UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

BIOLOGY **9700/21**

Paper 2 Structured Questions AS **May/June 2012**

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 provided at the top of the page.
Write in dark blue or black ink.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use red ink, staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
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.

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1	
2	
3	
4	
5	
6	
Total	

This document consists of **15** printed pages and **5** blank pages.

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1 Name as precisely as you can the structure described in each of the following statements.

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(a) The blood vessel that transports deoxygenated blood from the heart.

.....[1]

(b) The cell that ingests and digests cell debris and bacteria in the lungs.

.....[1]

(c) The cell that secretes antibodies.

.....[1]

(d) The epithelial cell that secretes mucus in the trachea.

.....[1]

(e) The tissue that prevents the collapse of the trachea during inhalation.

.....[1]

[Total: 5]

[Turn over

2 Fig. 2.1 shows a drawing made from an electron micrograph of two adjacent cells in a leaf.

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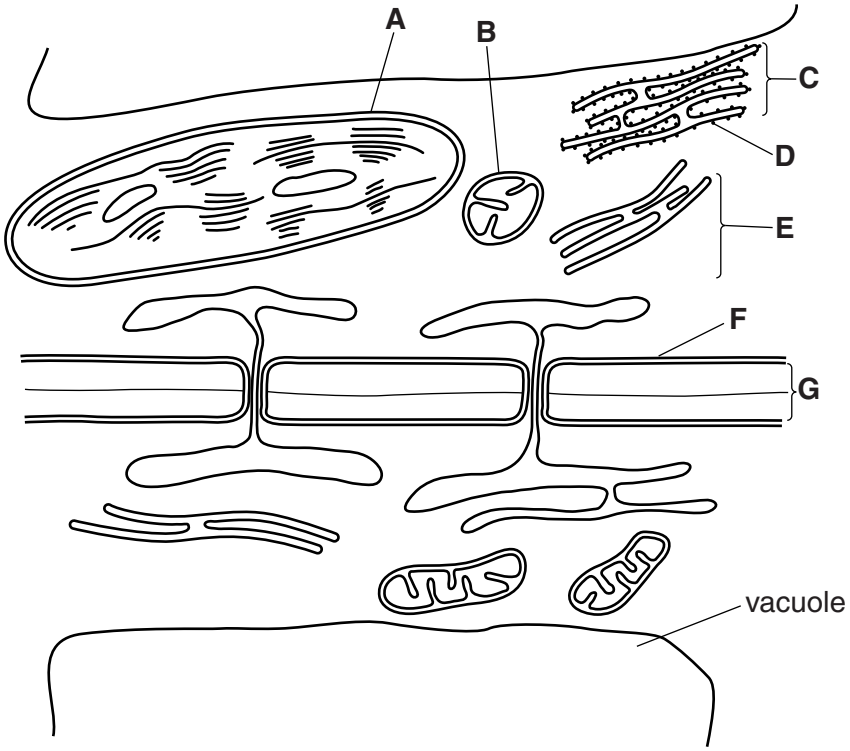

Fig. 2.1

(a) Structures **A** and **B** are both visible using the light microscope, but the internal detail of these organelles shown in Fig. 2.1 is only visible using the electron microscope.

Explain why the internal details of structures **A** and **B** are only visible when using the electron microscope and not when using the light microscope.

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.....[3]

(b) Name in full the structures labelled **C**, **D** and **E**.

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C .....

D .....

E ..... [3]

(c) State **one** role of vacuoles in plant cells.

..... [1]

(d) Structures **F** and **G** have very different permeability properties.

Explain how the composition of structures **F** and **G** determines the permeability properties of these structures.

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(e) Fig. 2.1 shows two plasmodesmata connecting the adjacent cells.

Describe the roles of plasmodesmata in transport in plants.

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..... [3]

[Total: 14]

3 Haemoglobinopathies are inherited conditions linked to the structure and function of haemoglobin. Sickle cell anaemia is one of these conditions in which the transport and delivery of oxygen to tissues is less than normal.

