Cambridge Assessment

A Level

Biology

Session:	2010 June
Type:	Question paper
Code:	H021-H421
Units:	F211; F212; F214; F215

THIS IS A NEW SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

BIOLOGY

F211

Cells, Exchange and Transport

Candidates answer on the Question Paper

OCR Supplied Materials:
- Insert (inserted)

Other Materials Required:
- Electronic calculator
- Ruler (cm/mm)

Tuesday 25 May 2010
Morning

Duration: 1 hour

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your Candidate Number, Centre Number and question number(s).

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **60**.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

Where you see this icon you will be awarded marks for the quality of written communication in your answer.

- This document consists of **16** pages. Any blank pages are indicated.

Answer **all** the questions.

1 **(a)** Fig. 1.1 is a diagram of a bacterium as seen under an electron microscope.

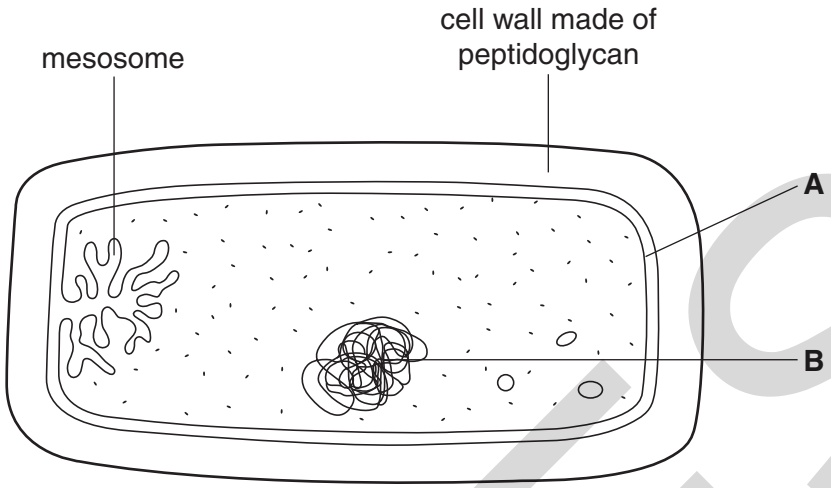

Fig. 1.1

(i) Name the structures labelled **A** and **B**.

A .....

B ..... **[2]**

(ii) It has been suggested that the mesosome has the same role as mitochondria in eukaryotic cells.

Suggest the role of the mesosome in prokaryotic cells, such as bacteria.

..... **[1]**

(iii) Eukaryotic cells, such as *Euglena*, contain membrane-bound organelles. Each organelle has a specific function in the cell.

State the **process** that is carried out in each of the organelles listed below.

ribosome .....

chloroplast ..... **[2]**

(b) Explain why a single-celled organism, such as *Euglena*, does **not** need a specialised area to carry out gaseous exchange.

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..... **[2]**

(c) The mammalian gas exchange system contains a variety of types of cells and tissues.

Complete Table 1.1, stating the function of each of the cells and tissues. The first row has been completed for you.

Table 1.1

cell / tissue	function
squamous epithelium	to provide a thin surface for a short diffusion distance
elastic tissue	....
ciliated epithelium	....
goblet cells	....
smooth muscle	....

[4]

[Total: 11]

2 Fig. 2.1, **on the insert**, is a photomicrograph of a blood smear. The smear has been stained.

(a) State **two** reasons why the blood smear has been stained.

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..... **[2]**

(b) Suggest **one** detail that would be made visible if the micrograph were taken using:

(i) a scanning electron microscope

.....

(ii) a transmission electron microscope.

..... **[2]**

(c) The red colouration of the red blood cells is caused by the pigment haemoglobin. The main function of haemoglobin is to transport oxygen in the form of oxyhaemoglobin.

Fig. 2.2 shows the dissociation curves of adult oxyhaemoglobin (curve **A**) and fetal oxyhaemoglobin (curve **F**).

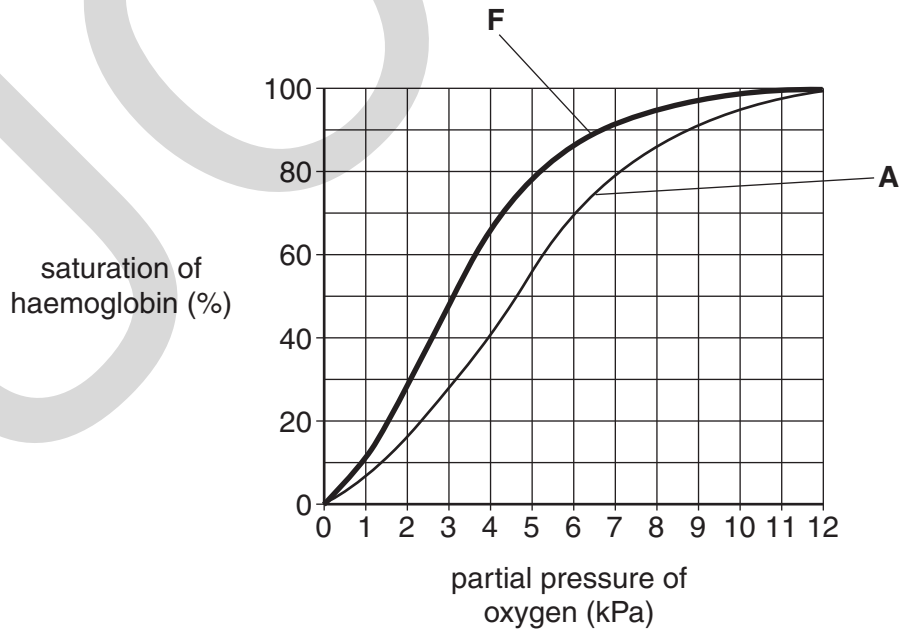

Fig. 2.2

Explain why the curve for fetal oxyhaemoglobin is to the left of the curve for adult oxyhaemoglobin.

In your answer you should use appropriate technical terms, spelt correctly.

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..... **[4]**

(d) In high partial pressures of carbon dioxide, the oxyhaemoglobin dissociation curve undergoes a change known as the Bohr shift.

(i) **Draw a curve on Fig. 2.2** to show the effect of the Bohr shift. **[2]**

(ii) Outline the benefits of the Bohr shift to actively respiring tissue.

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..... **[2]**

[Total: 12]

3 A student carried out an investigation involving uptake of the stain methylene blue by yeast cells.

The investigation involved adding methylene blue to a suspension of yeast cells. Samples of the stained yeast cells were heated to different temperatures.

The student then observed the cells at high power under a light microscope.

The results are shown in Table 3.1.

Table 3.1

temperature (°C)	cells observed stained blue (%)	colour of solution surrounding cells
10	98	colourless
20	96	colourless
30	97	colourless
40	96	colourless
50	73	colourless
60	12	light blue
70	2	blue
80	0	blue

(a) (i) Yeast cells take up methylene blue by active transport.

Using **only** the information provided in Table 3.1, outline the evidence that supports this statement.

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..... **[2]**

(ii) Suggest why some cells did **not** stain blue at 20 °C.

.....

..... **[1]**

(b) (i) Suggest **one** change that occurred to the plasma (cell surface) membranes of the yeast cells at temperatures above 60 °C.

.....

.....

..... **[1]**

(ii) Explain why the stained yeast cells lost their colour at higher temperatures.

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..... **[2]**

(c) The student concluded that yeast cells are killed between 50 °C and 70 °C.

Suggest **one** way in which the student could have improved the **accuracy** of this experiment and **one** way in which he could have improved the **reliability**.

accuracy .....

.....

.....

reliability .....

.....

..... **[2]**

(d) The student placed a small sample of the yeast suspension on a microscope slide and observed it under high power.

Fig. 3.1 shows what the student observed.

Fig. 3.1

Cell **Z** is undergoing a process called *budding*.

Outline the process of budding in yeast.

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..... **[2]**

[Total: 10]

4 Fig. 4.1 shows diagrams of two different types of cells, **X** and **Y**.

The cells are **not** drawn to scale.

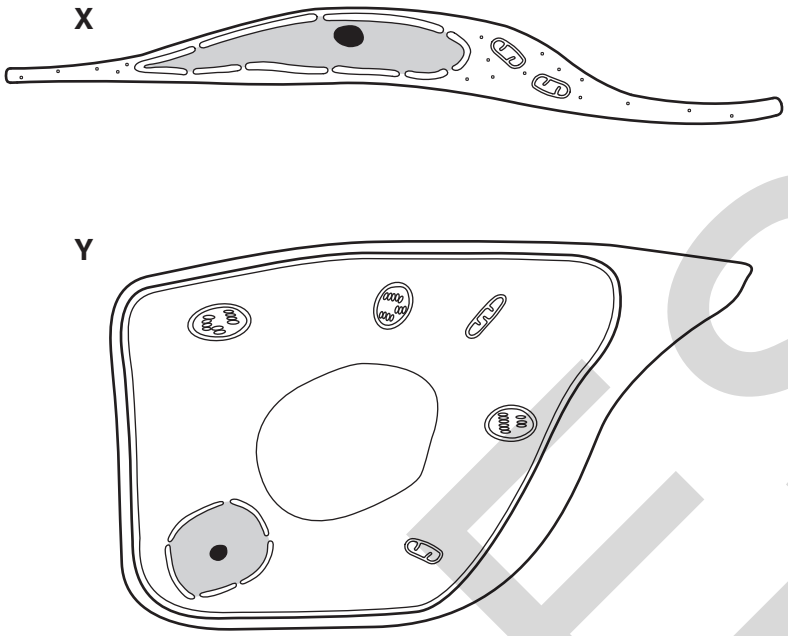

Fig. 4.1

(a) (i) State, using **only the information in Fig. 4.1**, two **differences** between plant cells and animal cells.

