Rewarding Learning

Centre Number	
71	

Candidate Number

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2013

Biology

Assessment Unit AS 1

assessing

Molecules and Cells

[AB111]

AB111

WEDNESDAY 9 JANUARY, MORNING

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.
Write your answers in the spaces provided in this question paper.
There is an extra lined page at the end of the paper if required.
Answer **all eight** questions.
You are provided with **Photograph 1.4** for use with Question 4 in this paper.
Do not write your answers on this photograph.

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**, and awarded a maximum of 2 marks.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
Total Marks	

Section A

Examiner Only	
Marks	Remark

1 Identify the cell structure associated with each of the following processes.

- Protein synthesis

  _____

- Formation of secretory vesicles

  _____

- Destruction of worn out organelles

  _____

- Direct movement of substances between adjacent plant cells

  _____

- Formation of ribosomes

  _____ [5]

Examiner Only	
Marks	Remark

2 **(a)** Identify **two** similarities and **two** differences between polysaccharides and triglycerides.

Similarities:

1. _____

_____

_____

2. _____

_____

_____

Differences:

1. _____

_____

_____

2. _____

_____

_____ [4]

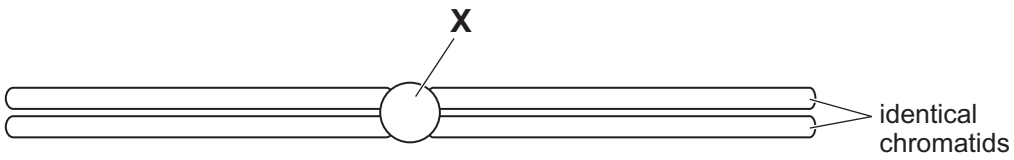
(b) Name the biochemical tests used specifically to identify starch (a polysaccharide) and glucose.

Starch _____

Glucose _____ [1]

Examiner Only	
Marks	Remark

3 **(a)** The diagram below represents a chromosome as it would appear during prophase of mitosis.



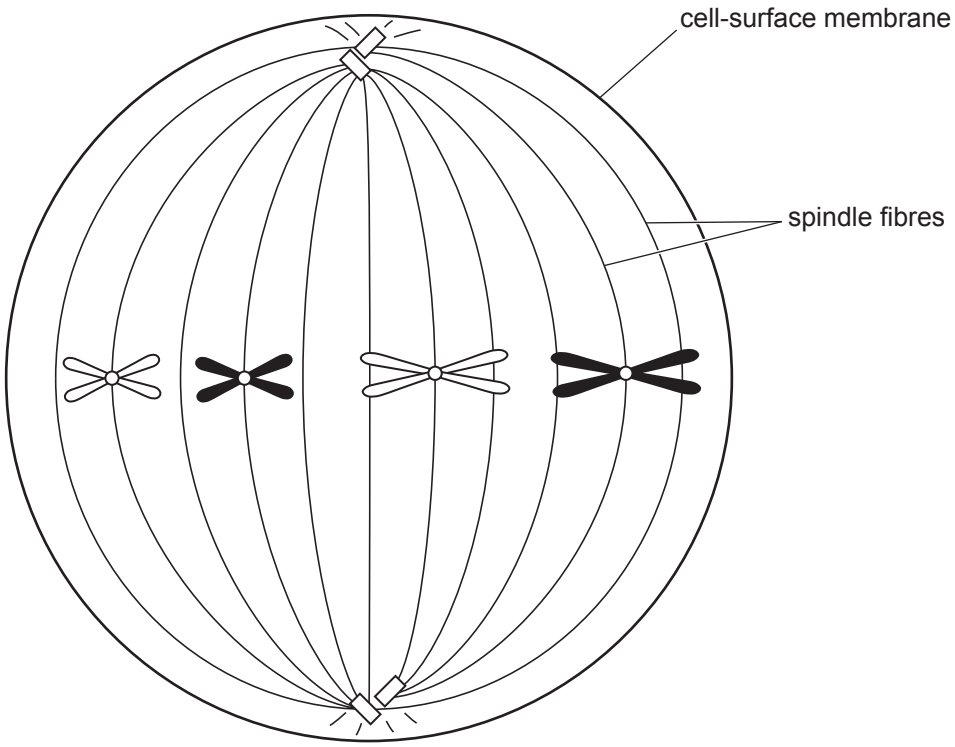
(i) Name the structure labelled **X**.

