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Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2811202278

BIOLOGY **9700/22**

Paper 2 AS Level Structured Questions **October/November 2024**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages. Any blank pages are indicated.

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[Turn over

1 The olive plant, *Olea europaea*, is grown in many parts of the world. The fruits of the plant (olives) and the oil that can be obtained from the fruits (olive oil), provide food for humans.

Triglycerides are the main type of lipid in olive oil. They are synthesised in the olive plant from glycerol and fatty acids.

Scientists can analyse samples of different olive oils to identify:

- the fatty acids used to synthesise triglycerides
- the composition of the different triglycerides present.

(a) Table 1.1 shows some details of the five most common fatty acids found in samples of olive oil produced by olive plants grown in different regions in Portugal.

Table 1.1

Key
C : D = number of carbon atoms : number of double bonds in the hydrocarbon chain
X = missing detail

fatty acid	percentage of total fatty acid content	C : D	chemical structure
oleic acid	55.0–83.0	18 : 1	$CH_3(CH_2)_7CH{=}CH(CH_2)_7\mathbf{X}$
palmitic acid	7.5–20.0	16 :	$CH_3(CH_2)_{14}\mathbf{X}$
linoleic acid	3.5–21.0	18 :	$CH_3(CH_2)_4(CH{=}CH)CH_2(CH{=}CH)(CH_2)_7\mathbf{X}$
stearic acid	0.5–5.0	18 :	$CH_3(CH_2)_{16}\mathbf{X}$
palmitoleic acid	0.3–3.5	16 :	$CH_3(CH_2)_5CH{=}CH(CH_2)_7\mathbf{X}$

(i) Table 1.1 shows the **C : D** values for oleic acid.

In Table 1.1, write the values for **D** for each of the four other fatty acids listed. [1]

(ii) In the first column of Table 1.1, draw a circle around each of the fatty acids that can be described as saturated. [1]

(iii) State the detail of chemical structure, represented by **X**, which is missing from Table 1.1.

..... [1]

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(iv) The analysis of the triglycerides present in the different samples of olive oil showed that:

- there are many different triglycerides present in olive oil
- each olive oil is different in its composition, but the same few triglycerides are present in all olive oils.

With reference to Table 1.1 and to the structure of triglycerides, suggest explanations for these observations.

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(b) Glycerol is soluble in water. Triglycerides are insoluble in water.

Explain why water is a good solvent for some substances such as glycerol, but is a poor solvent for substances such as triglycerides.

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(c) Phloem is the plant tissue responsible for the transport of organic substances, such as fatty acids, from one area of a plant to another. The tissue is composed of more than one type of cell.

Name the type of cell that forms the transport vessels of phloem tissue.

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2 People who become infected with human immunodeficiency virus (HIV) are at risk of developing HIV/AIDs, particularly if antiretroviral therapy (ART) is not available.

(a) In people infected with HIV, the use of ART also helps to reduce transmission of the virus to uninfected people.

Outline **two** control methods, other than ART, that can be used to reduce the transmission of HIV.

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In people with HIV/AIDs, a serious lung disease known as pneumocystis pneumonia can result from infection by an opportunistic pathogen known as *Pneumocystis jirovecii*.

Fig. 2.1 shows *P. jirovecii* cells in one stage of their life cycle, as seen using a light microscope at a magnification of ×600.