An investigation was carried out to discover the effect of sickle cell anaemia on the ability of blood to carry oxygen. Blood samples were taken from two people:

- person **L** without sickle cell anaemia
- person **M** with sickle cell anaemia.

The percentage saturation of haemoglobin with oxygen was determined over a range of partial pressures of oxygen.

Fig. 3.1 shows oxygen haemoglobin dissociation curves for the two blood samples.

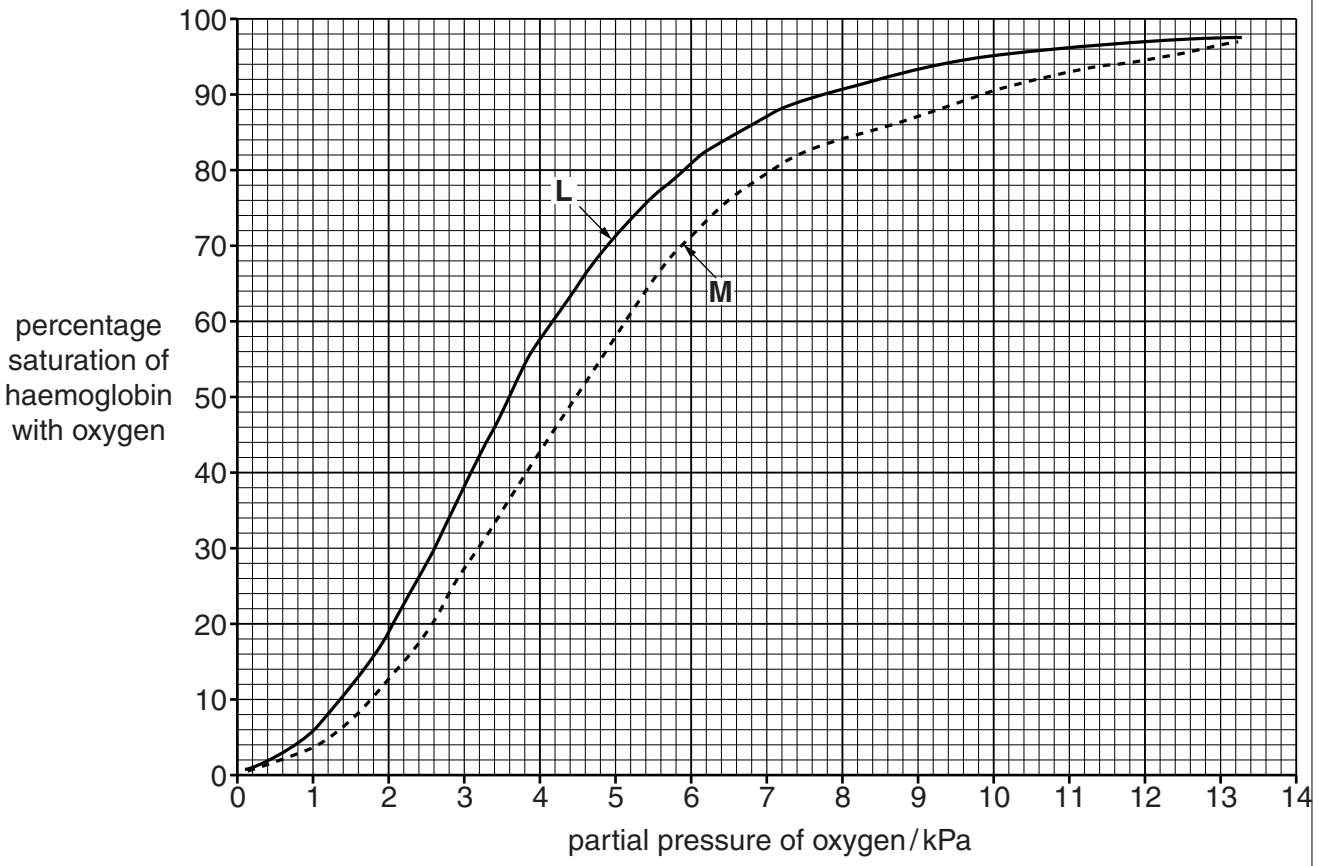

Fig. 3.1

(a) P50 is the partial pressure of oxygen at which haemoglobin is 50% saturated with oxygen. It is taken as a measurement of the affinity of haemoglobin for oxygen.

