Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

7833903871 9

BIOLOGY **9700/22**

Paper 2 Structured Questions AS **May/June 2015**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of the page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **13** printed pages and **3** blank pages.

CAMBRIDGE International Examinations

Answer **all** the questions.

1 Each of statements **A to E** describe a structure associated with the mammalian heart.

For each statement, identify the structure that is being described.

A The chamber that pumps blood into the pulmonary artery.

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B A blood vessel that transports deoxygenated blood into the right atrium.

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C The specialised tissue responsible for delaying the conduction of impulses from the atria to the ventricles.

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D The blood vessels that supply cardiac muscle with oxygenated blood.

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E The valve that prevents the backflow of blood from the ventricle that contains oxygenated blood.

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[5]

[Total: 5]

2 Fig. 2.1 is a scanning electron micrograph of an area of the trachea showing the presence of *Bordetella pertussis* bacteria.

B. pertussis is the causative organism of a respiratory disease in humans known as whooping cough. The disease is transmitted from person to person in a similar way to tuberculosis (TB).

A symptom that is common to TB and to whooping cough is the production of an excess of mucus.

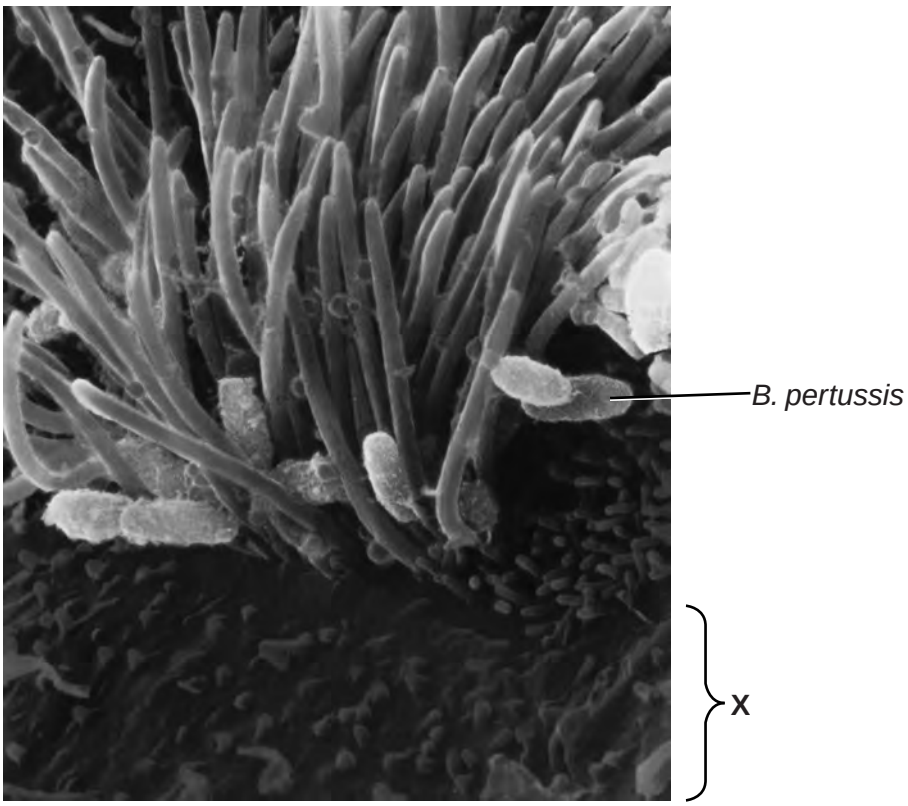

Fig. 2.1

(a) Describe the damage caused by *B. pertussis* that is shown in the area labelled **X** on Fig. 2.1 **and** explain how this will affect the functioning of the epithelial tissue of the trachea.

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.....[3]

(b) Goblet cells produce mucus. Name one other structure in the gas exchange system that also produces mucus.

.....[1]

(c) Suggest how whooping cough is transmitted.

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.....[2]

(d) The presence of *B. pertussis* stimulates the production of mucin, a gel-like glycoprotein that is the main component of mucus.

The mucin produced by the cell is packaged into vesicles ready for exocytosis.