1 .....

.....

2 .....

..... **[2]**

(ii) Cell **Y** is a guard cell.

State, using **only the information in Fig. 4.1**, one adaptation of this cell and explain how the adaptation allows the cell to carry out its function.

adaptation .....

explanation .....

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..... **[2]**

(b) Fig. 4.2 shows drawings of the six chromosomes inside an animal cell viewed during late prophase of mitosis.

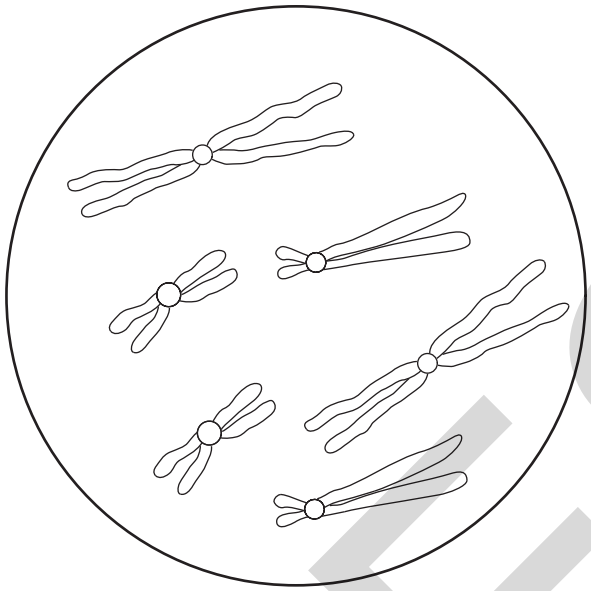
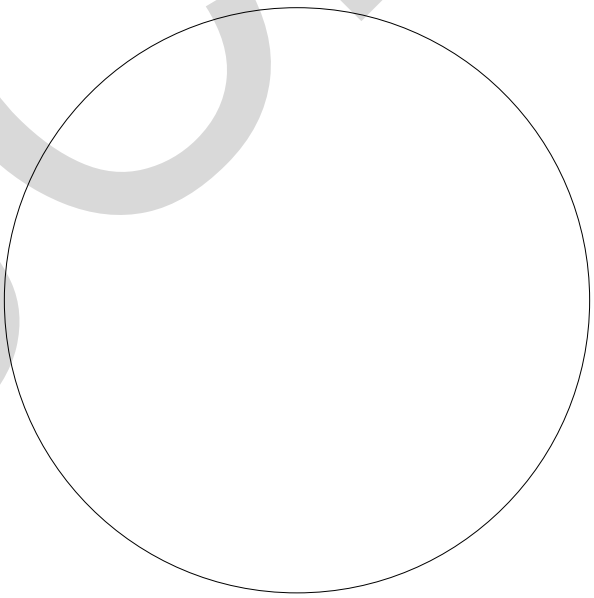


Fig. 4.2

(i) Identify **one pair** of *homologous chromosomes* in Fig. 4.2 by drawing around each chromosome in the pair **on the diagram**. **[1]**

(ii) The nucleus of a sperm cell is produced by **meiosis**.

Draw a diagram in the space below to represent the chromosomes that are present in the nucleus of a sperm cell from **the same animal**.



[2]

[Total: 7]

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QUESTION 5 STARTS ON PAGE 12

5 Fig. 5.1 shows the possible pathways taken by water across the root of a plant.

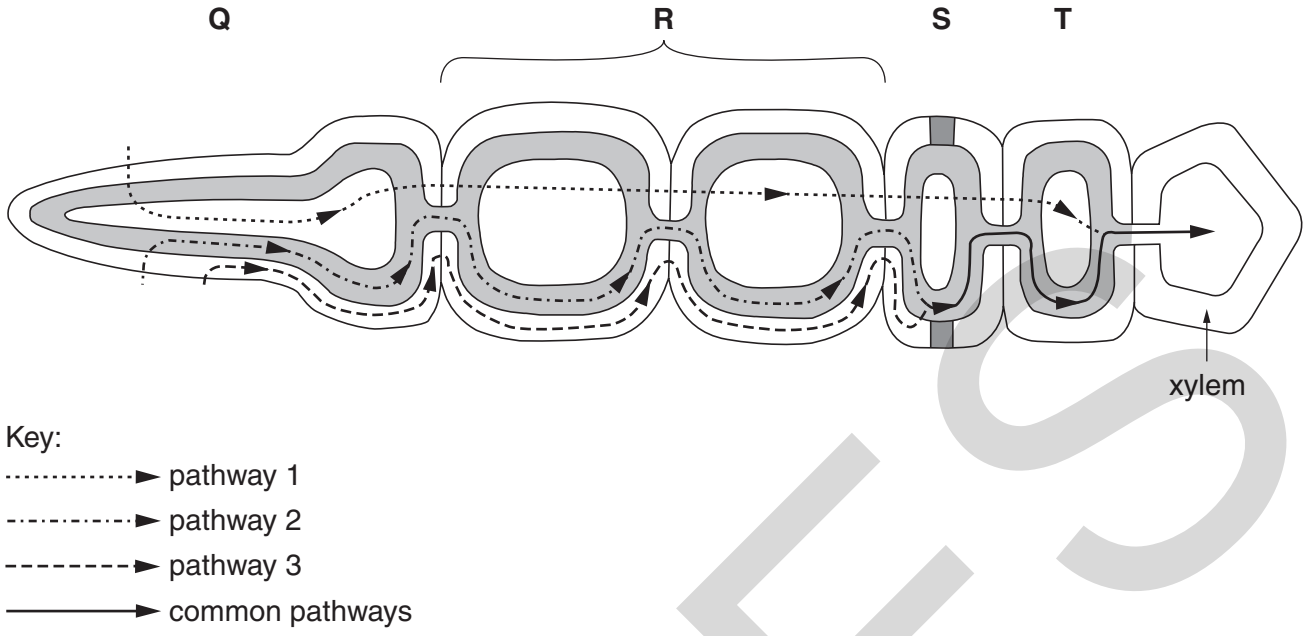

Fig. 5.1

(a) (i) Name the process by which water enters cell **Q** from the soil.

..... **[1]**

(ii) Pathway 1 is known as the vacuolar pathway, as the water passes into and through the cell vacuoles.

Name pathway 2 and pathway 3.

pathway 2 .....

pathway 3 ..... **[2]**

(iii) State which letter, **Q**, **R**, **S** or **T**, on Fig. 5.1, represents the endodermis.

..... **[1]**

(b) Describe **and** explain how water is moved up the xylem from the roots to the leaves.

In your answer you should use appropriate technical terms, spelt correctly.

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..... **[5]**

(c) Table 5.1 shows a comparison of xylem vessels and phloem sieve tube elements.

Complete the table. The first row has been done for you.

Table 5.1

feature	xylem vessel	phloem sieve tube element
cells living or dead	dead	living
bordered pits present or absent		
lignin present or absent		
substances transported		
direction of transport		

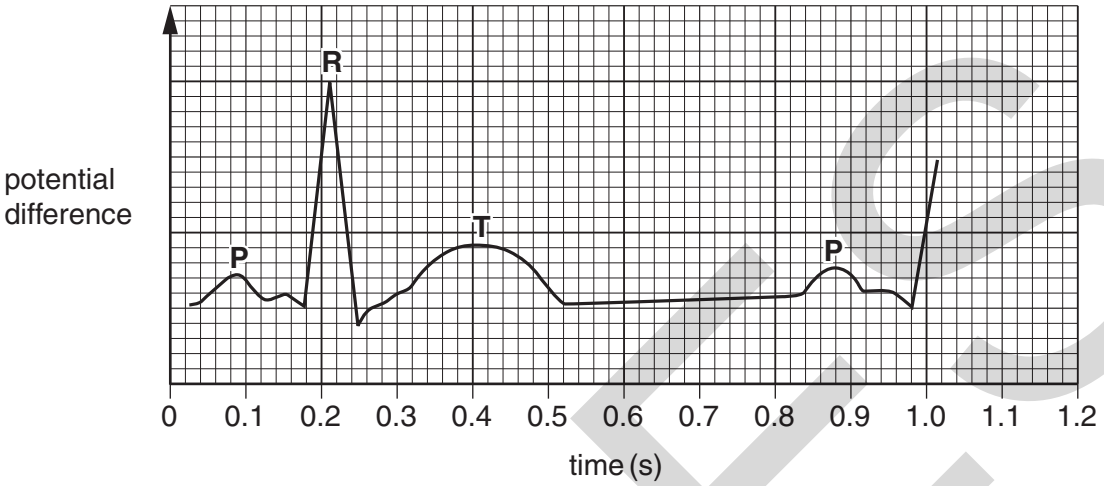
[4]

[Total: 13]

6 Fig. 6.1 shows two electrocardiogram (ECG) traces.

- Trace **A** is a normal trace.
- Trace **B** is a trace from a heart after treatment with the drug digitalis.

