) Describe how the structure of a phospholipid differs from the triglyceride shown above.

_____ [1]



Triglycerides perform several functions in living organisms. They are synthesised in the smooth endoplasmic reticulum of cells and can be broken down in a number of metabolic processes.

- (c) (i) Name the types of reactions that occur during the synthesis and breakdown of triglycerides.

Synthesis _____

Breakdown _____ [2]

- (ii) State **two** functions of triglycerides in living organisms.

1. _____

2. _____

_____ [2]



- 3 Human Immunodeficiency Virus (HIV) is a retrovirus which invades and destroys lymphocytes. HIV can lead to Acquired Immunodeficiency Syndrome (AIDS). The number of viral particles (viral load) detected in a sample of blood can contribute to a diagnosis of AIDS.

AZT is a drug which can be used to treat HIV, either on its own or in combination with other drugs. After drug treatment, measuring viral load can determine the drug's effectiveness for an infected individual. The aim of the treatment is to reduce the viral load to below 50 particles in one cubic centimetre of blood.

The blood of an infected individual was tested monthly after beginning AZT treatment. The results are shown in the table below.

Time/months	Viral load/cm ⁻³
0	150 000
1	97 573
2	10 320
3	15 720
4	16 666

- (a) Calculate the percentage reduction in viral load between the beginning of treatment with AZT and the lowest viral load.

_____ [2]



(c) Suggest how scientists in a laboratory could ensure reliability and validity when testing blood samples.

Reliability _____

Validity _____

_____ [2]

(d) AZT can also be used to treat other conditions caused by retroviruses. Using this information and your knowledge of the genetic make-up of retroviruses, suggest how AZT works.

_____ [1]





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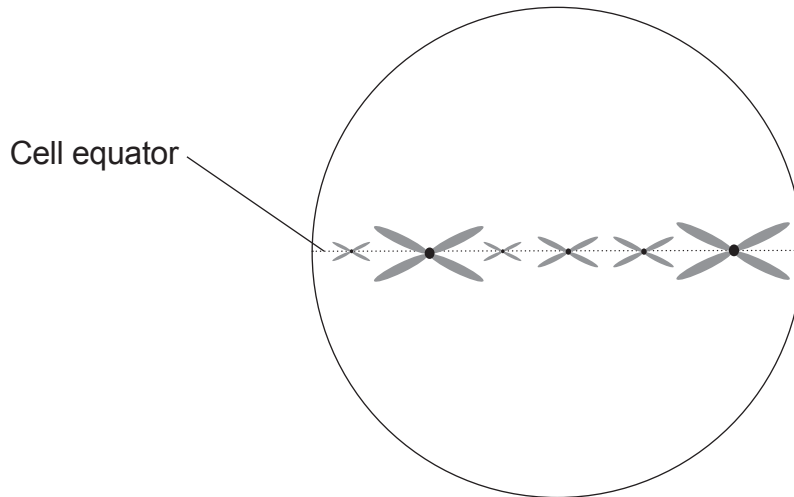
(Questions continue overleaf)



- 4 The Indian muntjac deer (*Muntiacus muntjak*) is a small deer that was introduced to England in the early 20th Century. This species has the lowest number of chromosomes recorded for any mammal.

The nuclei of diploid cells in the female *M. muntjak* contain six chromosomes ($2n=6$).

The simplified diagram below represents a stage of mitosis in such a cell, where the six chromosomes are aligned at the cell equator.

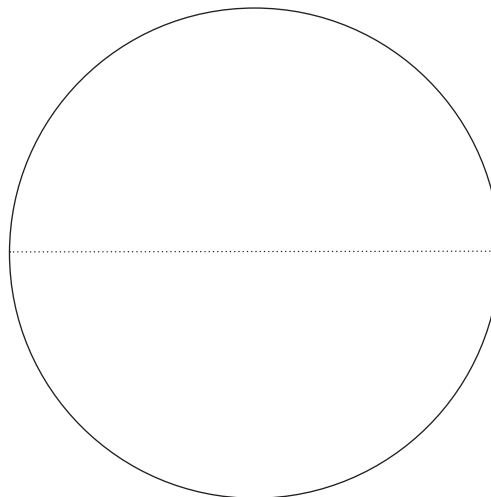


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- (a) State the stage of mitosis represented.