_____ [1]

(ii) Identify the specific stage in the cell cycle when DNA replicates to form the two chromatids.

_____ [1]

(b) **(i)** The diagram below shows a cell at a stage of mitosis.



Name the stage of mitosis shown in the diagram.

_____ [1]

(ii) Describe how the arrangement of the chromosomes would differ in a cell at the same stage of the first division of meiosis.

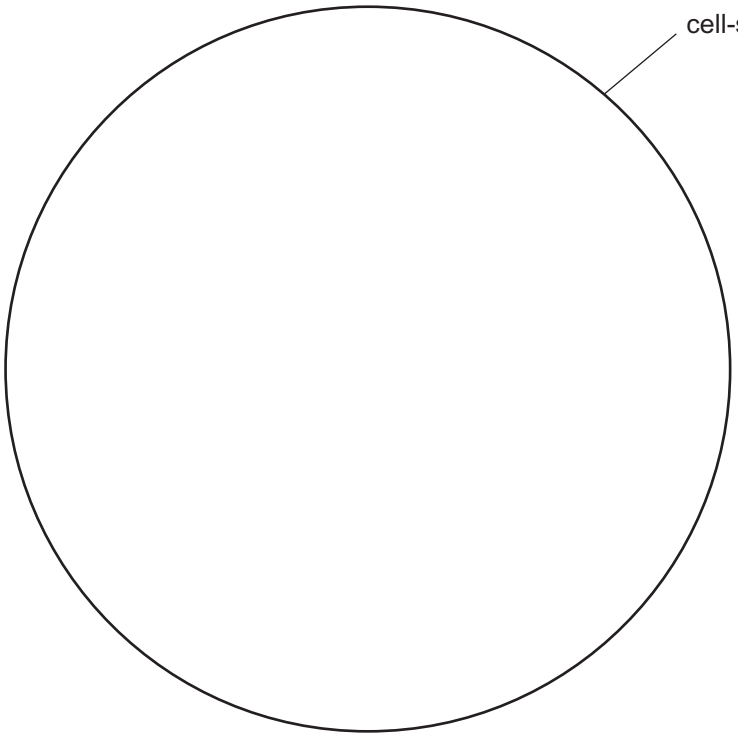
_____

_____

_____

_____ [2]

(c) An outline of a cell-surface membrane is shown below. Within this outline draw the cell shown in **(b)(i)** as it would appear at the next stage of mitosis.



[2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

4 **Photograph 1.4** is a colour-enhanced, transmission electron micrograph of part of a villus in the ileum.

(a) Identify the cells labelled **A** and **B**, and structures **C** and **D**.

A _____

B _____

C _____

D _____ [4]

(b) The magnification of this photograph is ×2050. Calculate the actual length in micrometres (μm) of the cell along the line indicated by **X–Y.** (Show your working.)

Answer _____ μm [3]

There are other structures visible in the cytoplasm of cell **A**. However, they are not distinct in this particular photograph and it is not possible to identify them.

(c) Suggest **two** organelles that you would expect to be present in cell **A**. For each organelle, explain its role in cell **A**.

Organelle 1 _____

_____

_____

_____

Organelle 2 _____

_____

_____

_____ [4]

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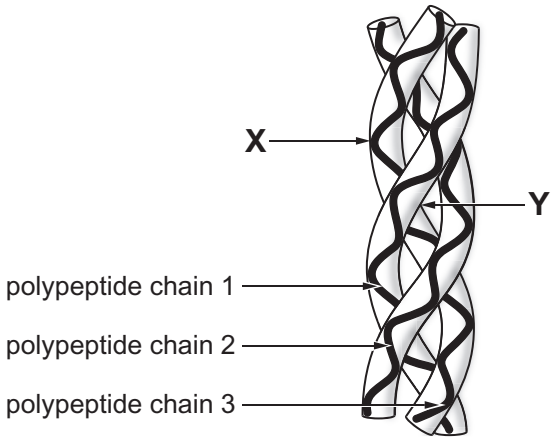
(Questions continue overleaf)

Examiner Only	
Marks	Remark

5 Proteins may be classified as globular or fibrous. The structural properties of globular and fibrous proteins are related to their functions.