Trace **A** – an electrocardiogram from a normal heart



Trace **B** – an electrocardiogram from a heart after treatment with digitalis

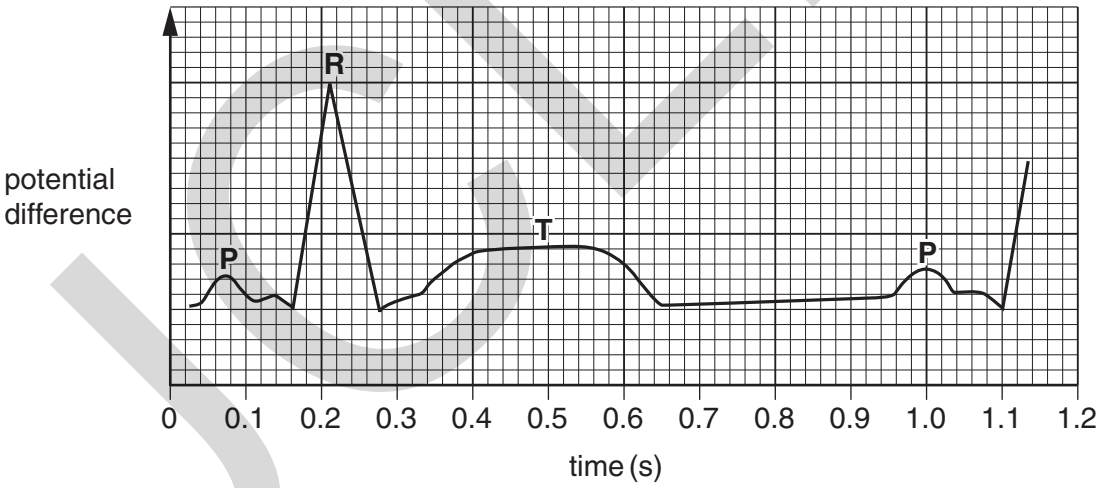


Fig. 6.1

(a) Calculate the heart rate using the information in Trace **A**.

Show your working.

Answer = ... beats per minute **[2]**

(b) Using the information in Fig. 6.1, state **two** effects of digitalis on the activity of the heart.

1 .....

.....

2 .....

..... **[2]**

(c) Describe the roles of the sinoatrial node (SAN) **and** the atrioventricular node (AVN) in coordinating the cardiac cycle.

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..... **[3]**

[Total: 7]

END OF QUESTION PAPER

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THIS IS A NEW SPECIFICATION

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BIOLOGY

F212

Molecules, Biodiversity, Food and Health

Candidates answer on the Question Paper

OCR Supplied Materials:
- Insert (inserted)

Other Materials Required:
- Electronic calculator
- Ruler (cm/mm)

Tuesday 8 June 2010
Morning

Duration: 1 hour 45 minutes

OCE/16440

F212

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

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- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your Candidate Number, Centre Number and question number(s).

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **100**.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- This document consists of **24** pages. Any blank pages are indicated.

Answer **all** the questions.

1 **(a)** Milk is considered to be a complete food containing most of the components of a balanced diet.

A student carried out a series of food tests on a sample of milk. The student's observations and conclusions are shown in Table 1.1.

(i) Complete Table 1.1 by

- naming the molecule being tested for
- stating whether this molecule is present or absent.

The first row has been completed for you.

Table 1.1

reagent	observation	molecule being tested for	present or absent
ethanol and water	white emulsion	lipid	present
Benedict's solution	brick-red precipitate		
biuret I and II	lilac colour		
iodine solution	yellow / brown		

[3]

(ii) Although the student entered 'present' for lipid in the first row of the table, he was unsure whether the result was correct.

Suggest why the student was unsure if the positive result for lipid was correct for the milk sample.

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..... **[1]**

(iii) Triglycerides are a type of lipid found in milk.

Describe the structure of a triglyceride molecule.

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..... **[3]**

(b) State **three** roles of lipids in living organisms.

1 .....

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2 .....

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3 .....

..... **[3]**

(c) Human populations with diets high in animal fats have a lower life expectancy than those with diets high in vegetable oils.

(i) Suggest **one** difference between lipids from animals and those from plants.

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..... **[1]**

Animal fats are thought to raise blood cholesterol levels. High blood cholesterol levels can lead to premature death.

Fig. 1.1 shows the relationship between blood cholesterol level and annual death rate per 10 000 of the population.

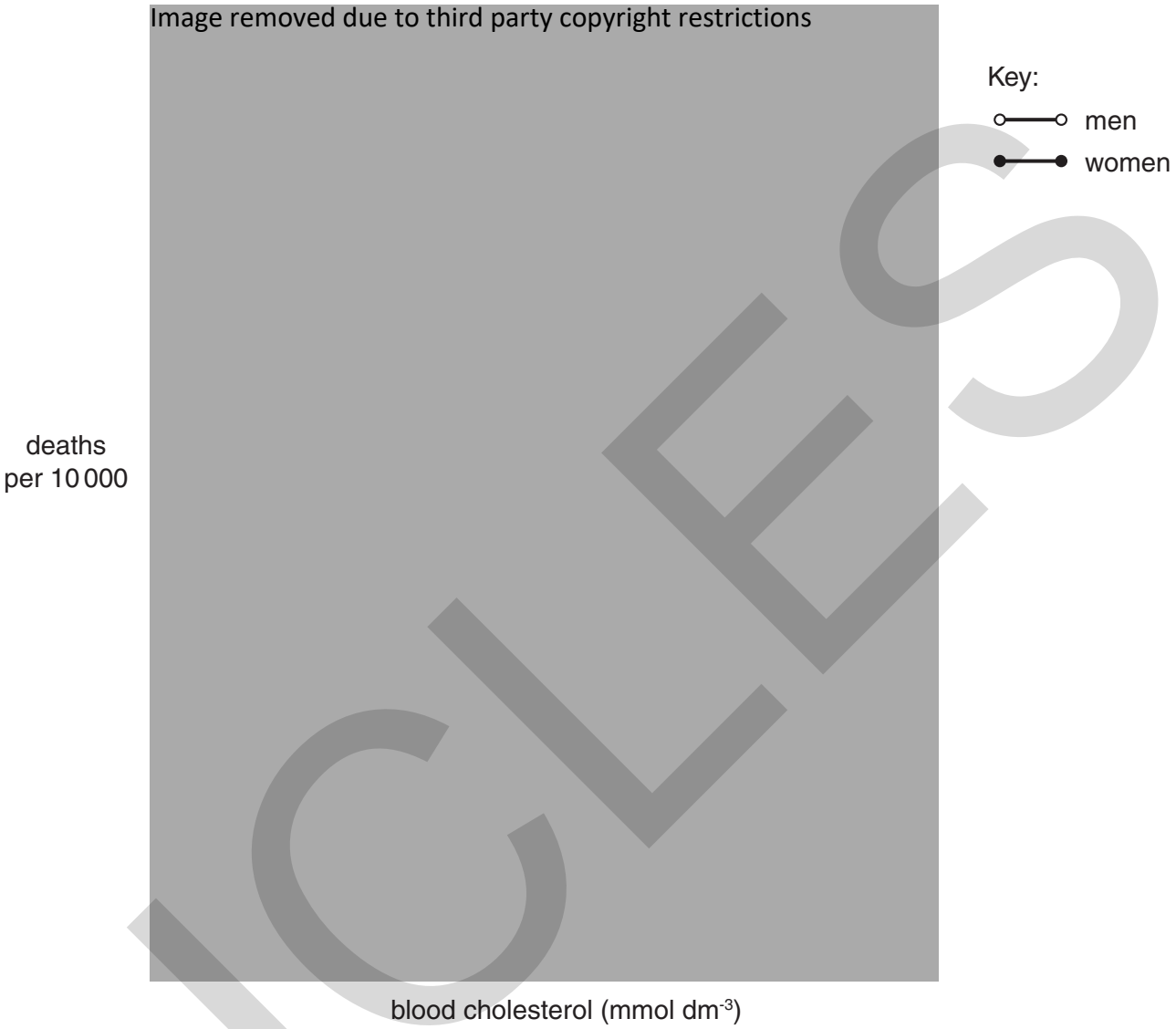

Fig. 1.1

(ii) Describe the trends shown in Fig. 1.1.

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..... **[3]**

(iii) Increased blood cholesterol levels are associated with certain medical conditions.

Suggest **two** medical conditions that may be associated with increased blood cholesterol levels.

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..... **[2]**

[Total: 16]

2 When a new species is discovered, it needs to be classified.

(a) Define the term *classification.*

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..... **[2]**

(b) **(i)** Suggest what criteria a taxonomist may take into account when classifying a new species.

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..... **[3]**

(ii) Table 2.1 shows the main taxonomic groups. The groups are **not** in the correct order.

Table 2.1

	Q	R	S	T	U	V	W
taxonomic group	species	order	class	phylum	genus	kingdom	family

Place the **letters** representing the taxonomic groups into the correct order.

The first one has been done for you.

V .... **[3]**

(c) The classification of organisms into domains is relatively new.

Describe the differences between a classification system based on domains and one based on kingdoms.

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..... **[4]**

[Total: 12]

3 **(a)** In Scotland, in 2007, there was a major food poisoning outbreak that killed three people.

Suggest **one** group in the population that is more likely to die from food poisoning **and** give a reason for your suggestion.

group .....

reason .....

..... **[2]**

(b) The food poisoning outbreak involved the bacterium *Escherichia coli* 0157 (*E. coli* 0157) which had been responsible for contaminating meat products. The meat had been stored at 11 °C rather than the recommended 5 °C and this led to meat spoilage.

(i) Explain how bacteria cause food spoilage.

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..... **[3]**

(ii) Food normally spoils much faster if stored at temperatures higher than 5 °C.

Explain why food spoils faster at higher temperatures.

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..... **[3]**

(iii) Food can be preserved by keeping it at low temperature in a refrigerator or freezer.

Name **two other** methods of food preservation and state how each method works.

method .....

.....

how the method works .....

.....

.....

method .....

.....

how the method works .....

.....

..... **[4]**

QUESTION 3(c) STARTS ON PAGE 10

(c) Microorganisms, such as the fungus *Fusarium*, can be grown and then purified to produce mycoprotein. This mycoprotein can be used as a food source for humans.

Table 3.1 compares mycoprotein with beef.

