Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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6170897587

BIOLOGY **9700/22**

Paper 2 AS Level Structured Questions **October/November 2018**

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 on all the work you hand in.
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 **16** printed pages.

CAMBRIDGE International Examinations

Answer **all** questions.

1 Fig. 1.1**A** is a photomicrograph of healthy lung tissue.

Fig. 1.1**B** is a photomicrograph of lung tissue from a person with emphysema, a chronic obstructive pulmonary disease (COPD). The images are both at magnification ×40.

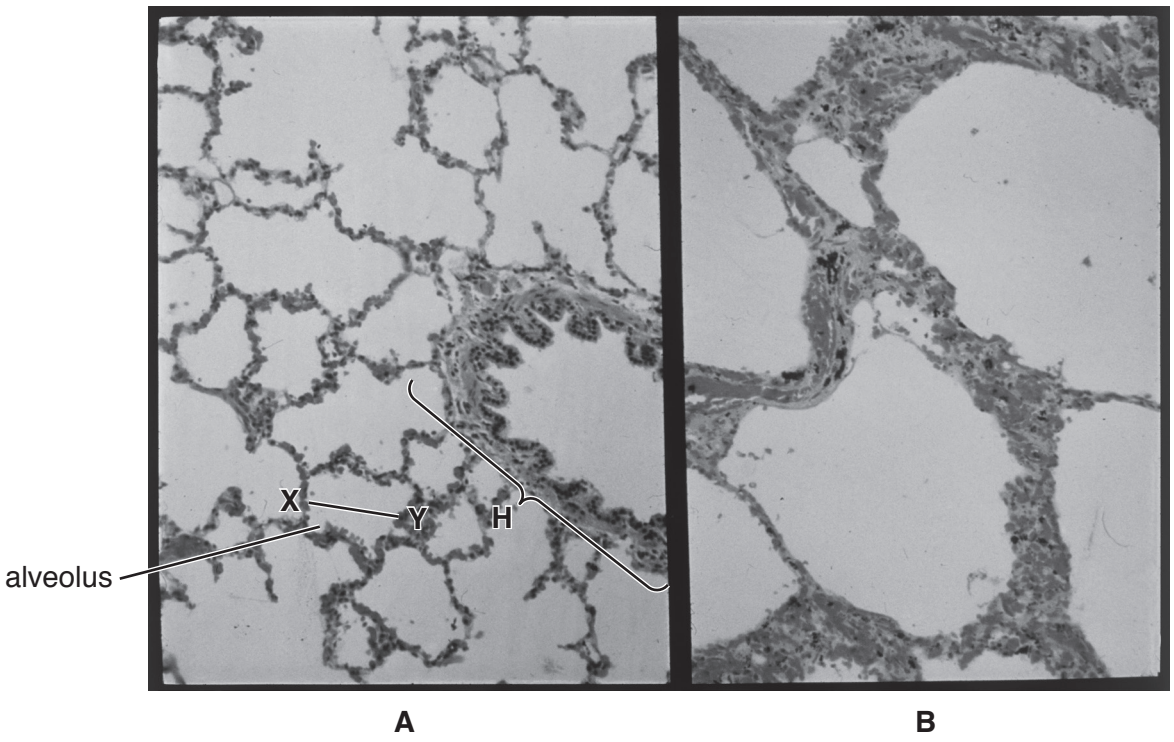

Fig. 1.1

(a) Name the structure labelled **H** in Fig. 1.1**A**.

..... [1]

(b) Calculate the actual diameter of the alveolus at **X**–**Y**.

Write down the formula and use it to make your calculation.

Give your answer to the nearest whole micrometre (μm).

formula

actual size ..... μm [2]

(c) Gas exchange in the lungs occurs in the alveoli.

Describe the process of gas exchange in healthy lungs **and** suggest how this compares with gas exchange in the diseased lung shown in Fig. 1.1**B**.

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..... [4]

[Total: 7]

2 Woolly foxglove, *Digitalis lanata*, shown in Fig. 2.1**A**, and common oleander, *Nerium oleander*, shown in Fig. 2.1**B**, are plants grown for the attractive flowers that they produce.

Both plants are poisonous, as their leaves produce toxic organic compounds known as cardiac glycosides. Cardiac glycosides have a powerful effect on the action of cardiac muscle.

A

B

Fig. 2.1

(a) *N. oleander* is able to grow in very dry conditions. The leaves have adaptations to reduce water loss by transpiration.

State the term used to describe a plant, such as *N. oleander*, that has adaptations to allow it to grow in conditions where water is in short supply.

..... [1]

(b) Aphids are small insects that feed on plant fluids using piercing and sucking mouthparts. When aphids feed on the sap present in vascular tissue of leaves and stems, a sugary liquid called honeydew is passed out of the gut. The honeydew can be analysed to find out what is present in the sap.