(i) State the P50 for the two blood samples, **L** and **M**.

L .....

M .....[1]

(ii) With reference to Fig. 3.1, describe how the dissociation curve for person **M differs** from the dissociation curve for person **L**.

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..... [3]

(b) Explain the advantage of the position of the dissociation curve for people with sickle cell anaemia.

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..... [3]

(c) The partial pressure of oxygen in the lungs at sea level is about 13.5 kPa. At an altitude of 3000 metres the partial pressure of oxygen in the lungs is about 7.5 kPa.

When people move from sea level to high altitude they become adapted to the low partial pressure of oxygen.

Describe **and** explain how humans become adapted to the low partial pressure of oxygen at high altitude.

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..... [4]

[Turn over

(d) Vaccination is used to control the spread of diseases, such as measles.

Explain why vaccination cannot be used to prevent sickle cell anaemia.

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.....[2]

[Total: 13]

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Question 4 starts on page 10

4 Penicillin is an antibiotic that interferes with the synthesis of cell walls in bacteria. Even before penicillin became widely available in the 1940s, the enzyme penicillinase which breaks down penicillin had been isolated. This enzyme is now found in many bacteria and gives them resistance to penicillin.

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Fig. 4.1 is a ribbon model of the structure of the enzyme penicillinase. The arrow indicates the active site of the enzyme.

Fig. 4.1

(a) Explain why the shape of the active site of an enzyme, such as penicillinase, is important.

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.....[3]

(b) With reference to Fig. 4.1, identify the aspects of protein structure that are shown and those that are **not** shown.

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aspects of protein structure shown

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aspects of protein structure not shown

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.....[3]

Fig. 4.2 shows the changes in energy during the progress of an uncatalysed reaction.

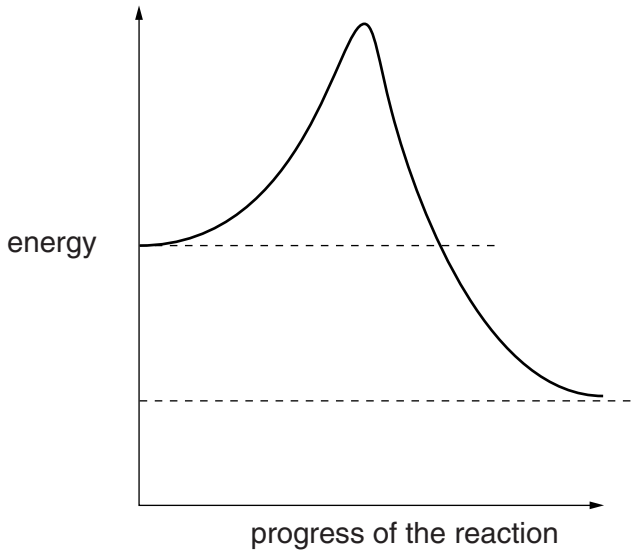

Fig. 4.2

(c) (i) Draw on Fig. 4.2 a curve to show changes in energy during the progress of the same reaction when catalysed by an enzyme. [2]

(ii) State the term given to the energy level that must be overcome before a reaction can progress.

.....[1]

(d) Antibiotic resistance is a serious worldwide problem.

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Suggest how antibiotics can be used effectively to avoid the development of widespread resistance in bacteria.

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.....[2]

[Total: 11]

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Question 5 starts on page 14

5 The slime mould, *Dictyostelium discoideum*, is a eukaryote and a decomposer of protein-rich material.

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Fig. 5.1 shows the life cycle of *D. discoideum*.

