Rewarding Learning

Centre Number

71	

Candidate Number

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2014

Biology

Assessment Unit AS 1
assessing
Molecules and Cells

[AB111]

MV18

WEDNESDAY 8 JANUARY, MORNING

TIME

1 hour 30 minutes, plus your additional time allowance.

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 1.3** for use with Question 3 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 at the end of each question 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.
This may be longer if you have an additional time allowance.
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.

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(Questions start overleaf)

Section A

1 Read the following passage about the structure of DNA and chromosomes, and write the most appropriate word in each blank space to complete the account. [5]

A DNA molecule consists of many repeating units called _____ which are joined by _____ reactions to form the sugar-phosphate backbone. The double helix consists of two single _____ strands held together by _____ bonds between _____ nitrogenous bases. Chromosomes are formed when the DNA coils round proteins called _____ .

2 The technique of chromatography can be used to separate, and subsequently identify, substances in solution. When setting up a chromatogram, certain procedures are followed.

(a) Describe **two** procedures, relevant to setting up a chromatogram, that would ensure valid results. [2]

1. _____

_____

_____

2. _____

_____

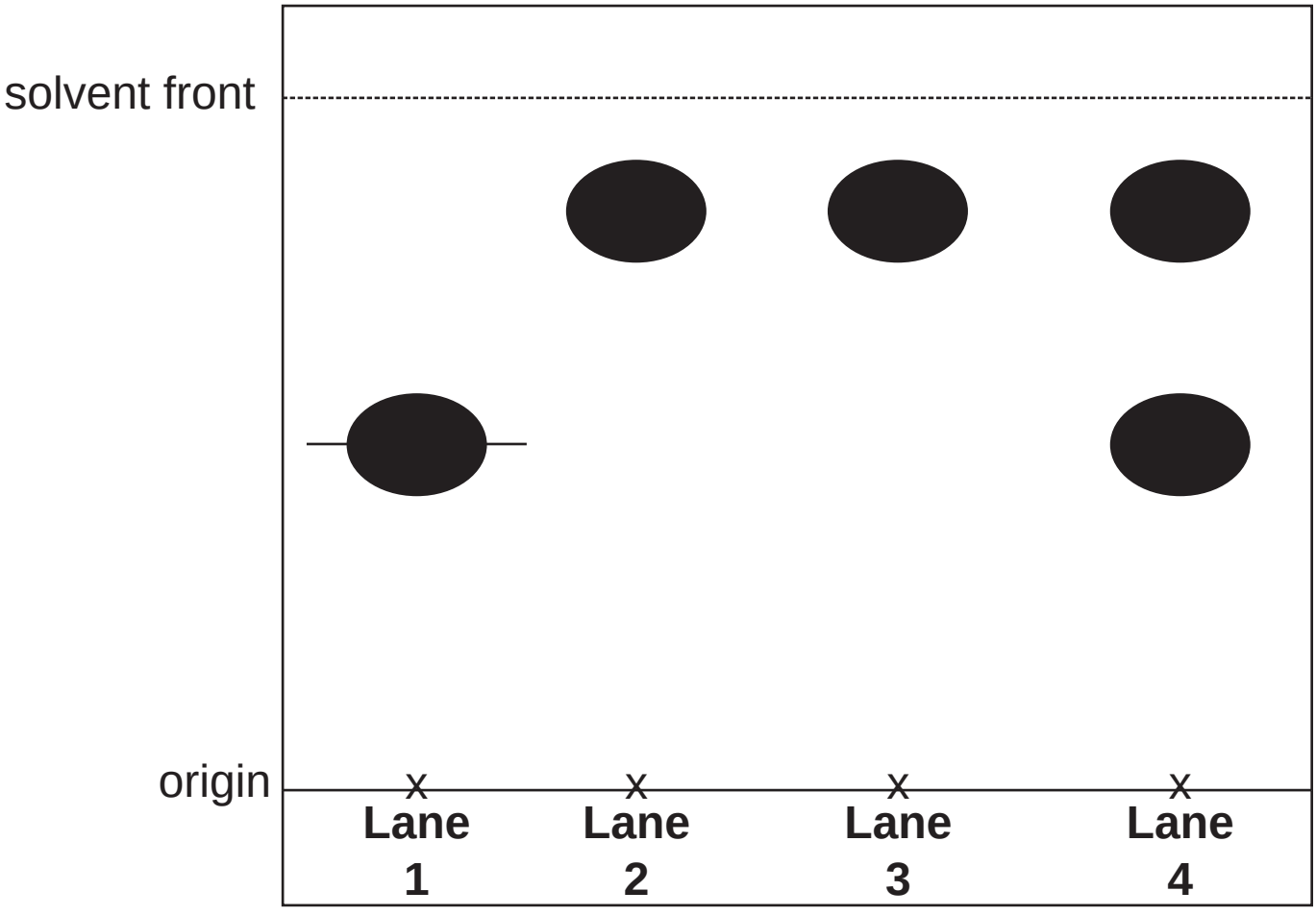