[1]

- (b) Complete the diagram below to show how chromosomes align at the equator during the **second** division of meiosis, in a cell from the same species.



[2]



(c) Describe and explain **two** features of meiosis that contribute to genetic variation.

1. _____

2. _____

[4]

(d) The cell cycle can be targeted by anti-cancer drugs such as 5' Fluorouracil.

State the stage of the cell cycle which is affected by this drug.

[1]

[Turn over



- 5 (a) Plants require a number of inorganic ions in order to synthesise biologically important compounds. State the name of one biologically important compound in plants which contains calcium and one which contains magnesium.

Calcium _____

Magnesium _____ [2]

- (b) Plant cell walls are composed of cellulose. Explain how the structure of cellulose provides plant cell walls with high tensile strength.

[2]

The tobacco mosaic virus (TMV) is a virus which infects a wide range of plants, including the tobacco plant. The virus usually enters through an open wound in the plant. Once it enters, it multiplies rapidly and spreads quickly from cell to cell.

- (c) (i) The virus cannot pass through plant cell walls. Suggest how it spreads from cell to cell.

[1]



(ii) Plants that are infected with TMV often have chloroplasts in the palisade layer that have an unusual shape. The chloroplasts appear to contain a large vacuole-like structure within the stroma.

Suggest and explain how the presence of this structure might affect the functioning of the chloroplast.

[2]

(d) Plant cells contain mitochondria as well as chloroplasts. State **two** similarities between the structures of mitochondria and chloroplasts.

1.

2.

[2]

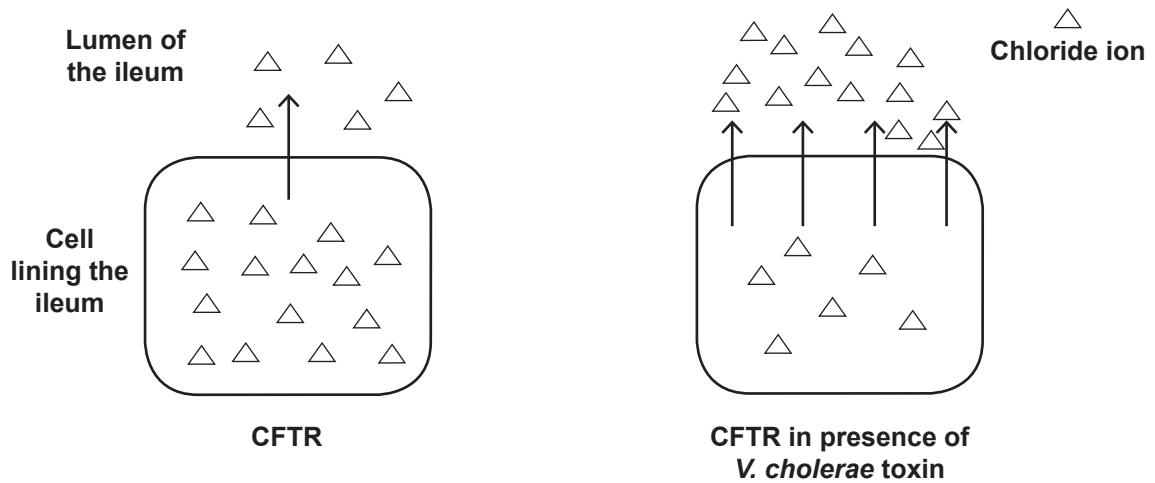
[Turn over



- 6 Cholera is a disease caused by the bacterium *Vibrio cholerae* and is transmitted through drinking contaminated water.

In the ileum, *V. cholerae* produces a toxin which activates a type of membrane glycoprotein called CFTR.

The presence of the toxin causes the CFTR glycoprotein to pump excessive levels of chloride ions out of the cells and into the gut lumen. This in turn affects the osmotic balance.



- (a) (i) Describe how the structure of a glycoprotein differs from a typical protein.