(i) The first stage in the production of mucin involves transcription of the gene *MUC5AC*.

Outline the stages occurring in transcription.

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(ii) Following translation, the polypeptide formed is modified by the addition of many short chains of monosaccharides in a process called glycosylation.

Suggest where glycosylation occurs in the cell **and** explain why mucin is packaged into vesicles.

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.....[2]

(e) Overproduction of mucus is one of the symptoms of chronic obstructive pulmonary disease (COPD).

Describe the signs and symptoms that enable diagnosis of COPD.

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.....[4]

[Total: 16]

3 Outside the body, red blood cells can be maintained in an intact state by keeping the cells in a 0.9% solution of sodium chloride. This is known as a normal saline solution.

Fig. 3.1 shows intact red blood cells.

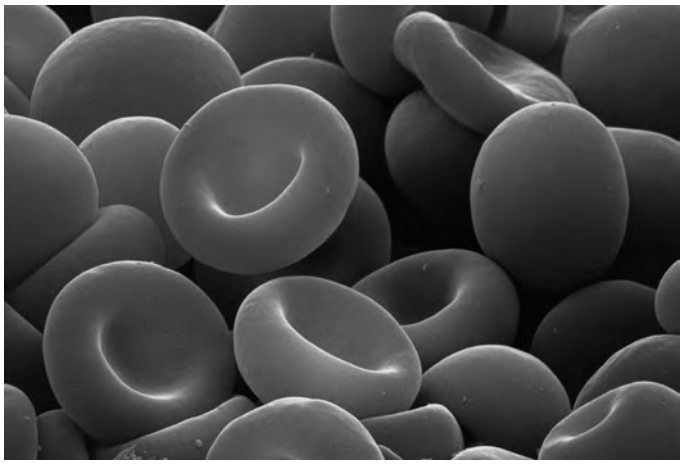

Fig. 3.1

(a) Explain why red blood cells can be maintained in an intact state by keeping them in a normal saline solution.

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.....[2]

(b) In the blood, red blood cells are suspended in plasma. The main component of blood plasma is water.

Suggest **one** other component of blood plasma that could enter red blood cells **and** describe how it would cross the cell surface membrane.

component .....

description .....

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.....[3]

Fig. 3.2 shows red blood cells within a capillary. The capillary shown in Fig. 3.2 allows the rapid exchange of substances between the blood, tissue fluid and body cells.

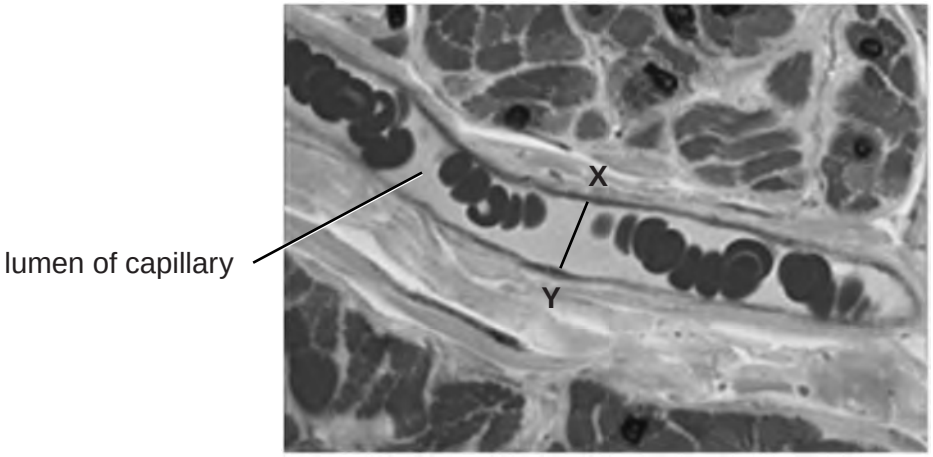

Fig. 3.2

(c) The actual diameter of the lumen of the capillary at the point **X**–**Y** in Fig. 3.2 is 9.5 μm.

Calculate the magnification of the image shown in Fig. 3.2. Show your working.

magnification × ..... [2]

(d) With reference to Fig. 3.2, explain **one** feature that enables the surrounding body cells to receive an adequate supply of oxygen from the blood supplied by the capillary.