_____

A chromatogram was prepared to identify four carbohydrates.

The following carbohydrate solutions were applied to the origin:

- Glucose
- Fructose
- Maltose treated with α-glucosidase (hydrolyses glycosidic bonds)
- Sucrose treated with α-glucosidase (hydrolyses glycosidic bonds)

One solution was added to each of the four lanes on the origin. The resulting chromatogram is shown below.



(b) Calculate the R_f value for the carbohydrate in **Lane 1**. (Show your working.) [2]

(c) Lanes **1** and **2** contain the monosaccharides. Lanes **3** and **4** contain the hydrolysed disaccharides.

Identify the carbohydrate added to each of the lanes **1–4**. [3]

1 _____

2 _____

3 _____

4 _____

(d) A starch solution was also treated with α-glucosidase, so that the starch was fully broken down. Give the full name of the monosaccharide which would be present in the resulting solution. [1]

_____

3 **Photograph 1.3** shows six photomicrographs of animal cells at different stages of mitosis. These are labelled **A–F**.

(a) **(i)** Identify the stages shown in photomicrographs **A–D**. [4]

A _____

B _____

C _____

D _____

(ii) Identify the structures labelled **X** and describe fully their role in the process of mitosis. [3]

_____

_____

_____

_____

_____

_____

(iii) The photomicrographs **A–F** do not show the stages of mitosis in the correct sequence. Rearrange the letters **A–F** to show the correct sequence of the stages. [2]

_____

(b) (i) Identify the process that is beginning to happen in **E**. [1]