Table 3.1

Image removed due to third party copyright restrictions

Use the data in Table 3.1 to **describe and explain** the advantages and disadvantages of using microorganisms to produce food for human consumption.

In your answer you should make comparisons using the information in Table 3.1.

advantages .....

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disadvantages .....

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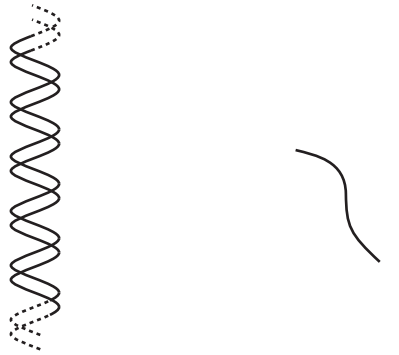
..... **[8]**

[Total: 20]

4 **(a)** Fig. 4.1 is a drawing that represents molecules of DNA and messenger RNA (mRNA).



DNA **mRNA**

Fig. 4.1

The mRNA molecule is shorter than the DNA molecule.

(i) State, using **only** the information in Fig. 4.1, **one other** way to distinguish between DNA and mRNA.

.....

..... **[1]**

(ii) Give **one** further difference in **structure** between DNA and RNA.

.....

..... **[1]**

DNA and mRNA are both involved in protein synthesis. The mRNA molecule, carrying the code for protein, leaves the nucleus and attaches to a ribosome. The ribosome is the site where a protein molecule is formed.

(iii) Complete the following statement:

A sequence of DNA nucleotides that codes for a protein is a ..... **[1]**

(iv) Suggest why DNA is not able to leave the nucleus.

.....

.....

..... **[1]**

(v) Explain why the mRNA molecule is shorter than a DNA molecule.

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..... **[2]**

(b) Enzymes are involved in the production of mRNA in eukaryotic cells. One enzyme is inhibited by the toxin, α-amanitin.

Fig. 4.2 shows the effect when α-amanitin attaches to this enzyme.

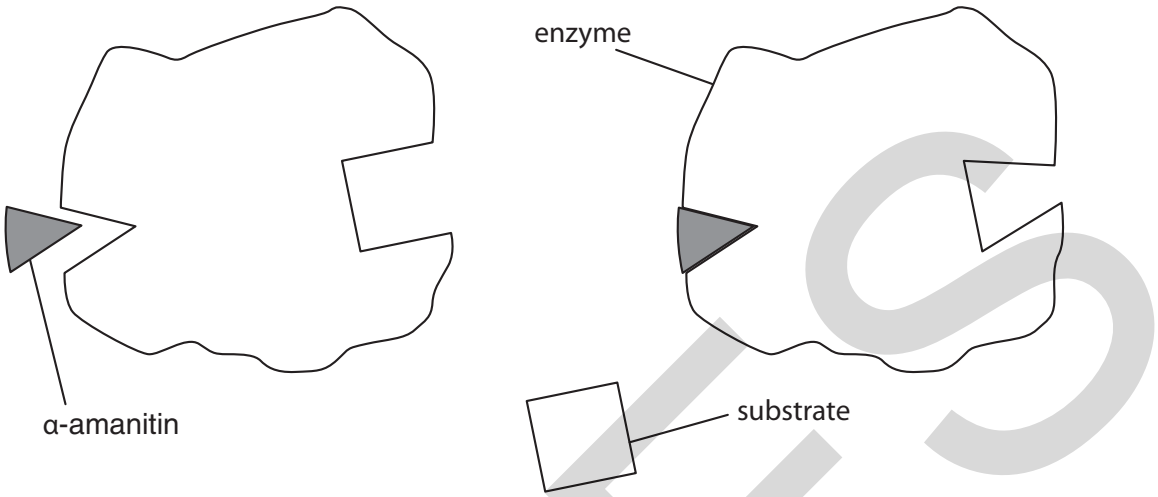

Fig. 4.2

(i) Explain how α-amanitin stops the formation of an enzyme-substrate complex during RNA production.

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..... **[2]**

(ii) The Roman Emperor Claudius was poisoned by his wife Agrippina when she gave him death cap fungus to eat. The death cap fungus contains α-amanitin.

Suggest how the toxin α-amanitin may lead to the death of an organism.

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..... **[2]**

(c) (i) Enzymes are globular proteins with a specific three dimensional shape. The shape is determined by the primary structure.

State the meaning of the term *primary structure*.

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..... **[1]**

Fig. 4.3 shows some of the chemical bonds that hold the **tertiary** structure of a protein together.

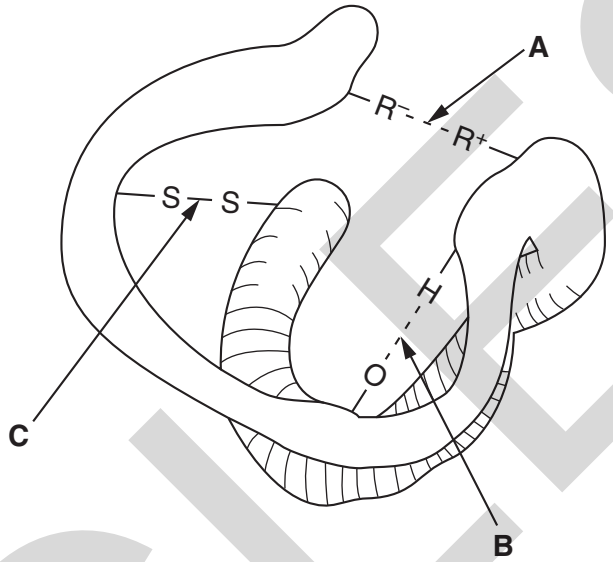

Fig. 4.3

(ii) Name the bonds labelled **A**, **B** and **C**.

A.....

B.....

C .....

[3]

(d) When proteins are heated to a high temperature, their tertiary structure is disrupted.

Explain how this occurs.

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..... **[3]**

[Total: 17]

5 **(a)** Smoking increases the risk of lung infections.

(i) Explain how the mucus and the cilia in the air passages reduce the chance of developing lung infections.

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..... **[2]**

QUESTION 5 CONTINUES ON PAGE 16

In an individual with bronchitis, the mucus contains a large number of pathogenic bacteria. Phagocytic white blood cells destroy the bacteria.

Fig. 5.1 shows the sequence of events that results in the destruction of a bacterium.

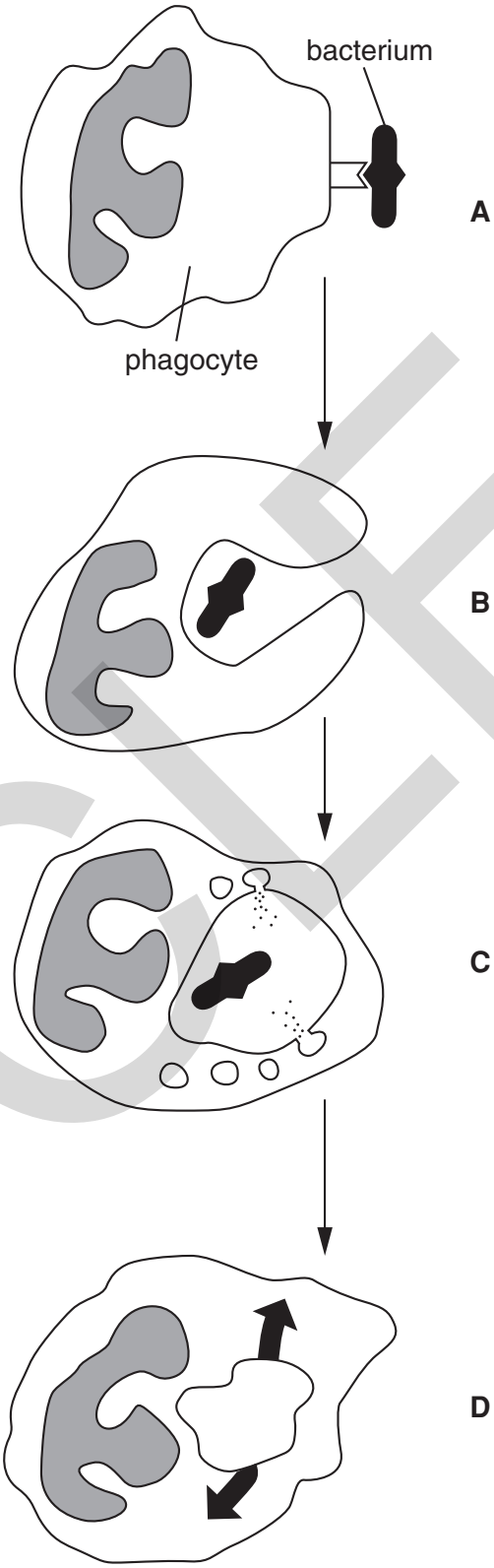

Fig. 5.1

(ii) Describe the events taking place at stages **A**, **B**, **C** and **D**, in sequence.

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..... **[6]**

(b) The immune system will produce specific antibodies in response to infection.

(i) Name the type of cell that produces antibodies.

..... **[1]**

(ii) Describe how the structure of an antibody molecule is related to its function.

In your answer you must clearly link structure and function.

.... **[7]**

(iii) Identify the type of immunity provided by antibodies in breast milk.

Place a tick (✓) in the correct box.

type of immunity	
artificial active	
artificial passive	
natural active	
natural passive	

[1]

[Total: 17]

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6 **(a)** Before any major development can take place, an Environmental Impact Assessment (EIA) needs to be carried out.

One such development is the proposed extension to the M27 motorway in Hampshire. This extension would cut through an important heathland ecosystem.

Suggest **three** aspects of this development that would need to be considered when carrying out the EIA.

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..... **[3]**

(b) An ecologist carried out a survey of butterfly species on the heathland.