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.....[2]

(e) Some areas of the brain, known as blood-brain barriers, have a type of capillary that is relatively impermeable to substances.

Suggest **one** way in which the structure of a capillary in the blood-brain barrier differs from the structure of the capillary shown in Fig. 3.2.

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.....[1]

[Total: 10]

4 Many microorganisms can digest cellulose by using a group of enzymes collectively known as cellulases. Cellobiose is the disaccharide produced during cellulose digestion.

The cellulase known as β-glucosidase completes the digestion of cellulose by hydrolysing the cellobiose molecule to produce two β-glucose molecules.

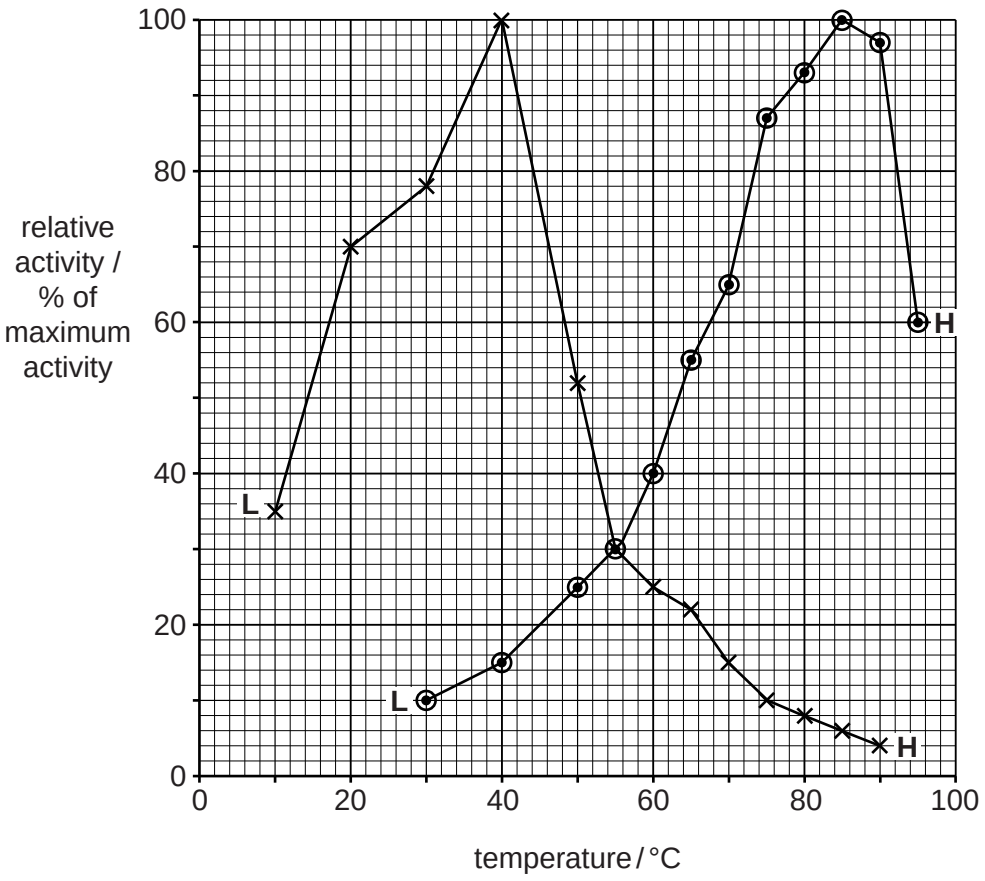
(a) Draw the ring structure of one β-glucose molecule in the space provided.

[2]

(b) β-glucosidase was extracted from two different bacteria, *Agrobacterium tumefaciens* and *Thermotoga maritima*.

Fig. 4.1 shows the results of an investigation into the effect of temperature between 0 °C and 100 °C, on the activity of each enzyme.

- **L** represents the lowest temperature at which activity of each enzyme was detected.
- **H** represents the highest temperature at which activity of each enzyme was detected.