_____

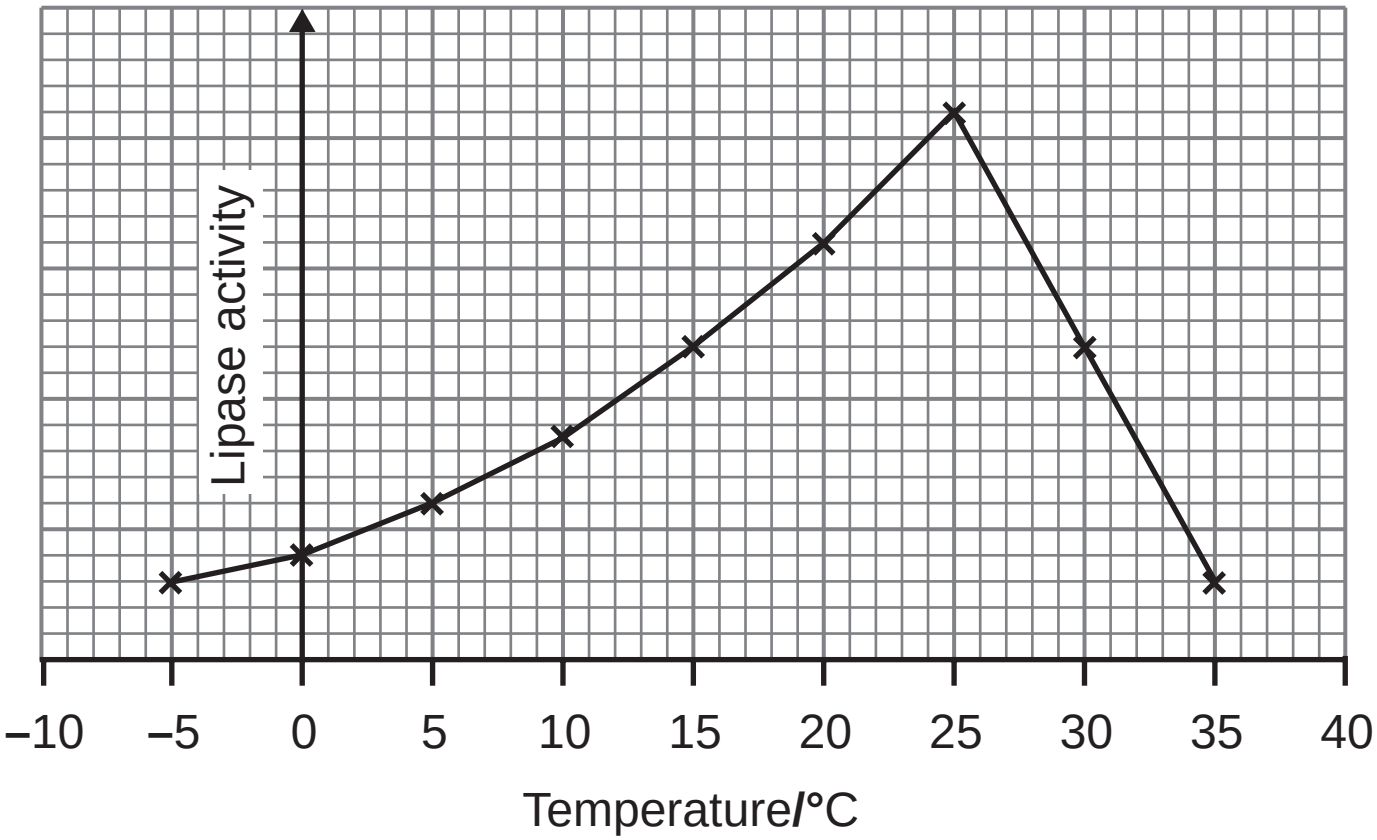
(ii) Outline how this process would be different in a plant cell. [1]

_____

_____

4 Mature seeds contain an embryo plant and a store of energy-rich food. In some seeds, such as soybean, the main energy store is lipid. When seeds are planted in springtime they absorb water, which activates enzymes such as lipase.

The graph below shows the relative activity of soybean lipase at various temperatures.



(a) (i) Describe precisely the trends evident in this graph. [2]

(ii) Using your understanding of enzyme action, explain the trends you have identified. [3]

(b) The temperature range for soybean lipase activity, as shown in the graph, is different to that for mammalian lipase. Suggest a reason for this difference in temperature range and suggest how this is an advantage to the growth of the soybean plants. [2]

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5 The earliest method of producing a genetic fingerprint involved an analysis of RFLPs. In this method, DNA is cut into pieces using enzymes, such as **EcoRI** and **BamHI**, and the resulting fragments are separated using electrophoresis.