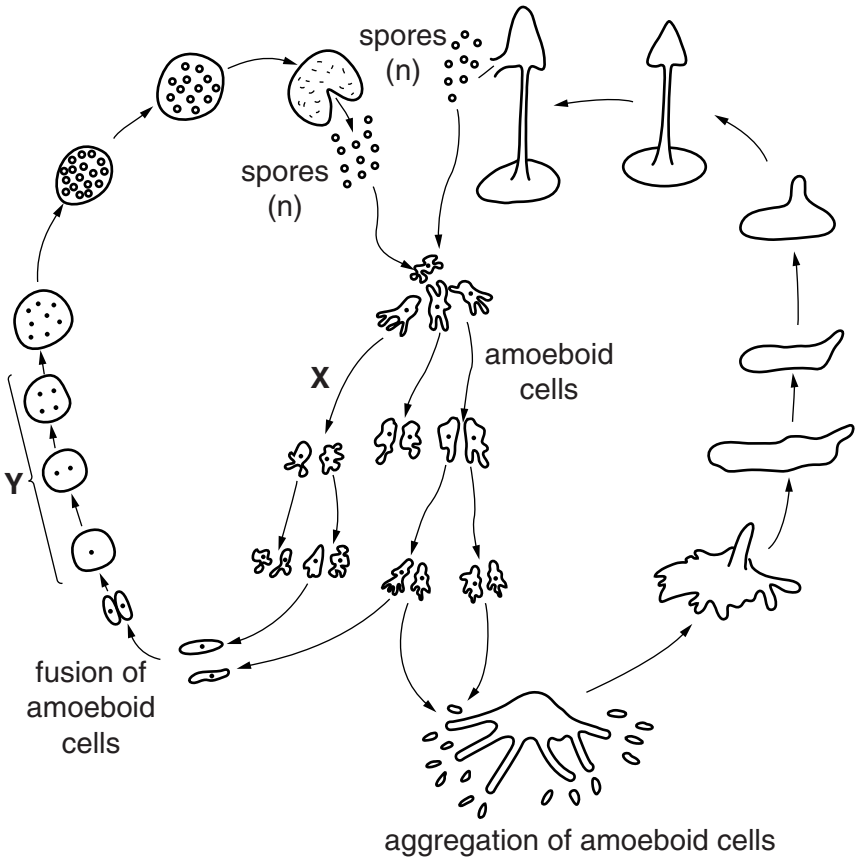

Fig. 5.1

(a) State the type of nuclear division that occurs at **X** and at **Y**.

X .....

Y .....[1]

(b) State what is meant by the term *reduction division* **and** explain why this division is necessary in a life cycle, such as that shown in Fig. 5.1.

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(c) The amoeboid cells of *D. discoideum* feed on protein-rich material and break it down to form ammonium ions (NH_4^+). The cell membranes of *D. discoideum* have transporter proteins that are responsible for the excretion of ammonium ions.

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Describe what happens to the ammonium ions excreted by *D. discoideum* into the soil.

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(d) Suggest why a transporter protein is required for the removal of ammonium ions from *D. discoideum*.

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[Total: 8]