(i) State the name of the vascular tissue from which the aphids feed.

..... [1]

(ii) An investigation found that aphids feeding on *D. lanata* produced honeydew containing cardiac glycosides.

Suggest why cardiac glycosides were present in the sap from the vascular tissue.

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..... [2]

Cardiac glycosides have an effect on the movement of ions into and out of cardiac muscle cells. The outcome is an increased ability for the cells to contract.

(c) Investigations into the action of the cardiac glycoside oleandrin, extracted from *N. oleander*, have shown that it acts to prevent the correct functioning of Na/K-ATPase, a membrane transport protein.

Na/K-ATPase has a role as an enzyme **and** as a transport molecule.

- ATPase is an enzyme that catalyses the hydrolysis of ATP to ADP and inorganic phosphate.
- Energy released from this hydrolysis is used to transport sodium ions (Na^+) out of cardiac muscle cells and potassium ions (K^+) into the cells.

(i) Explain what is meant by the *hydrolysis of ATP*.

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..... [2]

(ii) Name the type of transport mechanism involved in the transport of Na^+ and K^+ across the cell surface membrane of cardiac muscle cells.

..... [1]

(iii) Oleandrin is a non-competitive reversible inhibitor of ATPase.

Describe the mode of action of oleandrin **and** explain how this will affect ion movement through Na/K-ATPase transport proteins of the cell surface membranes of cardiac muscle cells.

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..... [4]

[Turn over

(d) Digoxin, a cardiac glycoside extracted from *D. lanata* leaves, can be purified and used as a drug to treat some heart disorders.

Examples of these heart disorders are:

- atrial fibrillation, where the normal rhythmic cardiac cycle is disrupted
- heart failure, where cardiac muscle is contracting weakly.

(i) Describe the **sequence** of events occurring in the left side of the heart during one **normal** cardiac cycle. Include reference to blood pressure changes.

The first event in the sequence is described for you.

The left atrium fills with blood during relaxation of the left atrium and left ventricle.

..... [4]

(ii) Suggest how the health of a person with heart failure can be improved by treatment with the drug digoxin.

..... [3]

[Total: 18]

3 The response of the human body to tissue damage depends on the types of tissues involved. Epithelial tissue, liver tissue and cardiac muscle tissue each respond differently to damage.

- Epithelial tissue of the gas exchange system contains stem cells.
- Liver tissue contains cells in a non-dividing state that can enter a cell cycle when stimulated.
- Cardiac muscle tissue contains cells that cannot divide at all. Damage is permanent and is associated with scar tissue formation.

(a) Explain the importance of mitosis in the repair of damaged tissue.

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..... [2]

(b) Explain why stem cells are important in tissue repair.

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..... [2]

(c) Following liver tissue damage, chemicals are produced and released into the circulation. These chemicals are able to stimulate the liver cells to help tissue repair.

Explain how this is an example of cell signalling.

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..... [3]

[Total: 7]

[Turn over

4 Viruses share common structural features. Some viruses, such as human immunodeficiency virus (HIV), also have an outer envelope as part of their structure.

(a) Outline the key structural features of viruses.

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..... [3]

HIV can remain in a dormant state within infected immune system cells for many years. A person diagnosed as HIV-positive (HIV+) has the virus but does not have symptoms of HIV/AIDS.

The chances of an HIV+ person developing HIV/AIDS can be greatly reduced with a drug treatment programme known as anti-retroviral therapy (ART).

(b) In 2010, the World Health Organization (WHO) published recommendations for the treatment of pregnant women living with HIV. This includes both HIV+ women and women who have developed HIV/AIDS.

The publication recommended that **all** pregnant and breastfeeding women living with HIV should be provided with ART.

Fig. 4.1 shows the number of pregnant women living with HIV, and the number of these receiving ART, between 2005 and 2013, in low and middle income countries.