The ecologist walked along a marked path on four different days in June. She counted

- the number of butterfly species
- the number of individual butterflies of each species.

(i) Suggest how this method of collecting data could be improved.

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..... **[3]**

(ii) The ecologist's results are shown in Table 6.1.

These results can be used to calculate the Simpson's Index of Diversity (D) for butterflies in this heathland using the formula:

$$D = 1 - [\Sigma (n/N)^2]$$

where n = number of individuals of a species in the sample
N = total number of individuals of all species in the sample

Complete the table by filling in the **three** missing values.

Table 6.1

species	n	n/N	$(n/N)^2$
Grayling (*Hipparchia semele*)	3	0.0968	0.09370
Large Heath (*Coenonympha tullia*)	11	……	0.12588
Gatekeeper (*Pyronia tithonus*)	6	0.1935	0.03744
Green Hairstreak (*Callophrys rubi*)	2	0.0645	0.00416
Silver-studded Blue (*Plebeius argus*)	2	0.0645	0.00416
Small Heath (*Coenonympha pamphilus*)	7	0.2258	0.05099
		Sum (Σ)	……
		$1 - \Sigma$	D = ……

[3]

(iii) Suggest the implications of a high value of Simpson's Index of Diversity on planning decisions.

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..... **[2]**

(c) (i) The six species of butterfly identified by the ecologist in the survey are shown **on the insert** in Fig. 6.1.

The ecologist used a dichotomous key to identify these butterflies. This key is shown below:

Key:

Question 1	Round spots on the under wing	yes	go to question 2
		no	go to question 4
Question 2	Orange upper wing	yes	go to question 3
		no	**Silver-studded Blue**
Question 3	One spot on upper wing	yes	**Gatekeeper**
		no	**Large Heath**
Question 4	Spots on upper wing	yes	go to 5
		no	**Green Hairstreak**
Question 5	One spot on upper wing	yes	**Small Heath**
		no	**Grayling**

Identify the butterflies shown in Fig. 6.1 using the key.

Complete Table 6.2 below. One butterfly has been identified for you.

Table 6.2

species	letter
Grayling (*Hipparchia semele*)	
Large Heath (*Coenonympha tullia*)	
Gatekeeper (*Pyronia tithonus*)	
Green Hairstreak (*Callophrys rubi*)	
Silver-studded Blue (*Plebeius argus*)	
Small Heath (*Coenonympha pamphilus*)	E

[5]

QUESTION 6(c)(ii) STARTS ON PAGE 24

(ii) State why Small Heath and Large Heath butterflies both share part of their scientific name.

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.....

..... **[2]**

[Total: 18]

END OF QUESTION PAPER

THIS IS A NEW SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

BIOLOGY

F212

Molecules, Biodiversity, Food and Health

INSERT

Tuesday 8 June 2010
Morning

Duration: 1 hour 45 minutes

OCE/16441

INFORMATION FOR CANDIDATES

- This insert contains **Fig. 6.1**.
- This document consists of **2** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER/INVIGILATOR

- Do not send this Insert for marking; it should be retained in the centre or destroyed.

DC (SJF5615/DJ) 16441/4

upper wing

A B C

under wing

D E F

Fig. 6.1

THIS IS A NEW SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE

BIOLOGY

F214

Communication, Homeostasis and Energy

Candidates answer on the Question Paper

OCR Supplied Materials:
None

Other Materials Required:
- Electronic Calculator
- Ruler (cm/mm)

Friday 25 June 2010
Afternoon

Duration: 1 hour

* F 2 1 4 *

* O C E / 1 3 7 1 0 *

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your Candidate Number, Centre Number and question number(s).

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- The total number of marks for this paper is **60**.
- This document consists of **16** pages. Any blank pages are indicated.

Answer **all** the questions.

1 **(a)** Fig. 1.1 represents a molecule of ATP.

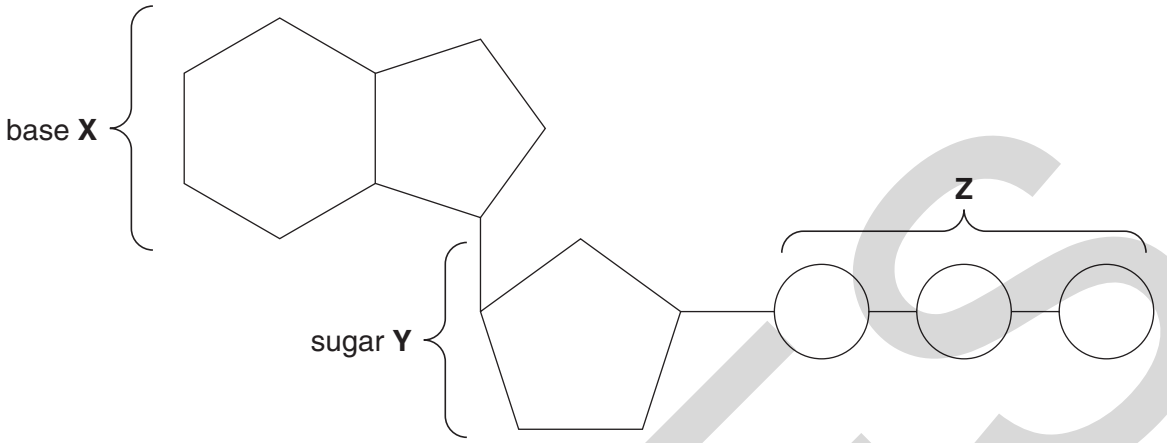

Fig. 1.1

(i) Name the parts of the ATP molecule labelled **X**, **Y** and **Z**.

X .....

Y .....

Z ..... **[3]**

(ii) With reference to Fig. 1.1, describe and explain the role of ATP in the cell.

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..... **[3]**

(b) Fig. 1.2 is an electron micrograph of a mitochondrion from an animal cell.

Fig. 1.2

(i) Name the structure labelled **A**.

..... **[1]**

(ii) Name the specific process that is carried out by structure **A** in the mitochondrion.

..... **[1]**

(c) Some animals conserve energy by entering a state of torpor (a short period of dormancy), in which they allow their body temperature to fall below normal for a number of hours.

In an investigation into torpor in the Siberian hamster, *Phodopus sungorus*, the animal's respiratory quotient (RQ) was measured before and during the period of torpor.

The respiratory quotient is determined by the following equation:

$$RQ = \frac{\text{volume of carbon dioxide produced}}{\text{volume of oxygen consumed in the same time}}$$

RQ values for different respiratory substrates have been determined and are shown in Table 1.1.

Table 1.1

substrate	RQ
carbohydrate	1.0
lipid	0.7
protein	0.9

(i) Initially, the RQ value determined for the hamster was 0.95, but as the period of torpor progressed, its RQ value decreased to 0.75.

What do these values suggest about the substrates being respired by the hamster during the period of the investigation?

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..... **[3]**

(ii) Describe the way in which an endothermic animal, such as a mammal, normally prevents its body temperature from decreasing when the external temperature decreases.

In your answer, you should use appropriate technical terms, spelt correctly.

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..... **[5]**

[Total: 16]

2 **(a)** Fig. 2.1 is a photomicrograph through the centre of a lobule of a mammalian liver.

Fig. 2.1

(i) Name the type of vessel labelled **B**.

..... **[1]**

(ii) Name the cells that make up the lobule.

..... **[1]**

(b) Fig. 2.2 outlines the formation of urea in the liver.