(a) Collagen is a fibrous protein and comprises approximately 35% of the total protein in the human body. It is a major constituent of connective tissue, including tendons.

The diagram below represents the structure of collagen.



(i) Using the information in the diagram, identify evidence for the presence of a secondary and a quaternary structure in collagen.

Secondary structure _____

_____

_____

Quaternary structure _____

_____

_____ [2]

(ii) Suggest how the structure of collagen, as shown in the diagram, relates to its function.

_____

_____ [1]

Examiner Only	
Marks	Remark

(b) In both fibrous and globular proteins, hydrophobic and hydrophilic interactions between the amino acids and water play a part in maintaining structure.

In which part of the collagen molecule, **X** (exterior) or **Y** (interior), would you expect amino acids with hydrophobic R-groups to be found? Explain your answer.

_____

_____

_____ [2]

Albumen is a globular protein which is an important soluble constituent of blood plasma. It contributes significantly to the solute potential of the plasma. This, in turn, has an effect on the movement of water in and out of body cells.

Albumen is produced in the liver and people suffering from liver disease are unable to produce sufficient amounts of albumen.

(c) **(i)** How would a lack of albumen change the solute potential of blood plasma?

_____ [1]

(ii) Describe and explain the effect this change would have on the red blood cells.

_____

_____

_____

_____ [2]

One symptom of liver disease is the accumulation of watery fluid in body cavities such as the abdominal cavity.

(iii) Explain the accumulation of water in the abdominal cavity of patients with liver disease.

_____

_____ [1]

Examiner Only	
Marks	Remark

6 Powdered milk contains a protein called casein, which forms a milky-white suspension when mixed with water. When a protease enzyme is added to the mixture it digests the casein and the mixture will become clear.

An experiment was carried out to investigate the effect of temperature on the protease enzyme.

- Two test tubes, one containing 10 cm^3 of milk suspension and one containing 10 cm^3 of protease enzyme solution were placed in a water bath at 20 °C.
- After 10 minutes, the contents were mixed and the time taken for the mixture to clear was recorded.
- The experiment was repeated at a series of temperatures up to 80 °C. The rate of reaction (min^{-1}) was then calculated.
- The results are shown in the table below.

Temperature/°C	Rate of reaction/min^{-1}
20	0.95
30	2.00
40	4.00
50	7.50
60	8.00
70	6.00
80	1.00

(a) Using the most appropriate graphical technique, plot the above data. (Use the graph paper opposite.) [4]

(b) **(i)** Using the graph, estimate the optimum temperature for this enzyme.

_____ [1]

(ii) Describe how the experiment could be extended to obtain a more precise value for the optimum temperature.

_____

_____

_____ [1]

Examiner Only	
Marks	Remark

(iii) Protease enzymes such as trypsin, normally found in the human body, have an optimum rate of reaction at about 37 °C. Suggest an explanation for the different optimum obtained from the graph.

_____

_____ [1]

(c) Explain why the enzyme and casein suspension were incubated separately before mixing.

_____

_____ [1]

(d) To make the investigation valid, all other variables should be kept constant. For example, an optimum pH must be maintained.

(i) State how pH could have been kept constant.

_____ [1]

(ii) Explain precisely why pH should be maintained at the optimum level for this enzyme.

_____

_____

_____

_____

_____

_____ [2]

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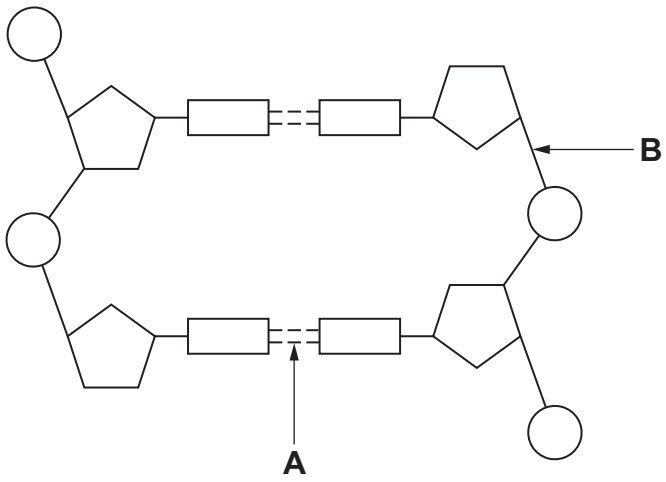
(Questions continue overleaf)

Examiner Only	
Marks	Remark

7 The diagram below represents a short section of DNA.



(a) Identify the type of bonds labelled **A** and **B**.