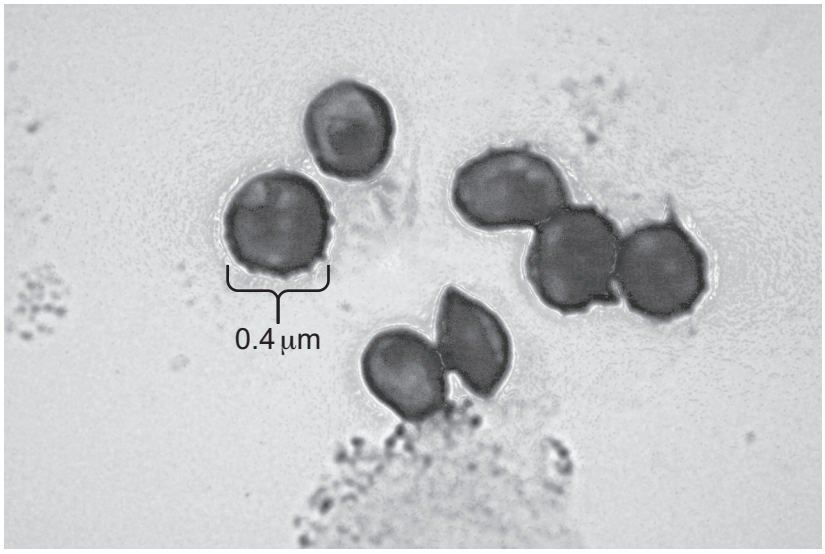


Fig. 2.1

(b) Define magnification.

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(c) Fig. 2.1 shows that *P. jirovecii* is a unicellular organism. Although the cells of many species of bacteria are the same size as those of *P. jirovecii*, research concluded that the organism is a eukaryote and is **not** a bacterium.

In 1988, analysis of ribosomal RNA (rRNA) resulted in *P. jirovecii* being classified as a fungus.

(i) Studies of the structure of *P. jirovecii* have identified that the cell wall is made of polysaccharides such as chitin and 1,3-β-D-glucan.

Explain why this feature helped scientists to confirm that *P. jirovecii* is **not** a bacterium.

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..... [1]

(ii) Scientists have identified other features of the cell structure of *P. jirovecii*. Some of these are listed in Table 2.1.

Complete each row of Table 2.1 so that the table shows:

- four structural features identified in *P. jirovecii*
- one function for each structural feature
- whether the structural feature is present (✓) or absent (✗) in bacterial cells.

Table 2.1

structural feature of *P. jirovecii*	**function**	**present (✓) or absent (✗) in bacterial cells**
ribosomes	protein synthesis	
smooth endoplasmic reticulum		
Golgi body	modification of proteins and lipids	
	aerobic respiration	

[3]

(d) *P. jirovecii* can adhere (attach) to squamous epithelial cells of the alveoli and to the network of fibrous proteins that support the alveolar wall, known as the extracellular matrix (ECM). Examples of proteins in the ECM are elastin and collagen.

Adhesion (attachment) of *P. jirovecii* to alveolar epithelial cells and the ECM stimulates the growth of its population.

(i) Cell surface glycoproteins known as gpA glycoproteins are essential in allowing *P. jirovecii* cells to adhere to alveolar epithelial cells and ECM proteins.

Suggest how a gpA glycoprotein is able to adhere to alveolar epithelial cells and ECM proteins.

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(ii) One consequence of the pneumonia that results from *P. jirovecii* infection is a decrease in the quantity of oxygen that is delivered to body tissues.

Explain why a severe *P. jirovecii* infection results in a decrease in the quantity of oxygen that is delivered to body tissues.

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(e) *P. jirovecii* produces an enzyme known as 1,3-β-D-glucan synthase. The enzyme catalyses the synthesis of 1,3-β-D-glucan.

The therapeutic drug caspofungin is a non-competitive inhibitor of 1,3-β-D-glucan synthase.

With reference to the mechanism of action of caspofungin, explain how the drug may be useful to treat cases of pneumonia caused by *P. jirovecii*.

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3 During transcription, base pairing occurs between nucleotides.

Fig. 3.1 is a diagram to show complementary base pairing between a DNA nucleotide and an RNA nucleotide.

Only the base pair is shown in molecular detail.

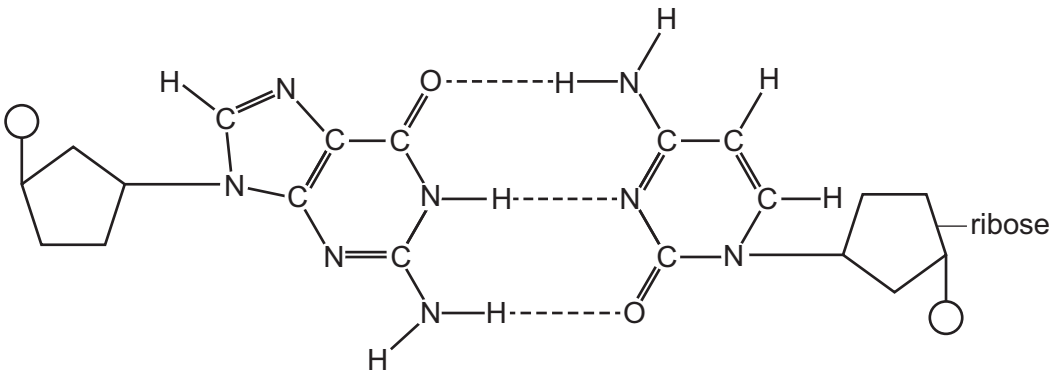


Fig. 3.1

(a) Explain why Fig. 3.1 does **not** include any phosphodiester bonds.