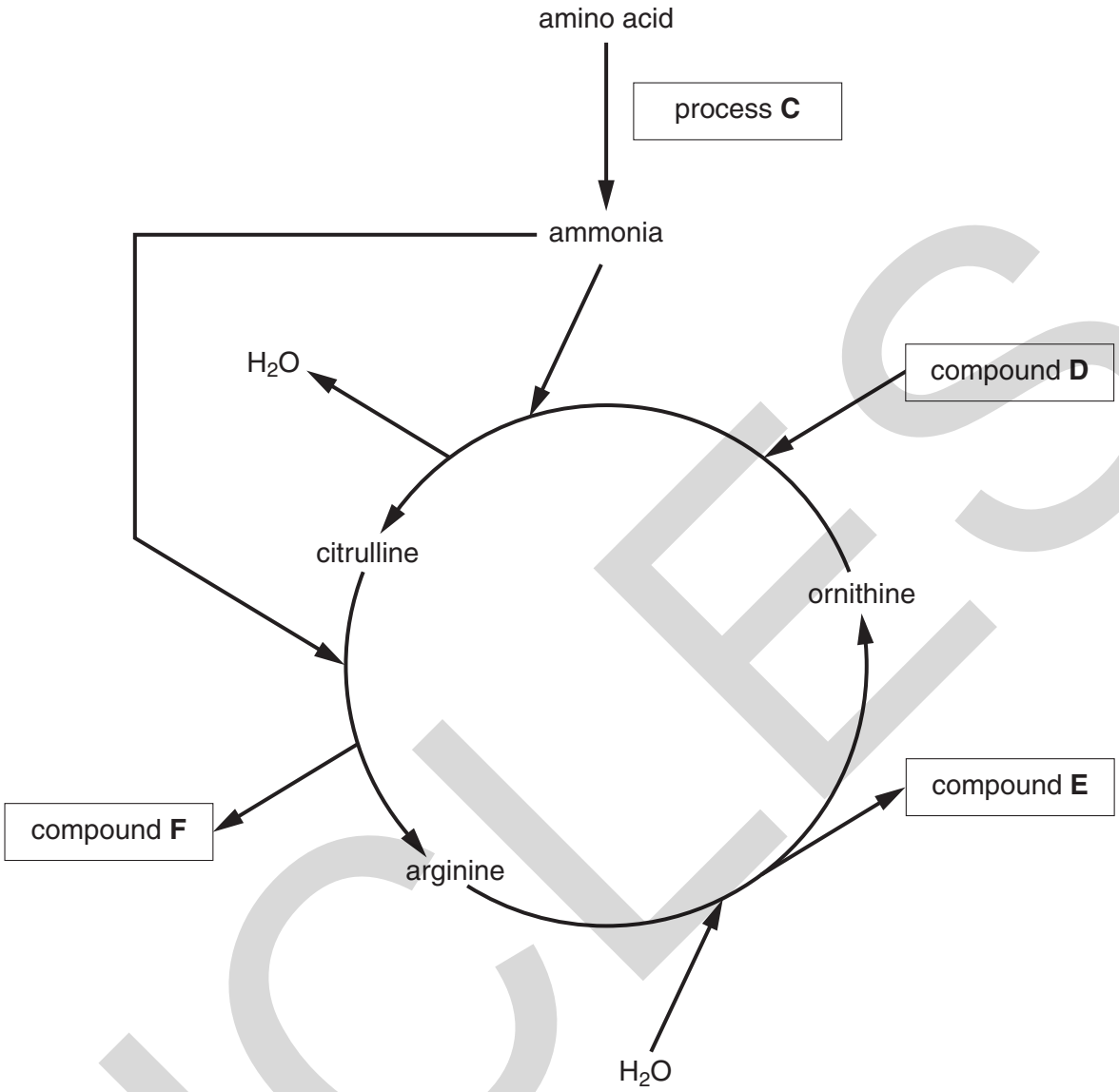

Fig. 2.2

Using Fig. 2.2, identify:

process **C** .....

compound **D** .....

compound **E** .....

compound **F** ..... **[4]**

(c) The urea formed in the ornithine cycle will be excreted from the body in urine. Urine also contains other chemicals.

Procedures have been developed to test for the presence of some of these chemicals, such as hormones.

(i) A pregnancy testing kit contains a testing 'stick' to detect a hormone in the urine.

Explain how the stick detects this pregnancy hormone.

In your answer, you should use appropriate technical terms, spelt correctly.

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(ii) The urine of some high profile athletes has been tested and found to contain abnormally high levels of banned steroids or their metabolites.

The pressure on elite athletes to succeed in their sport leads some of them to resort to the use of these performance-enhancing steroids.

Comment on whether the use of steroids should be permitted in sport.

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..... **[3]**

[Total: 13]

3 **(a)** The Calvin cycle is the stage of photosynthesis during which carbon dioxide is fixed. The Calvin cycle uses the products of the light dependent stage.

(i) Name the products of the light dependent stage that are used in the Calvin cycle.

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..... **[2]**

(ii) Discuss the fate of triose phosphate (TP) in the Calvin cycle.

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..... **[3]**

(b) A process known as **photorespiration** also takes place in photosynthetic cells. In this process, oxygen competes with carbon dioxide for the active site of the enzyme RuBP carboxylase (Rubisco).

Fig. 3.1 (a) and Fig. 3.1 (b) outline the processes of photosynthesis and photorespiration.

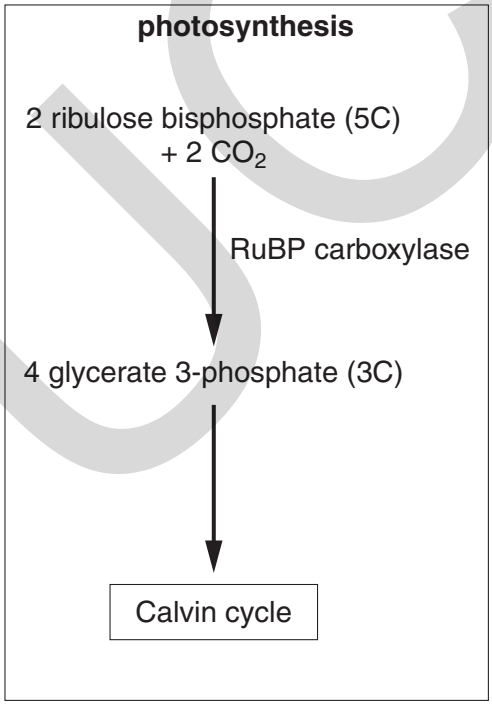

Fig. 3.1 (a)

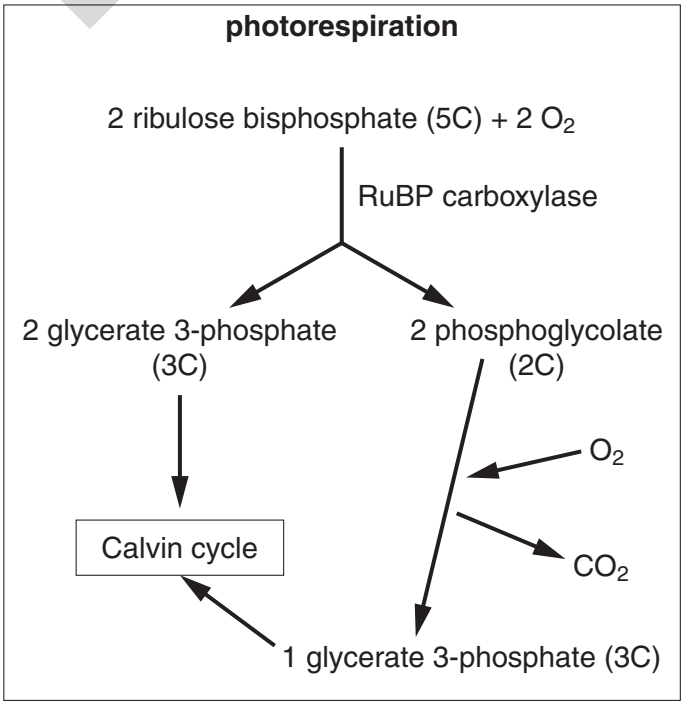

Fig. 3.1 (b)

(i) Suggest why the process outlined in Fig. 3.1 (b) is known as photorespiration.

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..... **[2]**

(ii) Using Fig. 3.1 (a) and Fig. 3.1 (b), describe and explain the likely effect on photosynthesis of an increase in the oxygen concentration.

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..... **[3]**

(iii) Some plants, known as C_4 plants, use an enzyme called PEP carboxylase, instead of Rubisco, to fix carbon dioxide.

Suggest why these plants do **not** show photorespiration.

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..... **[1]**

[Total: 11]

4 As part of a study to control Type 2 diabetes by modification of the diet, an investigation was carried out into the effects of different food compounds on the blood glucose and blood insulin concentrations of patients with this type of diabetes.

The food compounds, their components and their effect on blood glucose and blood insulin concentrations are summarised in Table 4.1.

Table 4.1

food compound	component(s)	effect on blood glucose concentration	effect on blood insulin concentration
sucrose	glucose and fructose	moderate increase	moderate increase
lactose	glucose and galactose	moderate increase	moderate increase
starch	glucose	substantial increase	substantial increase
cellulose	glucose	no effect	no effect
protein	amino acid	no effect	moderate increase
fat	fatty acid and glycerol	no effect	moderate increase

(a) Suggest an explanation for the differences observed in **blood glucose concentration**:

(i) between starch and sucrose,

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..... **[2]**

(ii) between starch and cellulose.

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..... **[2]**

(b) With reference to the food compounds in Table 4.1, explain how a person with Type 2 diabetes could control the condition by modifying their diet.

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..... **[3]**

(c) Glycogen and glucagon are compounds that are involved in the control of blood glucose concentration.

Complete the table below to distinguish between these two compounds.

	glycogen	glucagon
type of compound		
role of compound		
site of production		

[3]

[Total: 10]

5 Fig. 5.1 is a trace that shows the changes that occur in the membrane potential of a neurone during the generation of an action potential.

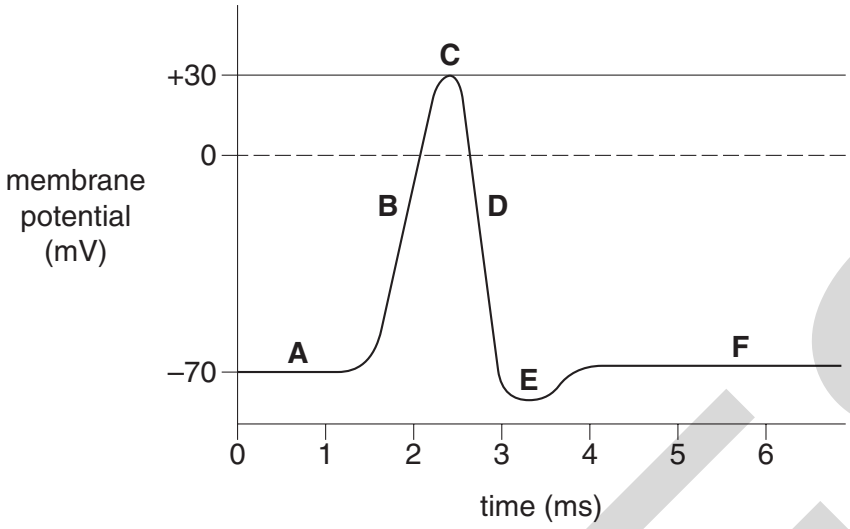

Fig. 5.1

(a) Using the letters **A** to **F**, indicate the point or points on the trace which correspond to the following:

(i) hyperpolarisation,

..... **[1]**

(ii) resting potential,

..... **[1]**

(iii) the membrane is most permeable to potassium ions,

..... **[1]**

(iv) depolarisation.

..... **[1]**

(b) Puffer fish, *Fugu spp.*, produce a powerful poison, tetradotoxin, and some species store it in high concentrations in their body tissues. Unless these fish are correctly prepared, eating them can be fatal.