[1]

- (ii) Define the term 'osmosis'.

[1]



The CFTR glycoprotein is also involved in the condition cystic fibrosis. Cystic fibrosis affects several systems in the body, including the respiratory system.

In individuals with cystic fibrosis the CFTR glycoprotein does not form correctly and therefore does not function normally. The mucus in the respiratory system is normally thin and watery. However, in patients with cystic fibrosis, it becomes thick and sticky.

(c) Using the information provided (including the diagram at the start of this question), suggest how the mucus becomes thick and sticky in individuals with cystic fibrosis.

[2]



7 When a tadpole changes to an adult frog, its tail is broken down and reabsorbed into the body. A major component of the tail is the protein collagen, which provides support.

Collagen in the tail is broken down by the enzyme collagenase, which has a zinc cofactor.

(a) (i) Define the term 'cofactor'.

[1]

(ii) Describe how the structure of the protein collagen is related to its function of support.

[3]



- (b) An investigation was carried out to determine how zinc availability affects the rate of collagenase activity and therefore the reabsorption of tadpole tails.

Tadpoles of the clawed frog (*Xenopus laevis*) were allowed to mature in water containing normal zinc concentrations and in water containing no zinc. The average diameters of the collagen fibrils in tadpole tails during the first 25 minutes of the investigation are shown in the table below.

Time/min	Average collagen fibril diameter/nm	
	Zinc present	Zinc absent
0	27	28
5	26	27
10	12	27
15	8	26
20	2	25
25	1	24

- (i) Plot the results, using an appropriate graphical technique. (Use the graph paper opposite.) The caption is already included. [4]
- (ii) Describe and explain the trend evident in the results.

[3]



The effect of zinc availability on average collagen fibril diameter due to collagenase action over time

[Turn over

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(c) Collagen is also found at joints in the human body. The breakdown of this collagen by collagenase is a factor in arthritis. Use the information provided and your knowledge of enzymes to suggest how a therapeutic drug could treat arthritis. Explain your answer.

[2]





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Section B

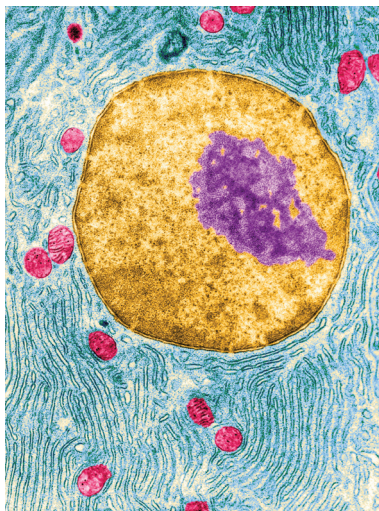
Quality of written communication will be assessed in this section.

- 8 A wealth of knowledge about biological structures has been obtained using the different types of microscope, including the light microscope (LM), the transmission electron microscope (TEM) and the scanning electron microscope (SEM).



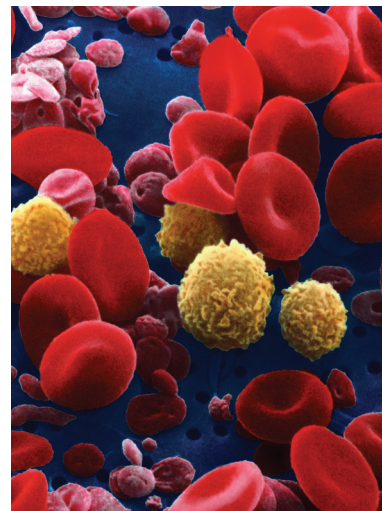
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**Light micrograph
(photomicrograph)**



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**Transmission electron
micrograph**



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**Scanning electron
micrograph**

- (a) Discuss the advantages and disadvantages of the light microscope (LM), the transmission electron microscope (TEM), and the scanning electron microscope (SEM) to observe biological structures. [6]
- (b) Microscopy has enabled extensive study of the tissue layers of the ileum. Describe the structure and function of each of the tissue layers of the ileum. [9]





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[Turn over



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Question Number	Marks
1	
2	
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Total Marks	
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Examiner Number

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