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(b) Identify **and** describe the DNA-RNA nucleotide pair shown in Fig. 3.1.

You may add labels and annotations to Fig. 3.1 if you wish.

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4 Adult stem cells are undifferentiated cells that are found in most animal tissues.

Adult stem cells can divide by mitosis throughout their lifespan to form identical stem cells (self-renewal) or to form cells that can differentiate into the functioning cells of that tissue.

(a) Mitosis is important for the repair of tissues.

Explain what is meant by repair of tissues.

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(b) Uncontrolled cell division is a characteristic feature of tumour formation from a differentiated cell.

Describe **other** features of tumour formation from a fully differentiated cell.

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(c) Telomeres prevent loss of genes.

Adult stem cells have chromosomes with long telomeres.

Explain why long telomeres are an advantage to cells that carry out many cell cycles.

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Haematopoietic stem cells (HSCs) are adult stem cells that are located in the bone marrow of bones. HSCs have a role in the formation of blood cells.

Fig. 4.1 is an outline summary showing the formation of some of the different types of blood cell that can be formed from HSCs. The first stage is the division of HSCs to produce progenitor cells. These cells are also able to divide by mitosis, but are **not** stem cells.

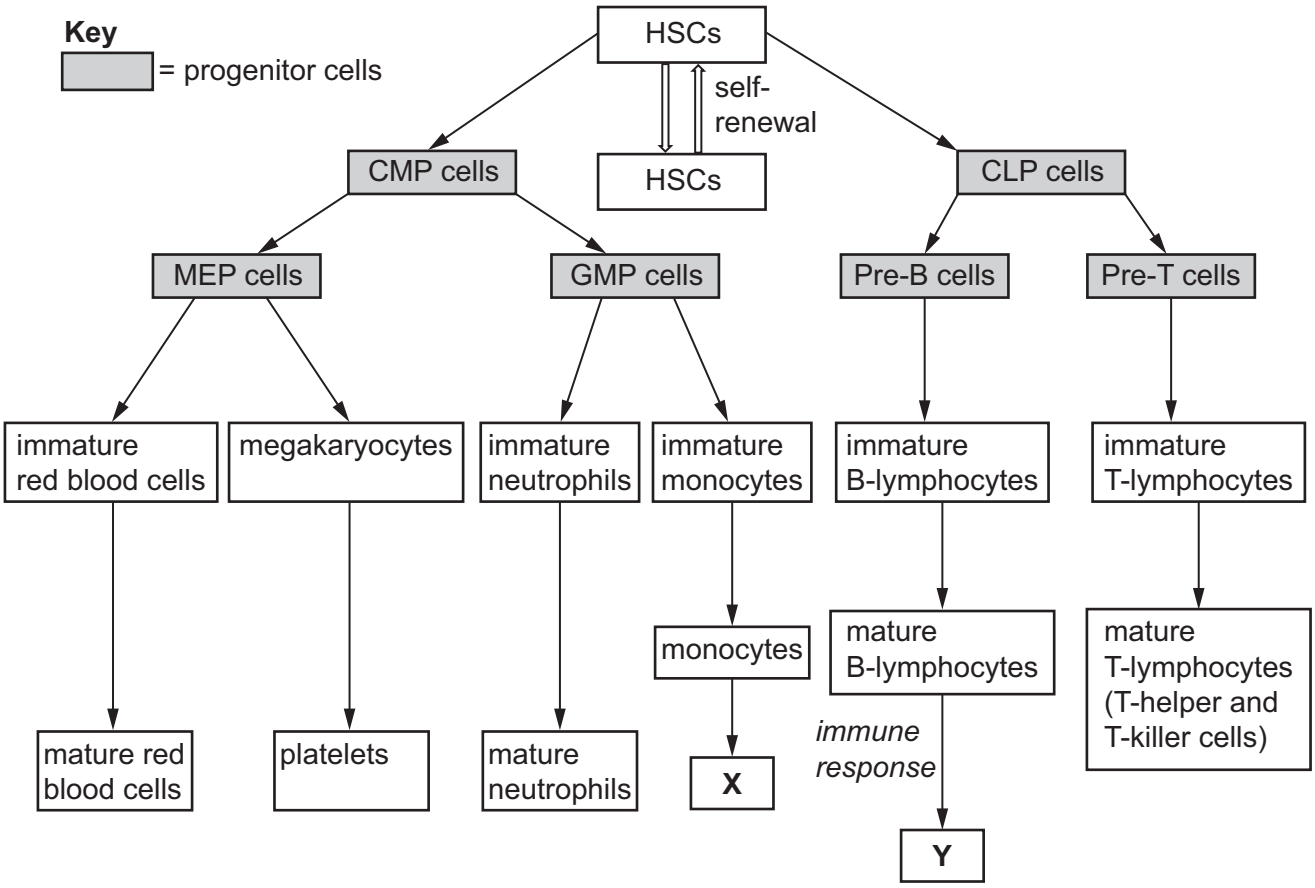


Fig. 4.1