Tetradotoxin is poisonous to humans because it blocks **gated** sodium channels in cell membranes, preventing action potentials. This does not happen in the fish themselves.

(i) With reference to Fig. 5.1, identify, using the appropriate letter, the part of the action potential trace that will be affected by tetradotoxin.

..... **[1]**

(ii) Suggest why tetradotoxin is **not** toxic to the puffer fish.

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..... **[1]**

QUESTION 5(c) STARTS ON PAGE 16

(c) Multiple sclerosis (MS) is an auto-immune condition in which the nervous system is damaged. This damage leads to loss of sensation. One form of damage is shown in Fig. 5.2.

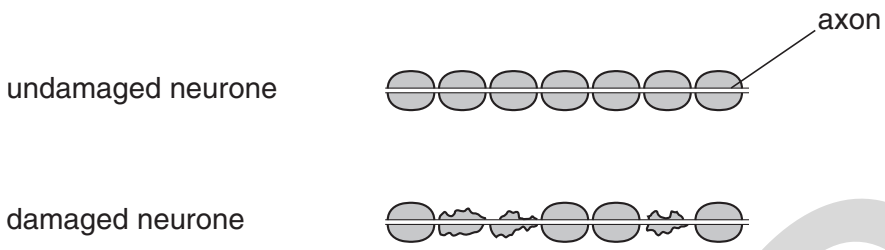

Fig. 5.2

(i) Suggest why MS is described as an auto-immune condition.

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..... **[2]**

(ii) Explain why this damage leads to a loss of sensation.

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..... **[2]**

[Total: 10]

END OF QUESTION PAPER

THIS IS A NEW SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE

BIOLOGY

Control, Genomes and Environment

F215

Candidates answer on the Question Paper

OCR Supplied Materials:
- Insert (inserted)

Other Materials Required:
- Electronic calculator
- Ruler (cm/mm)

Wednesday 16 June 2010
Morning

Duration: 1 hour 45 minutes

OCE/16442

F 2 1 5

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **100**.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **20** pages. Any blank pages are indicated.

Answer **all** the questions.

1 Fig. 1.1 is a flow diagram showing the main stages involved in making cheese. The starting material is milk, which contains the protein, casein.

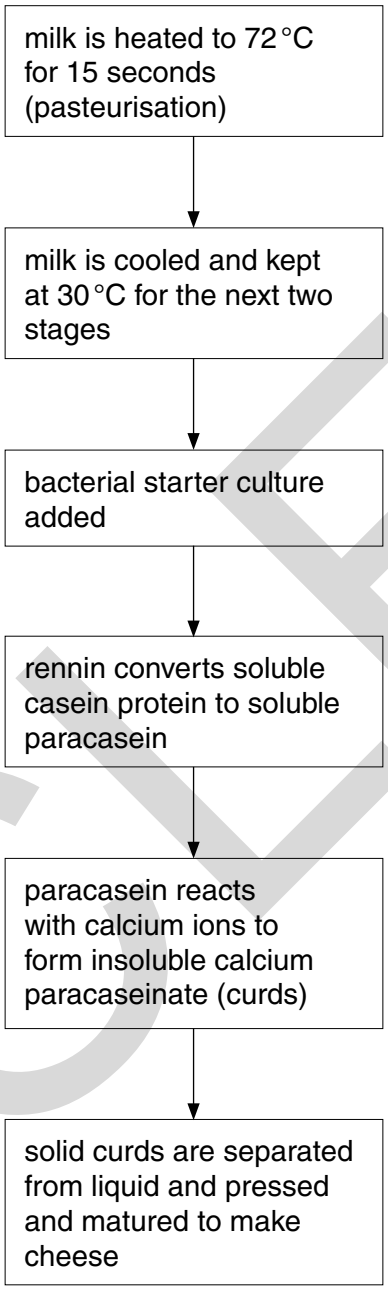

Fig. 1.1

(a) (i) Explain why making cheese can be described as a biotechnological process.

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..... **[2]**

(ii) Suggest **two** benefits of the pasteurisation stage.

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..... **[2]**

(b) (i) Rennin is a protein that can be obtained from the stomach lining of calves. It is used in the cheese-making process in the ratio one part rennin to 10 000 parts milk.

Suggest what type of protein rennin is **and** explain how a very small quantity of rennin is able to convert a large quantity of milk.

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..... **[3]**

(ii) Rennin could, in theory, be immobilised for use in cheese-making.

List **two** potential advantages of this.

1 .....

2 ..... **[2]**

(c) Rennin can now be made by genetically modified microorganisms.

Outline the process by which bacteria can be genetically modified to produce rennin.

In your answer, you should make clear how the steps in the process are sequenced.

[8]

[Total: 17]

2 Four different eye pigments in the fruit fly, *Drosophila melanogaster,* are made from the amino acid tryptophan. A simplified metabolic pathway of pigment production is shown in Fig. 2.1.

Three different gene loci control the pathway. Each locus has two alleles. These alleles are **V** or **v**, **C** or **c** and **B** or **b**, as shown in Fig. 2.1.

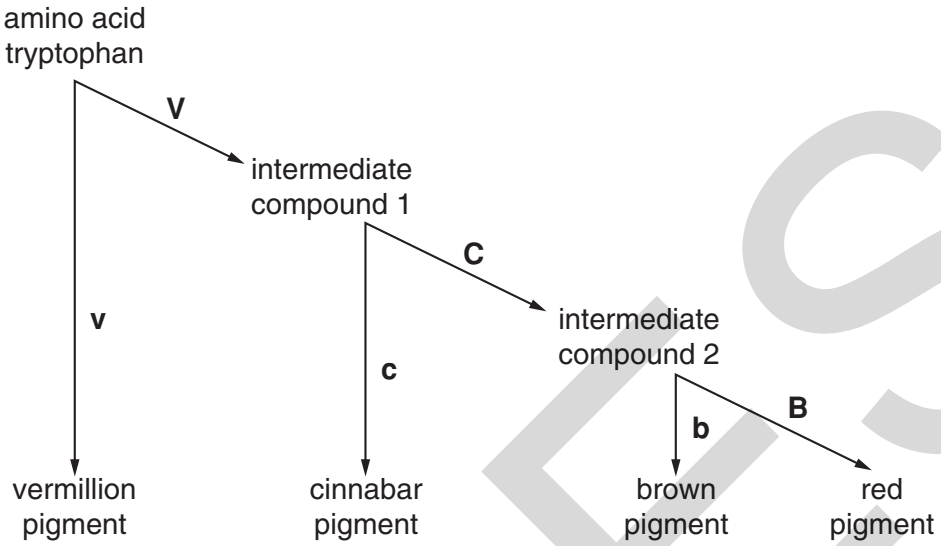

Fig. 2.1

(a) (i) Using the information in Fig. 2.1, deduce the phenotypes of flies with the following genotypes:

genotype	*phenotype*
VvCcBb	.....
vvCCBB	.....
VvccBB	..... **[3]**

(ii) State the term that is applied to this type of gene interaction.

..... **[1]**

(iii) Explain how the products **coded for** by the genes interact to give the different pigments.

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..... **[3]**

(b) A mutation in another gene at another locus in *Drosophila* gives rise to white-eyed flies. The red eye allele of this gene (**R**) is known to be dominant to the white eye allele (**r**).

A student crossed a red-eyed fly with a white-eyed fly, expecting to get an F1 generation of red-eyed flies. In fact, the results were as shown in Table 2.1.

Table 2.1

phenotype of fly	number of offspring
red-eyed female	27
red-eyed male	0
white-eyed female	0
white-eyed male	23

(i) The student first suggested that the reason for there being red-eyed and white-eyed flies in the offspring was that the red-eyed parent was heterozygous.

Explain why this **cannot** be the correct explanation for the results shown in Table 2.1.

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..... **[2]**

(ii) In *Drosophila*, the males are the heterogametic sex, possessing two different sex chromosomes, X and Y.

Draw a genetic diagram to show how the results shown in Table 2.1 could have been produced.

Parental genotypes …… ……

Gametes …… ……

F_1 genotypes …… ……

[3]

(iii) The chi-squared (χ^2) test can be used to analyse the results in Table 2.1.

The expected ratio of red-eyed females to white-eyed males is 1:1.

Use Table 2.2 to calculate a value for chi-squared (χ^2).

$$\chi^2 = \Sigma \frac{(O - E)^2}{E} \qquad df = n - 1$$

Key to symbols:

Σ = 'sum of …'
df = degrees of freedom
n = number of classes
O = observed value
E = expected value

Table 2.2

phenotype of fly	O	E	O – E	$(O - E)^2$	$\frac{(O - E)^2}{E}$
red-eyed female					
white-eyed male					

χ^2 = ...

Use your calculated value of χ^2 and the table of probabilities shown in Table 2.3 to test the significance of the difference between the observed and expected results.

State your conclusion in the space below.

Table 2.3

degrees of freedom	probability, p			
	0.90	0.50	0.10	0.05
1	0.02	0.45	2.71	3.84
2	0.21	1.39	4.61	5.99

Conclusion .....

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..... **[4]**

[Total: 16]

3 **(a)** The fruit fly, *Drosophila melanogaster*, the zebra fish, *Danio rerio*, and the mouse, *Mus musculus*, have all been used by scientists to find out more about how genes control development in all animals, including humans. They are described as 'model organisms'.

(i) Suggest why information gained from studying such model organisms can be applied to humans.

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..... **[2]**

(ii) Suggest **two** characteristics that researchers should look for when choosing an organism for research into how genes control development.

1 .....

2 ..... **[2]**

(b) Fig. 3.1 and Fig. 3.2, **on the insert**, show the heads of two *Drosophila* fruit flies.

