OCR
RECOGNISING ACHIEVEMENT

Monday 21 May 2012 – Afternoon

AS GCE BIOLOGY

F212 Molecules, Biodiversity, Food and Health

Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:
- Electronic calculator
- Ruler (cm/mm)

Duration: 1 hour 45 minutes

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Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

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

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 **24** pages. Any blank pages are indicated.

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Answer **all** the questions.

1 Enzymes are important in a wide range of biological reactions.

(a) Fig. 1.1 represents a mechanism of enzyme action.

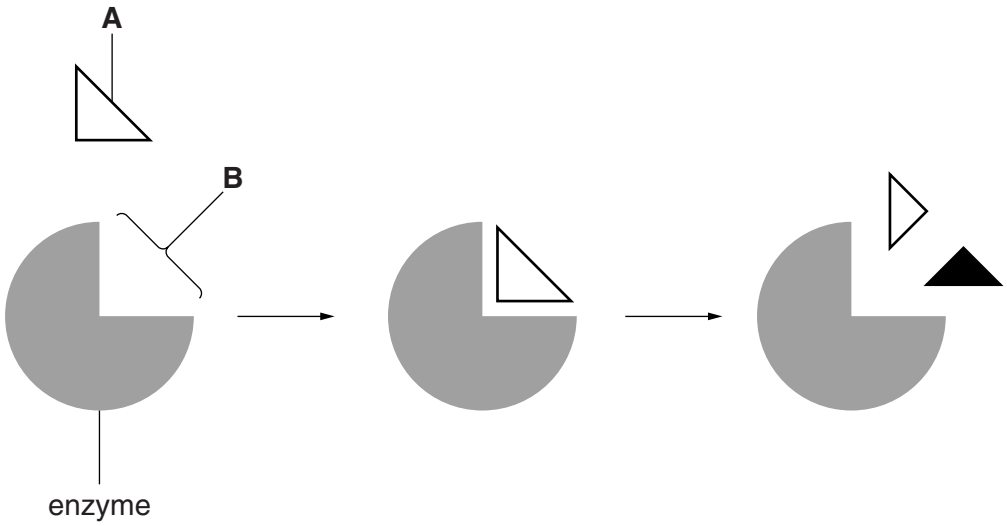


Fig. 1.1

(i) Name the structures represented by the letters **A** and **B**.

A .....

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

(ii) The mechanism of enzyme action was originally explained in terms of the 'lock-and-key model'. It is now more often explained in terms of the 'induced-fit' model.

Suggest why the lock-and-key and induced-fit explanations are termed **models**.

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

(iii) Suggest why most scientists now accept the induced-fit model rather than the lock-and-key model.

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

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(b) Many fish live in the Antarctic where the water temperature can be close to 0 °C.

- Scientists have studied enzymes from these Antarctic fish and also from non-Antarctic fish that live in water at a temperature of 10 °C.
- One of the enzymes studied has been lactate dehydrogenase (LDH), an important enzyme involved in cell metabolism.
- One way in which LDH works is to catalyse the conversion of lactate to an important compound known as pyruvate.

(i) Scientists investigated the rates of reaction of LDH from Antarctic and non-Antarctic fish at a range of temperatures.

Suggest **three** variables that should be controlled in an investigation of this type.

1 .....

2 .....

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

(ii) Some suggested controls used in this investigation are listed below.

J	water, lactate and heated LDH (non-Antarctic at 10 °C)
K	lactate alone at all temperatures
L	lactate and water at all temperatures
M	boiled LDH (Antarctic and non-Antarctic) at all temperatures
N	pyruvate and water at all temperatures

Select the letter, **J**, **K**, **L**, **M** or **N**, that represents the most appropriate control to be used in this investigation.

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

(iii) The rate of conversion of lactate to pyruvate at 1 °C was found to be relatively slow when catalysed with LDH from **non-Antarctic fish**.

Suggest reasons for this result.

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

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(iv) It was discovered that the rate of conversion of lactate to pyruvate at 1 °C was higher if catalysed with LDH enzyme from Antarctic fish than when catalysed with LDH enzyme from non-Antarctic fish.