A _____

B _____ [2]

(b) Replication of DNA is described as 'semi-conservative'. Explain this term.

_____

_____

_____

_____ [2]

(c) Evidence in support of semi-conservative replication was provided by experiments carried out by Meselsöhn and Stahl in 1958. They grew bacteria on a nutrient medium containing 'heavy' nitrogen (^{15}N) until it was assumed that all bacterial DNA was of the 'heavy' type. They then transferred some bacteria to a nutrient medium containing 'light' nitrogen (^{14}N) and sampled the bacterial DNA at intervals corresponding to generation times for the bacteria. The DNA was subsequently separated using a centrifuge (which separates substances on the basis of density).

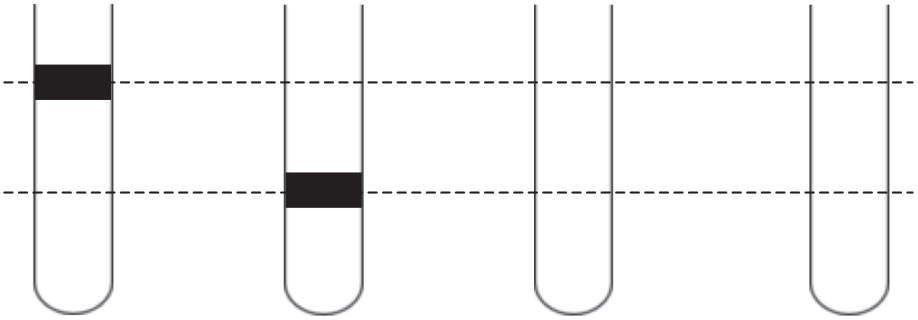
(i) Which part of the DNA molecule would be expected to incorporate the nitrogen?

_____ [1]

Examiner Only	
Marks	Remark

As shown in the diagram below, the parental DNA was 'heavy' (with ^{15}N only). The position of the 'light' DNA (with ^{14}N only) is shown for comparison.

(ii) Complete the diagram to show the position(s) which the bacterial DNA would occupy after successive generations in nutrient medium containing 'light' nitrogen (^{14}N).



DNA with ^{14}N only | Parental DNA with ^{15}N only | Following **one** generation in ^{14}N | Following **two** generations in ^{14}N

[2]

(iii) Explain the result obtained following **one** generation in ^{14}N.

_____

_____

_____ [1]

(d) DNA replication takes place naturally prior to cell division. An artificial technique for replicating DNA has also been developed by scientists.

(i) Name this technique.

_____ [1]

(ii) Describe an important property of the DNA polymerase enzyme involved in this technique which distinguishes it from most other DNA polymerases.

_____ [1]

(iii) The technique amplifies small samples of DNA. Give **two** examples of how this technique can be used.

1. _____

2. _____ [2]

Section B

Examiner Only	
Marks	Remark

Quality of written communication is awarded a maximum of 2 marks in this section.

8 Viruses such as bacteriophages infect bacterial cells like *Escherichia coli*, while human immunodeficiency virus (HIV) infects a particular type of animal cell.

(a) Describe the similarities and differences in the structure of a bacteriophage virus and the human immunodeficiency virus (HIV). [5]

(b) Describe the similarities and differences in the structure of a bacterial cell and an animal cell. [8]

Quality of written communication [2]

(a) Describe the similarities and differences in the structure of a bacteriophage virus and the human immunodeficiency virus (HIV).

Examiner Only	
Marks	Remark

(b) Describe the similarities and differences in the structure of a bacterial cell and an animal cell.

Examiner Only	
Marks	Remark

Extra lined page

Examiner Only	
Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

113562

GCE Biology Advanced Subsidiary (AS)
Assessment Unit AS 1: Molecules and Cells
January 2013

Photograph 1.4
(For use with Question 4)