Fig. 3.1 shows a normal wild type fly.
Fig. 3.2 shows a mutant fly.

(i) Name the type of microscope used to take the two pictures.

..... **[2]**

(ii) State one significant difference between the two heads.

.....

..... **[1]**

(iii) Name the type of gene which, if mutated, gives rise to dramatic changes in body plan.

..... **[1]**

(c) Describe how the information coded on genes is used to synthesise polypeptides **and** how these polypeptides control the physical development of an organism.

In your answer, you should consider both the synthesis of polypeptides and their roles.

[8]

[Total: 16]

4 Fig. 4.1 shows a junction between two neurones where the neurotransmitter is dopamine. Fig. 4.2 shows a neuromuscular junction.

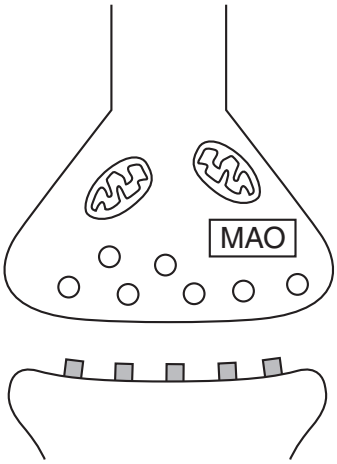

Fig. 4.1

Key:

○	vesicle containing neurotransmitter
■ ▲	receptors for neurotransmitter
AChE	acetylcholinesterase
MAO	monoamine oxidase

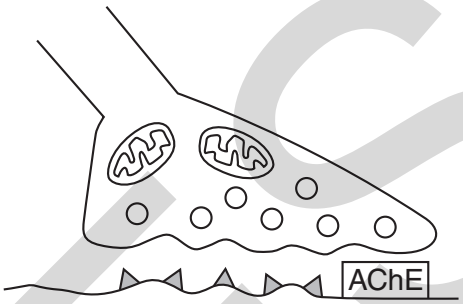

Fig. 4.2

(a) Complete Table 4.1 below to compare the structure and function of the dopamine synapse and the neuromuscular junction.

Table 4.1

	similarity	difference
structure		
function		

[4]

(b) The sequence of events at a dopamine synapse is given below:

- dopamine molecules bind to the protein receptors on the postsynaptic membrane and trigger a response
- dopamine leaves the receptors and moves back into the presynaptic neurone
- some dopamine is repackaged into vesicles
- some dopamine is broken down by the enzyme monoamine oxidase (MAO).

Table 4.2 summarises the action of some drugs that affect dopamine synapses.

Table 4.2

drug	action at synapse
phenothiazine	binds to and blocks dopamine receptors
phenelzine	acts as an inhibitor of MAO
amphetamine	binds to and activates the dopamine receptor and causes release of stored dopamine from vesicles

(i) Use the information in Table 4.2 to suggest which drug molecule could have a shape that **differs** from that of the dopamine molecule. Give a reason for your answer.

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..... **[2]**

(ii) Schizophrenia is a condition in which there is a higher than usual level of dopamine in certain areas of the brain.

Suggest why phenothiazine is used to treat schizophrenia.

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..... **[2]**

(c) DRD4 is a dopamine receptor in humans. The DRD4 receptor gene has a large number of alleles, of which a single individual can only have two.

(i) Explain why one individual can only have two of the different alleles of the DRD4 gene.

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..... **[2]**

(ii) Name a technique that would reveal differences in the lengths of the different forms of the DRD4 receptor gene.

..... **[1]**

(d) Three alleles of DRD4 have the following alterations:

- a single base-pair substitution
- a 21 base-pair deletion
- a 13 base-pair deletion.

Suggest which of the three mutations will have the most serious consequences for the structure of the protein receptor. Give a reason for your choice.

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..... **[3]**

(e) One allele of DRD4 has been found more frequently amongst individuals whose personality is described as 'novelty-seeking' and whose behaviour tends to be exploratory and impulsive.

Suggest how this particular allele of the DRD4 receptor could have become common in the human population.

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..... **[4]**

[Total: 18]

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QUESTION 5 STARTS ON PAGE 14

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5 Sarawak is an area of tropical rainforest in south-east Asia. Logging has been allowed in 60% of the forest.

A study was carried out into the effects of logging on the diversity of mammal species living in the forest. An area of rainforest was sampled before logging, immediately after logging and then again two years and four years after logging.

Before logging began, there were 29 mammal species and four years after logging there were 26 mammal species.

Table 5.1 shows the population densities of six groups of mammals before and after logging. Where numbers were too small to measure the density, the species was recorded as "present".

Table 5.1

mammal	mean number of animals per km^2			
	before logging	immediately after logging	two years after logging	four years after logging
marbled cat	present	0	0	0
oriental small-clawed otter	present	0	0	0
giant squirrel	5	1	4	1
small squirrel	16	24	104	19
tree shrew	10	5	10	38
barking deer	3	1	10	present

(a) Marbled cats and otters are carnivores, while squirrels, shrews and deer are herbivores.

Use the information provided to choose the best word(s) or terms to complete the following passage.

The rainforest …… is a dynamic set of interactions between populations of organisms and the abiotic environment. Energy flows from …… , such as trees, to …… consumers, such as squirrels, and on to consumers such as cats and otters at higher …… . The activities of decomposers contribute to the energy lost from the …… component of the rainforest but decomposers allow …… to be recycled. **[6]**

(b) (i) Table 5.1 shows that the number of small squirrels increases initially, but then decreases.

Explain, using your knowledge of factors affecting population growth, why the small squirrel population in this rainforest does **not** increase in size indefinitely.

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(ii) Describe, using the information provided, how species richness **and** species evenness change in the rainforest by comparing the situation before logging and four years after logging.

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..... **[2]**

(c) (i) Suggest why marbled cats and oriental small-clawed otters became extinct in this area but other mammals did not.

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..... **[1]**

(ii) Outline **three** reasons for conserving biological resources, such as the rainforest in Sarawak.

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3 .....

..... **[3]**

(d) Timber is produced sustainably in the United Kingdom.

Describe **and** explain the benefits of **two** management practices used in sustainable timber production in a temperate country.

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..... **[4]**

[Total: 20]

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QUESTION 6 STARTS ON PAGE 18

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6 **(a)** Plant responses to environmental changes are co-ordinated by plant growth substances (plant hormones).

Explain why plants need to be able to respond to their environment.

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..... **[2]**

(b) The following investigation was carried out into the effects of plant growth substances on germination:

- a large number of lettuce seeds was divided into eight equal batches
- each batch of seeds was placed on moist filter paper in a Petri dish and given a different treatment.

The different treatments are shown in Table 6.1. Each tick represents one of the eight batches of seeds.

Table 6.1

	treatment	concentration of gibberellin (mol dm^{-3})			
		0.00	0.05	0.50	5.00
A	water	✓	✓	✓	✓
B	abscisic acid	✓	✓	✓	✓

The batches of seeds were left to germinate at 25 °C in identical conditions and the percentage germination was calculated.

Fig. 6.1 shows the results of this investigation.

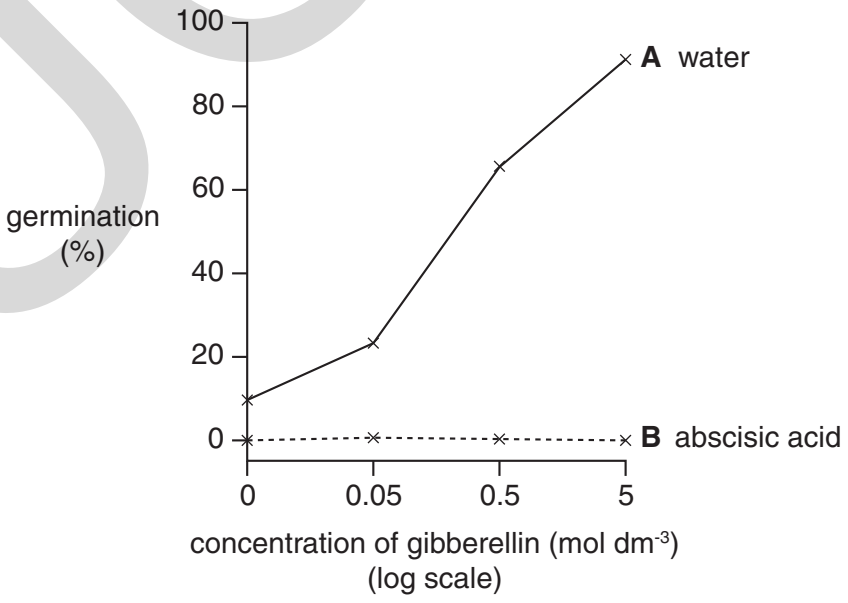

Fig. 6.1

(i) Describe, with reference to Fig. 6.1, the effects of the plant growth substances on the germination of lettuce seeds.

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..... **[4]**

(ii) Explain why all the lettuce seeds were kept at 25 °C.

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..... **[2]**

(iii) State **three** variables, **other than temperature**, that needed to be controlled in the investigation.

1 .....

2 .....

3 ..... **[3]**

(c) State **two** commercial uses of plant growth substances.

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..... **[2]**

[Total: 13]

END OF QUESTION PAPER

ADDITIONAL PAGE

If additional space is required, you should use the lined pages below. The question number(s) must be clearly shown.

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INSERT

Wednesday 16 June 2010
Morning

Duration: 1 hour 45 minutes

OCE/16444

INFORMATION FOR CANDIDATES

- This insert contains Fig. 3.1 and Fig. 3.2.
- This document consists of **2** pages. Any blank pages are indicated.

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Fig. 3.1

Fig. 3.2