Certain parts of the enzyme molecule from the Antarctic fish are more flexible than the equivalent parts of the molecule from the non-Antarctic fish.

Suggest how a more flexible structure might help this enzyme work faster at lower temperatures.

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

(c) Enzymes are proteins. The enzymes in Antarctic fish have a different structure from those found in non-Antarctic fish.

(i) Suggest how the structure of the **enzymes** may differ in Antarctic and non-Antarctic fish.

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

(ii) Suggest how the **DNA** of the Antarctic and non-Antarctic fish might differ.

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

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(d) If species of Antarctic fish were to become extinct, their unique enzymes would be lost.

(i) Suggest why the loss of these **enzymes** might be undesirable.

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

(ii) Suggest **two** ways in which the population of Antarctic fish could be conserved.

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

[Total: 18]

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2 Living organisms can be classified into five kingdoms, based on certain key characteristics.

(a) Table 2.1 shows some of the characteristics of the five kingdoms.

Complete the table.

Table 2.1

kingdom	membrane-bound organelles	cell wall	type(s) of nutrition
prokaryote	absent	present – made of peptidoglycan	
	present	sometimes present – composition varies	heterotrophic and autotrophic
fungi		present – made of chitin	heterotrophic
	present		autotrophic
animal		absent	heterotrophic

[6]

(b) An unknown species is discovered. Its cells contain many nuclei scattered throughout the cytoplasm of thread-like structures.

Suggest the kingdom to which this species belongs.

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

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(c) Living organisms can also be classified into three groups called **domains**.

Outline the features of this system of classification compared with the five kingdom system.

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

[Total: 10]

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3 Bats are the only mammals that can truly fly. Many species of bat hunt flying insects at night. Bats are able to use sound waves (echolocation) in order to help them find their prey in the dark.

(a) Suggest how the ability to use echolocation may have evolved from an ancestor that did not have that ability.

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

The pipistrelle is the most common species of bat in Europe. It was originally thought that all pipistrelles belonged to the same species, *Pipistrellus pipistrellus*. However, in the 1990s, it was decided that there were two species: the common pipistrelle, *Pipistrellus pipistrellus* and the soprano pipistrelle, *Pipistrellus pygmaeus*.

Data for both species are provided in Table 3.1.

Table 3.1

species	mean body mass (g)	mean wingspan (m)	range of echolocation call (kHz)	colour
common pipistrelle	5.5	0.22	42–47	medium to dark brown
soprano pipistrelle	5.5	0.21	52–60	medium to dark brown

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(b) (i) Name the genus to which the soprano pipistrelle belongs.

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

(ii) Using the data in Table 3.1, suggest why pipistrelles were originally classified as one species.

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

(iii) State **two** pieces of **molecular** evidence that can be used to identify organisms as belonging to different species.

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

(iv) Describe how it is possible to confirm, over a longer period of time, whether two organisms belong to different species or the same species.

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

QUESTION 3(c) STARTS ON PAGE 10

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(c) The soprano pipistrelle has an echolocation call that is 'high pitched' (between 52 and 60 kHz). The common pipistrelle has an echolocation call that is 'low pitched' (between 42 and 47 kHz).

Variation within and between species can be as a result of genetic or environmental factors. Whatever the causes of variation, the type of variation displayed can occur in two different **forms**.

Using the pipistrelle as an example, describe the key features of both **forms** of variation.

In your answer you should make it clear how genes and environment relate to each form of variation.

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[Total: 17]

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QUESTION 4 STARTS ON PAGE 12

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4 Fig. 4.1 shows a representation of part of a carbohydrate molecule called agarose.

One of the subunits of agarose is a sugar called galactose.

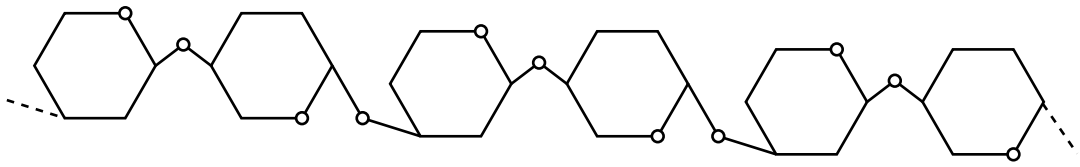


Fig. 4.1

(a) (i) Identify the type of carbohydrate molecule of which the carbohydrate agarose is an example.