(d) With reference to Fig 4.1, explain why GMP cells, which are progenitor cells, **cannot** be described as haematopoietic stem cells (HSCs).

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(e) Fig. 4.1 shows that monocytes differentiate into cell type **X**, which has a similar function to neutrophils.

Name cell type **X**.

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(f) Cell type **Y** shown in Fig. 4.1 releases molecules with antigen binding sites.

Name the molecules released by cell type **Y**.

..... [1]

(g) The differentiation of T-lymphocytes begins in the bone marrow and continues in an organ known as the thymus to produce fully differentiated T-helper and T-killer cells.

In the thymus, T-lymphocytes that bind to self antigens are destroyed.

Explain why T-lymphocytes that bind to self antigens need to be destroyed in the thymus.

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5 Malaria is an infectious disease caused by the protoctist, *Plasmodium*.

As part of its lifecycle, *Plasmodium* infects human red blood cells. Researchers can compare haemoglobin from the red blood cells of a healthy person with haemoglobin from a person with malaria.

(a) Throughout the world, most deaths from malaria are caused by *P. vivax* and *P. falciparum*.

Name **one** other species of *Plasmodium* that causes malaria.

Plasmodium ..... [1]

(b) In the laboratory, oxygen at different partial pressures can be bubbled through a solution of haemoglobin to determine the percentage saturation of haemoglobin at each partial pressure. A graph constructed from the results is known as an oxygen dissociation curve.

Fig. 5.1 is an oxygen dissociation curve for **normal** adult haemoglobin in **humans**.