Key

× enzyme **A** (extracted from *A. tumefaciens*)

⊙ enzyme **T** (extracted from *T. maritima*)

Fig. 4.1

(i) With reference to Fig. 4.1, describe the **differences** in the results for the two enzymes, **A** and **T**.

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.....[4]

(ii) Both enzyme **A** and enzyme **T** act on cellobiose. They have a similar, but not identical, primary structure.

Suggest how similarities **and** differences in the primary structure of the two enzymes could help to explain the results obtained in the investigation.

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[Total: 10]

5 **(a)** Natural immunity and artificial immunity can both be acquired in a passive or in an active manner.

Table 5.1 shows information about immunity acquired by two individuals, **P** and **Q**.

Complete Table 5.1.

Table 5.1

description of event	outcome for the individual	production of memory cells / yes or no	type of immunity acquired by individual
individual **P** is injected with a live, weakened disease-causing organism	individual **P** does not become ill from the disease and has long-lasting protection from the disease	.....	....
individual **Q** is injected with antibody against a specific disease-causing organism	individual **Q** does not become ill from the disease but is ill with the disease a year later	.....	....

[2]

Fig. 5.1 is a light micrograph of a sample of blood. Cell **X** is a phagocyte.

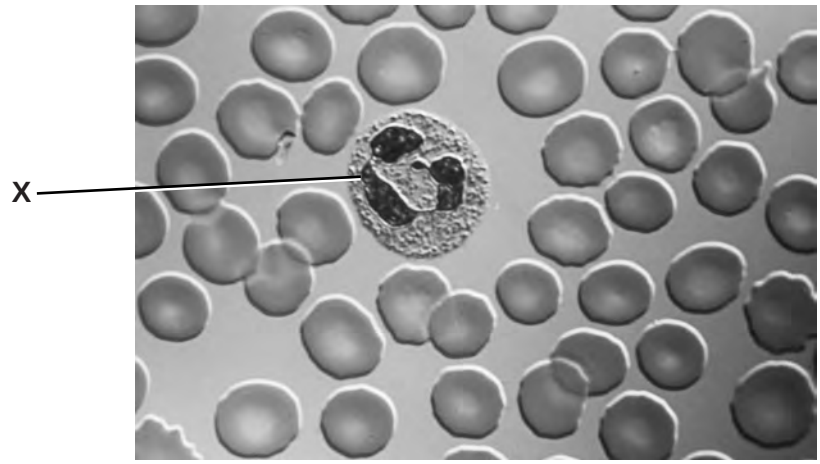

Fig. 5.1

(b) State the origin of the blood cell labelled **X**.

.....[1]

(c) Phagocytes play an important role when an immune response is initiated against cancerous tumour cells.

(i) Suggest how phagocytes can recognise the difference between healthy body cells and cancerous tumour cells.

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(ii) Outline briefly how a tumour forms.

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[Total: 7]

6 **(a)** Sentences **(i)** and **(ii)** are extracted from longer definitions of ecological terms. Each has one or more missing words.

Complete **(i)** and **(ii)** using the correct terms chosen from the list below.

a population	**a community**	**an ecosystem**
a niche	**a habitat**	**trophic level**
producers	**organisms**	**consumers**

(i) …… is the particular location and type of local environment occupied by …… or organism, characterised by its physical features or by its dominant …… . [3]

(ii) …… is the functional role or place of a species of organism within …… . [2]

(b) Only a small proportion of the light energy striking the leaves of producers becomes converted to chemical energy. The proportion that is converted is known as the photosynthetic efficiency (PE).

(i) Outline the possible reasons why a large proportion of light energy striking the leaves of plants is **not** converted into chemical energy.

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.....[3]

(ii) Most crops have a PE of 1% to 4%. Sugar cane, an important crop plant for food production and for the production of biofuel, has a PE of 7% to 8%.

Suggest the advantages of growing crops with high PE for food production or for biofuel.

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.....[2]

(iii) Fertilisers containing nitrate are added to improve or maintain yield of crops such as sugar cane.

Name two organic compounds containing nitrogen that are made by plants and state one function of each in plant growth.

organic compound 1 .....

function .....

.....

organic compound 2 .....

function .....

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.....[2]

[Total: 12]

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