(a) (i) What term is used to describe enzymes such as **EcoRI** and **BamHI**? [1]

_____

(ii) DNA is the substrate of both **EcoRI** and **BamHI**. However, the active site of the two enzymes is slightly different. Explain the effect of this difference. [2]

_____

_____

_____

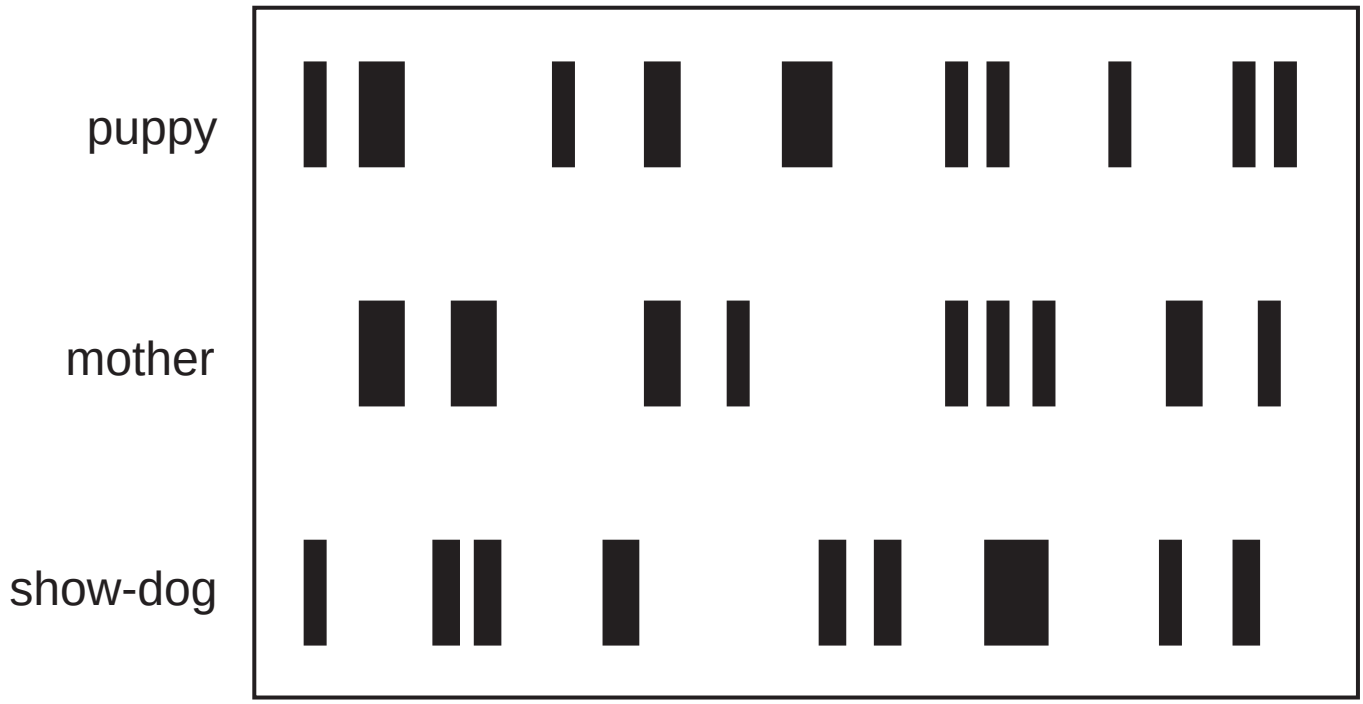
_____

_____

_____

One use of genetic fingerprinting is in paternity investigations. In dog breeding, it can be beneficial to have evidence of a dog's parentage.

One breeder claimed that a litter of puppies had been fathered by an award-winning show-dog. A buyer had cause to doubt this, based on the development of an inherited illness in a puppy that she had bought, and so sought evidence of parentage from the breeder. Genetic fingerprints of the puppy, its mother and the show-dog were produced. The results are shown below.