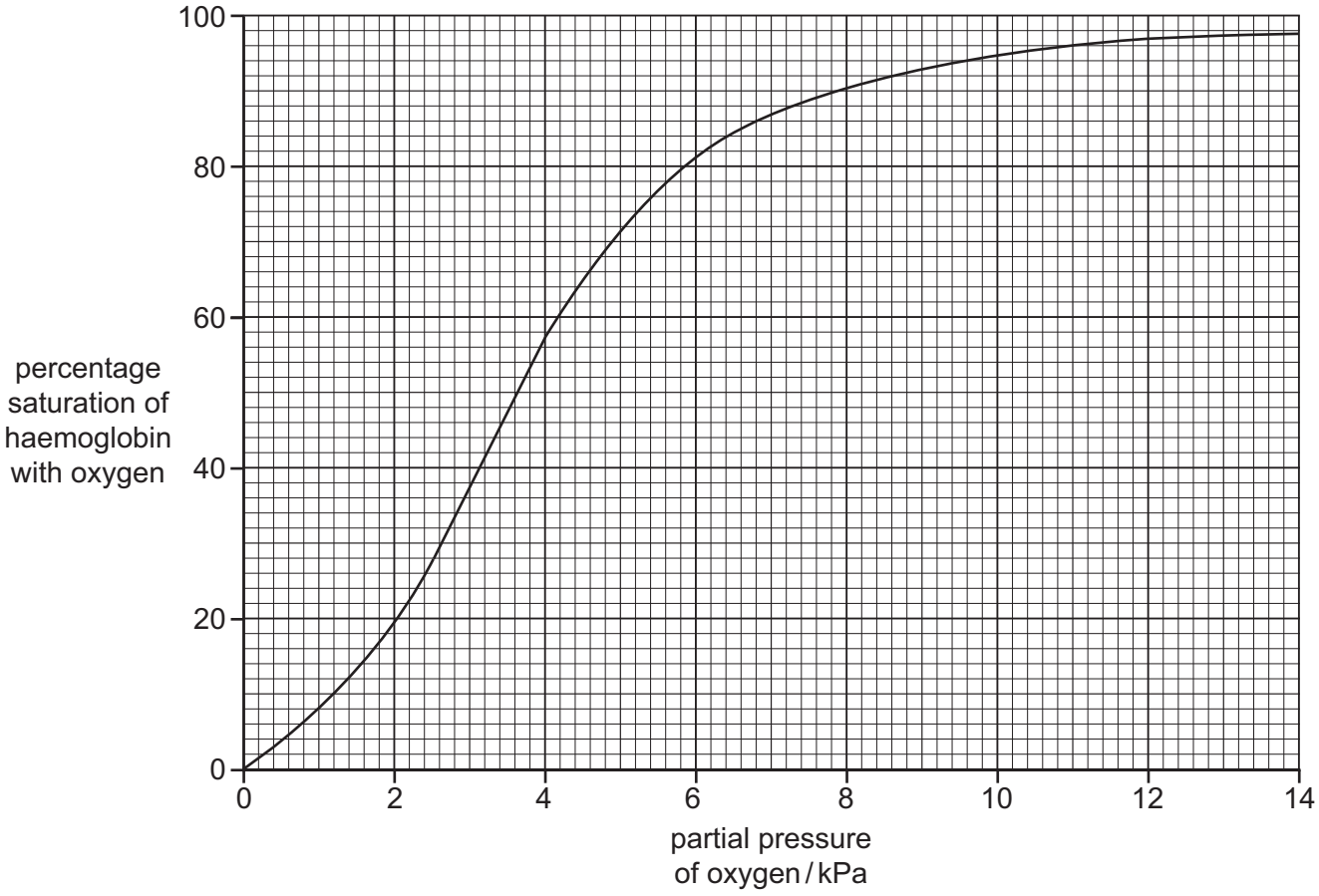


Fig. 5.1

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(i) In the experiment used to obtain the results shown in Fig. 5.1, the temperature and pH were standardised.

Explain what the researchers would consider when deciding which temperature and pH to use in the experiment.

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(ii) Using a different, more rapid technique, researchers compared the haemoglobin contained in red blood cells of a healthy person with the haemoglobin of a person with malaria who had been infected with *P. vivax.*

By analysing the results, the researchers concluded that the oxygen dissociation curve of a person with malaria would be shifted to the right.

With reference to Fig. 5.1, explain how a shift to the right of the oxygen dissociation curve would affect oxygen loading in the lungs, and unloading in respiring tissues, in a person with malaria.

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(c) A red blood cell that is infected with *Plasmodium* cannot carry out its function as effectively as a normal red blood cell.

Describe how the size **and** structure of a red blood cell is related to its function, **other than** the fact that it contains a very large number of haemoglobin molecules.

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6 The transport of water from the soil solution to the xylem of roots occurs by the apoplast and symplast pathways. Mineral ions can be transported dissolved in water.

(a) Describe the transport of water from the soil solution to the endodermis of roots by the **apoplast** pathway **and** explain why this pathway cannot continue at the endodermis.

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(b) Researchers investigated the mechanism of transport used for the uptake of potassium ions (K^+) into root epidermal cells at different concentrations of K^+ in the soil solution.

Complete Table 6.1 to provide information about the two different transport mechanisms that were identified by the researchers.

Table 6.1

net movement of K^+	membrane protein needed (yes or no)	ATP used (yes or no)	name of transport mechanism
against the concentration gradient			
down the concentration gradient			

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