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

(ii) Starch contains a carbohydrate called amylose. Amylose does not contain galactose.

Using the information in Fig. 4.1, identify **one** similarity and **one further** difference in structure between agarose and amylose.

similarity .....

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difference .....

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

(b) Agarose forms part of a more complex carbohydrate called agar, which is used as a growth medium for bacteria. Bacteria cannot break down the agarose in agar.

Suggest why bacteria cannot break down agarose.

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

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(c) A student wished to demonstrate experimentally that bacteria cannot break down agarose.

The student used a culture of *E.coli* bacteria which had been grown in a solution containing starch.

Two tubes, **A** and **B**, were set up as follows:

Tube **A**: contained 0.1 cm^3 of the *E.coli* culture and 5 cm^3 of a nutrient solution in which agarose was the only carbohydrate.

Tube **B**: contained 5 cm^3 of a nutrient solution in which agarose was the only carbohydrate.

Both tubes were incubated at 30 °C for 2 hours.

A sample from each tube was then tested for the presence of reducing sugar.

The results are shown in Table 4.1.

Table 4.1

source of sample	conclusion from test
tube **A**	very small amount of reducing sugar present
tube **B**	no reducing sugar present

(i) Explain the purpose of tube **B**.

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(ii) The student wrote the following conclusion:

My experiment showed that bacteria must be able to break down agarose. This is because reducing sugar was present in tube ***A***.

Suggest an alternative explanation for the presence of reducing sugar in tube **A** that is **not** consistent with the student's conclusion.

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

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(iii) Suggest **two** ways in which the **reliability** of the experiment could be improved.

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2 .....

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

(d) (i) The student did **not** have access to a colorimeter when testing solutions for the presence of reducing sugar.

Describe how the student could carry out a chemical test for reducing sugar **and** suggest how he could estimate the amount of reducing sugar in the sample from tube **A**.

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(ii) Another student suggested that the agarose may have been broken down to a **non-reducing** sugar.

Describe how the test for reducing sugar could be modified to investigate this hypothesis.

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[Total: 17]

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5 **(a)** An investigation was carried out into the effect on lung function on giving up smoking.

The investigators measured the maximum volume of air that could be exhaled in one second (FEV_1) in a group of people who had stopped smoking, and in a similar group of people who continued to smoke over a five year period.

The results are shown in Fig. 5.1.