(b) What can you conclude about the puppy's parentage from the genetic fingerprints? Explain your answer. [2]

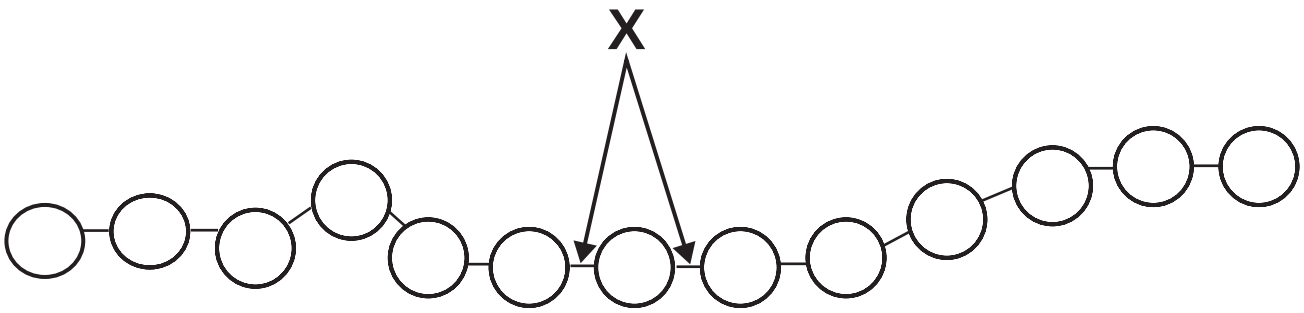
(c) The breeder insisted that the puppy was from a litter born following a mating between the mother and the show-dog. Comment on the relative validity (quality) of the genetic evidence compared to the breeder's evidence. [3]

(d) Enzymes such as **EcoRI** and **BamHI** were originally discovered in bacteria, where they are thought to offer protection from bacteriophages. Suggest how these enzymes could protect bacterial cells from infection. [1]

6 Proteins can be described as organic macromolecules.

(a) Explain the term ‘organic macromolecule’. [2]

(b) Gluten is a type of protein found in grains such as wheat, barley and rye. It is a ‘composite’ protein, made up of two simpler proteins called glutenin and gliadin. The following diagram represents the primary structure of part of a gliadin molecule.

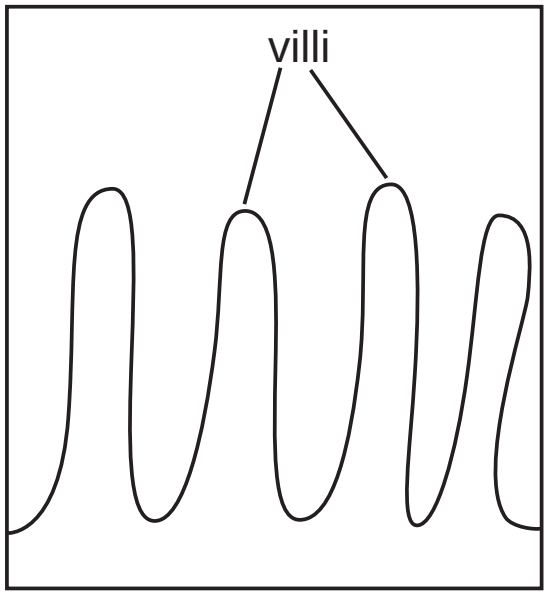


(i) Identify the building blocks of proteins, as represented by circles in the diagram. [1]

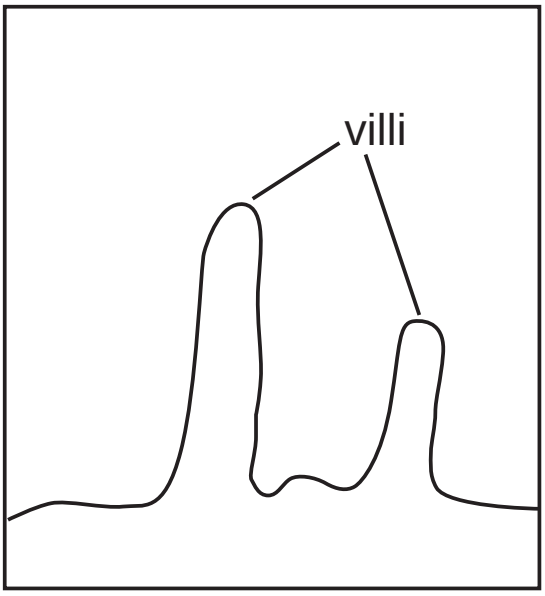
(ii) Identify the type of bond labelled **X**. [1]

(c) Some people are intolerant of gluten in the diet. This is the basis of the condition known as coeliac disease. One of the proteins in gluten, gliadin, triggers an immune response in sufferers which results in damage to the lining of the ileum. This damage is often patchy and does not affect the whole ileum.