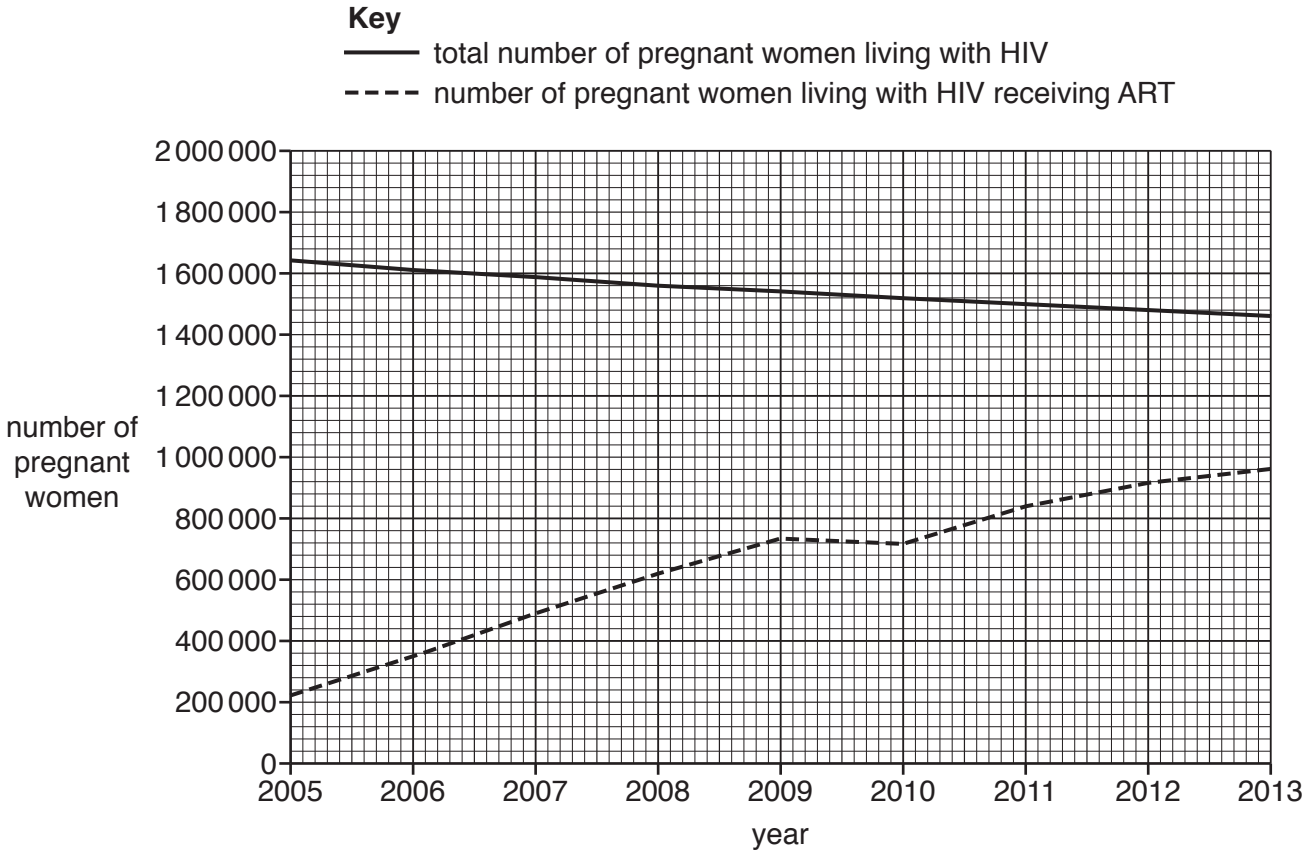

Fig. 4.1

(i) From the data in Fig. 4.1, it can be calculated that 13% of pregnant women living with HIV received ART in 2005.

Calculate the percentage of pregnant women living with HIV that received ART in 2013.

answer = ... % [1]

(ii) Describe the trends shown in Fig. 4.1.

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..... [3]

[Turn over

(iii) Suggest **and** explain the global importance of providing ART to all pregnant and breastfeeding women living with HIV.

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..... [3]

Question 4 continues on page 12

(c) In a person who has been infected with HIV-1, the most common strain of HIV, a sample of blood can be tested for the presence of the virus.
One test that can only be used in the early stages of infection involves a monoclonal antibody specific for p24, a structural protein present in the virus.

Fig. 4.2 is a flow chart outlining the steps in the production of anti-HIV p24 monoclonal antibody.