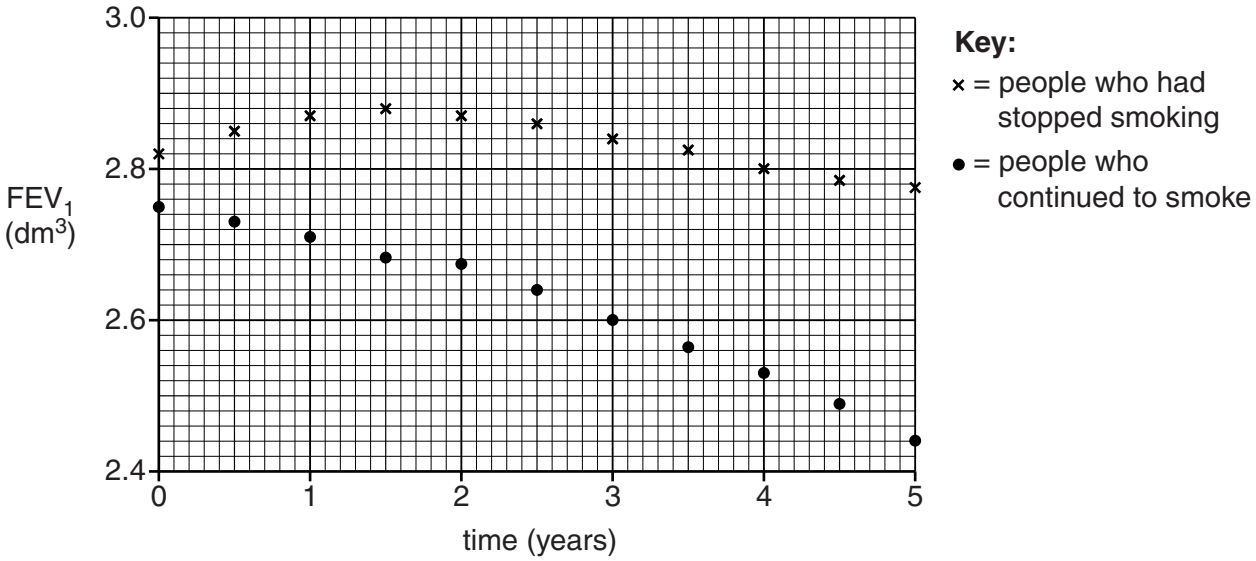


Fig. 5.1

(i) Using the information in Fig. 5.1, calculate the percentage decrease in the FEV_1 over the 5 year period for the group of people who **continued to smoke**.

Show your working. Give your answer to **one decimal place**.

Answer = ... % **[2]**

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(ii) Describe the trends shown by the results in Fig. 5.1.

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QUESTION 5(b)(i) STARTS ON PAGE 18

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(b) (i) One of the symptoms of smoking is the development of a smoker's cough.

Explain how smoking causes a smoker's cough **and** how the cough itself can lead to further problems in the lungs over a long period of time.



In your answer you should clearly distinguish between the development of the cough and the effects of prolonged coughing.

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(ii) Chronic obstructive pulmonary disease (COPD) is a combination of diseases that can result in coughing, breathing difficulties and fatigue.

Name **two** specific diseases that contribute to COPD.

1 .....

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

(iii) One form of COPD develops because enzymes are released by phagocytes entering the alveoli. This enzyme action can break down elastin in the lining of the bronchioles and alveoli.

Use the example of elastin breakdown to explain the induced-fit hypothesis of enzyme action.

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[Total: 20]

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6 **(a)** The traditional English folk song, *The Derby Ram*, contains the lyric:

"As I went out to Derby, all on a market day
I spied the biggest ram, sir, that ever was fed on hay"

The song is likely to have been inspired by the successes of farmers in the eighteenth century who developed a sheep known as the 'Dishly Ram'. This ram gave rise to a breed which grew more quickly, producing more wool and meat than other varieties of sheep.

(i) Explain how it would be possible for farmers in the eighteenth century to produce a larger, more profitable variety of sheep from an existing flock of sheep.

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(ii) Since the eighteenth century, other ways of improving productivity in sheep have been developed.

State **one** further way of improving productivity that is used by modern farmers.

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

(b) Crop yield can be improved by the use of fertilisers. In the eighteenth century, these are likely to have been organic fertilisers in the form of manure or compost.

(i) Suggest how organic fertilisers improve the yield of plant crops.

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(ii) Inorganic fertilisers are not directly toxic to living organisms. However, the excessive use of these fertilisers can lead to a reduction in the biodiversity of farmland.

Suggest how the excessive use of inorganic fertilisers on **farmland** can cause a reduction in its biodiversity.

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(iii) Explain why a reduction in biodiversity may present problems for **agriculture** in the future.

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[Total: 12]

QUESTION 7 STARTS ON PAGE 22

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7 Select the most appropriate term from the list below to complete the table.

abundance	**habitat**	**Simpson's diversity index**
biodiversity	**percentage cover**	**species evenness**
biased	**quadrat**	**species richness**
community	**quantitative**	**systematic**
dichotomous	**random**	**taxon**
ecosystem	**sample**	**transect**

definition	term
sampling in which the observer does not decide when and where to take measurements	
a representative group of organisms that are selected from a population	
an area in which an organism lives	
a measure of the relative numbers of individuals in each species	
the frequency of occurrence of plants in a particular area	
the number of species present in a particular area	

[6]

[Total: 6]

END OF QUESTION PAPER

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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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ADDITIONAL PAGE

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