Sections of the ileum mucosal layer from a normal individual and from a coeliac sufferer are represented in the diagram below.



normal



coeliac sufferer

(i) Describe the effect of coeliac disease on the structure of the ileum. [1]

(ii) Coeliac sufferers are often nutrient-deficient. With reference to the damage caused to the ileum, suggest an explanation for this. [2]

(iii) When investigating the ileum of a potential sufferer for signs of coeliac disease, several biopsies (tissue samples) are taken, each from a different region of the ileum. Suggest why. [1]

7 An experiment was carried out to investigate the effect of cyanide poison on cell organelles extracted from a sample of liver tissue.

Organelles can be separated from the rest of the cell contents using a centrifuge. Ground-up tissue is placed in a tube, which the centrifuge then spins at high speeds. The cell contents are separated into 'fractions', depending on their size. The smaller the organelle, the higher the speed required to separate it from the other cell contents.

(a) **Circle** the name of the organelle fraction which would require the slowest spinning speed in order to separate it from the rest of the cell contents. [1]

mitochondria **ribosomes** **nuclei**

(b) A fraction of mitochondria was obtained using the technique outlined above. These mitochondria were placed in a buffer which was isotonic to the liver tissue (i.e. with the same water potential as the liver tissue).

(i) Explain fully the purpose of the isotonic buffer. [2]

Two test tubes (**A** and **B**) were then prepared as follows:

- 2 cm^3 of mitochondria in buffer solution was added to each tube
- 1 cm^3 of cyanide solution was added to tube **A**
- 1 cm^3 of the isotonic buffer was added to tube **B**

(ii) Suggest why an extra 1 cm^3 of buffer was added to tube **B**, as detailed above. [1]

_____

The concentration of oxygen in each tube was then investigated using an oxygen probe. Readings were taken from each tube initially and then every minute for 10 minutes. Oxygen concentration was measured in micromoles (μM).

In tube **A**, the concentration of oxygen initially was 520. Subsequent readings were 511, 505, 500, 497, 495 and then five readings of 493.

In tube **B**, the concentration of oxygen initially was 505. Subsequent readings were 475, 444, 415, 386, 355, 324, 304, 297, 292 and 290.

(iii) Construct a table of these results in the space below.

Your table should have a caption and should include appropriate column headings, units and all the data. [4]

(iv) Describe the results of the experiment. [2]

(v) Suggest the effect of cyanide on cell function. [1]

(vi) Between 7 and 10 minutes, the rate of oxygen consumption in tube **B** slows significantly. Suggest a reason for this. [1]

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(Questions continue overleaf)

Section B

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

8 The cell membrane consists of a phospholipid bilayer with various proteins embedded in it. This structure enables different substances to travel through the membrane by either simple diffusion, facilitated diffusion or active transport.

(a) Describe the similarities and differences between simple diffusion, facilitated diffusion and active transport. [6]

(b) Large and small molecules, as well as ions, must be able to travel through the cell membrane. Explain why the different methods of transport named in part **(a)** are necessary to allow each of these substances to pass through and also how they may allow the membrane to be selective. [7]

Quality of written communication [2]

(a) Describe the similarities and differences between simple diffusion, facilitated diffusion and active transport.

(b) Large and small molecules, as well as ions, must be able to travel through the cell membrane. Explain why the different methods of transport named in part **(a)** are necessary to allow each of these substances to pass through and also how they may allow the membrane to be selective.

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

GCE Biology Advanced Subsidiary (AS)
Assessment Unit AS 1: Molecules and Cells
January 2014

Photograph 1.3
(For use with question 3)