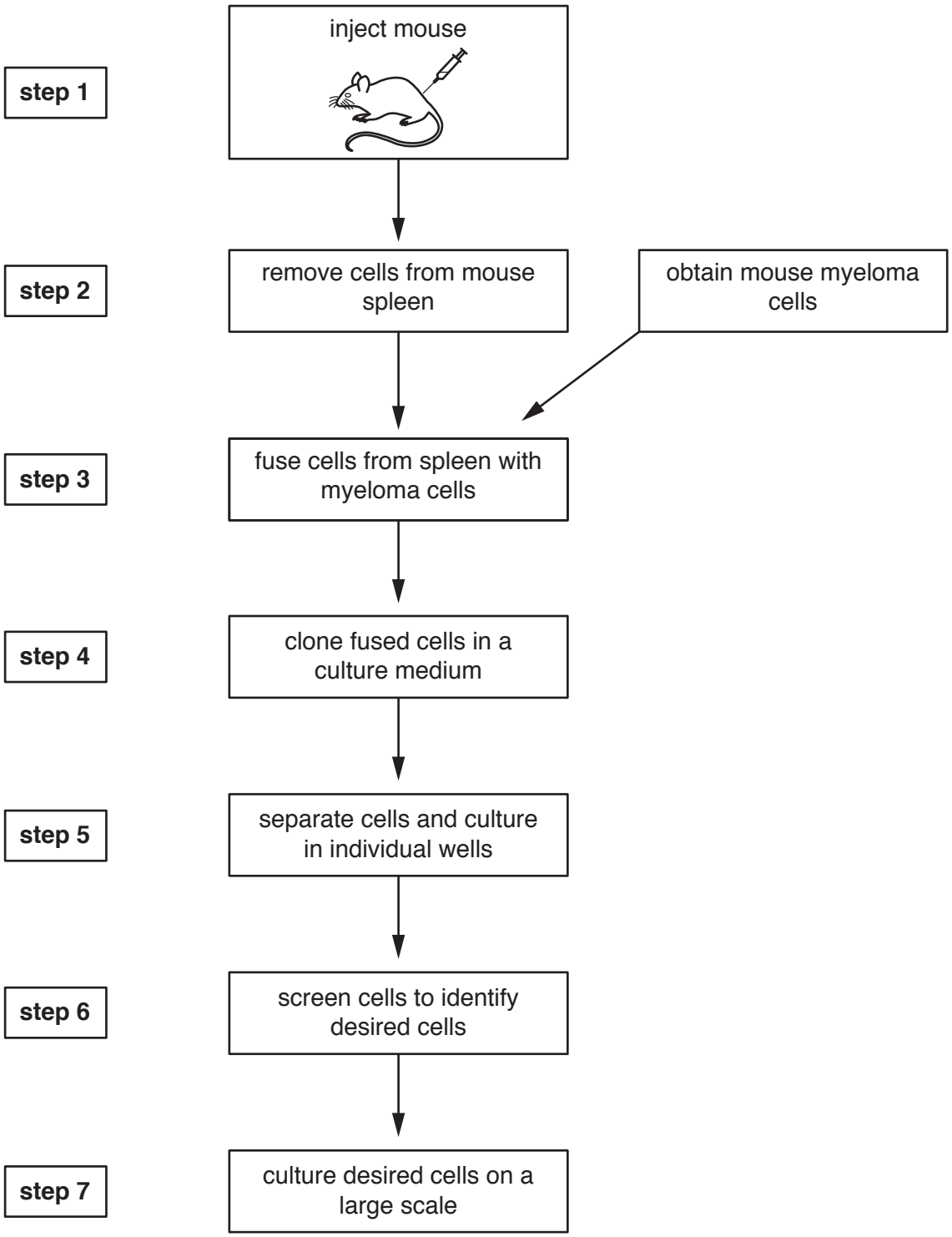

Fig. 4.2

(i) State what is being injected into the mouse in **step 1**.

..... [1]

(ii) Explain why several weeks, rather than several days, separates **step 1** and **step 2**.

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..... [1]

(iii) State **one** feature of the myeloma mouse cells, used in **step 3**, that is essential for this production process.

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..... [1]

(iv) Name the fused cells formed in **step 4**.

..... [1]

(v) Suggest why **step 6** is necessary.

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..... [1]

[Total: 15]

5 DNA and RNA are nucleic acids.

(a) Explain why RNA can be described as a polymer **and** as a macromolecule.

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..... [2]

(b) The sugar component of DNA is a reducing sugar.

Outline the test for reducing sugars **and** describe the observations for a positive result.

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..... [2]

(c) Nucleotides are structural components of nucleic acids. Each nucleotide consists of a pentose sugar, a phosphate group and a nitrogenous organic base.

Complete Table 5.1 to compare DNA nucleotides with RNA nucleotides as structural components of nucleic acids.

Table 5.1

feature	DNA nucleotides	RNA nucleotides
pentose sugar component		
purine bases		
pyrimidine bases		

[3]

[Total: 7]

[Turn over

6 As a red blood cell matures, cell organelles are lost from the cell. This provides more space for the haemoglobin molecules that have been synthesised.

(a) The red blood cell has a short lifespan due to the loss of the nucleus and other organelles.

State **one** function performed by each of the organelles listed, before they are lost from the developing red blood cell.

rough endoplasmic reticulum

.....

Golgi body

.....

centrioles

.....

[3]

(b) State the most appropriate term to match each of the descriptions **A** to **C**.

A The part of the haem group that binds oxygen in each haemoglobin polypeptide.

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B The compound formed when carbon dioxide binds to haemoglobin.

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C The compound formed when hydrogen ions (H^+) bind to haemoglobin.

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[3]

[Total: 6]