6 Fig. 6.1 shows part of a DNA molecule.

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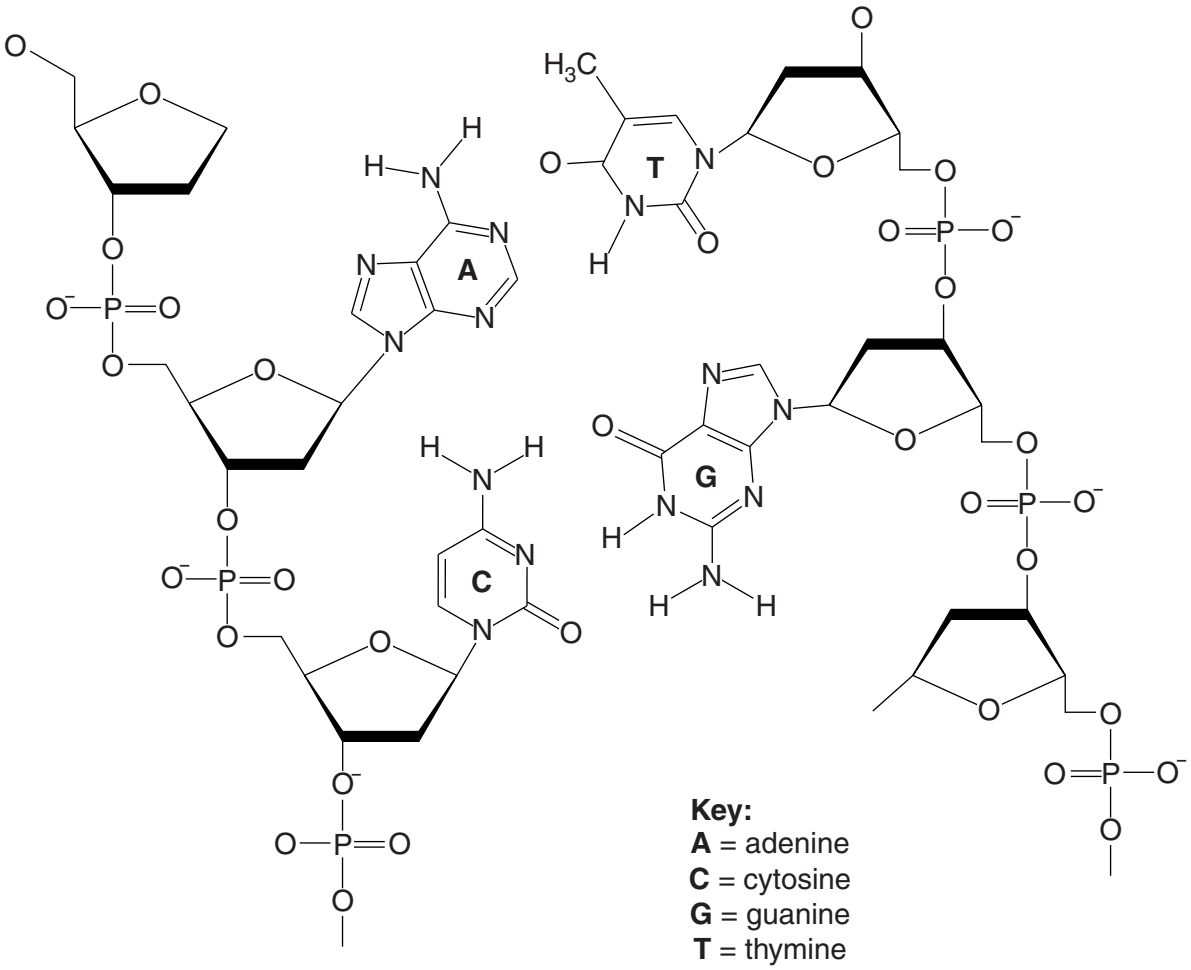

Fig. 6.1

(a) (i) Complete Fig. 6.1 by drawing on the hydrogen bonds between the two base pairs shown. [2]

(ii) State the importance of hydrogen bonding in DNA structure.

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.....[2]

In the 1950s, Erwin Chargaff determined the relative quantities of the four bases in DNA in different organisms. His results provided important evidence for the model of DNA proposed by James Watson and Francis Crick in 1953. Some of Chargaff's data is shown in Table 6.1.

Table 6.1

organism	percentage of adenine	percentage of thymine	percentage of guanine	percentage of cytosine
Escherichia coli (bacterium)	24.7	23.6	26.0	25.7
a yeast	31.3	32.9	18.7	17.1
wheat	27.3	27.1	22.7	22.8
octopus	33.2	31.6	17.6	17.6
sea urchin	32.8	32.1	17.7	17.3
chicken	28.0	28.4	22.0	21.6
human	29.3	30.0	20.7	20.0

(b) With reference to Fig. 6.1, explain how the data in Table 6.1 helps to confirm the arrangement of bases in DNA.

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.....[3]

(c) Table 6.2 shows Chargaff's data for a virus.

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Table 6.2

organism	percentage of adenine	percentage of thymine	percentage of guanine	percentage of cytosine
a virus	24.0	31.2	23.3	21.5

(i) State how the result for the virus differs from the results for all the organisms given in Table 6.1.

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.....[1]

(ii) Suggest why the results for the virus are different from all the other organisms.

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.....[1]

[Total: 9]

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