OCR
RECOGNISING ACHIEVEMENT

Monday 3 June 2013 – Morning

AS GCE BIOLOGY

F212/01 Molecules, Biodiversity, Food and Health

Candidates answer on the Question Paper.

OCR supplied materials:
- Insert (inserted)

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

Duration: 1 hour 45 minutes

F212O70613

F212O1

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.

Answer **all** the questions.

1 **(a)** Amino acids form part of the structure of proteins.

(i) State the name given to the sequence of amino acids in a protein molecule.

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

(ii) Draw the **general structure** of an amino acid molecule in the space below.

[3]

(b) Collagen is an important fibrous protein which forms part of the wall of blood vessels.

(i) State **one** property of collagen that makes it a useful component of blood vessel walls.

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

(ii) Describe the **structure** of the collagen molecule.

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

(c) Another protein that is important in mammals is haemoglobin.

(i) State **one** function of haemoglobin.

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

(ii) Haemoglobin contains a prosthetic group known as haem.

Collagen does not contain a prosthetic group.

Describe **three** other ways in which the structure of haemoglobin differs from that of collagen.

1 .....

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2 .....

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3 .....

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[3]

[Total: 15]

2 **(a)** Alcohol dehydrogenase is a protein molecule that is present in the liver. The molecule breaks down alcohols and other chemicals that would otherwise be toxic to the body.

Name the group of biological molecules to which alcohol dehydrogenase belongs.

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

(b) In 1985, health concerns were raised when the compound diethylene glycol (DEG) was detected in samples of wine. The DEG had been added, illegally, to make the wine taste sweeter.

In the liver, DEG is broken down by alcohol dehydrogenase to form a toxic product. Alcohol dehydrogenase also breaks down ethanol, the key ingredient in alcoholic drinks such as wine, to form a non-toxic product.

Fig. 2.1 shows the structures of DEG and ethanol.

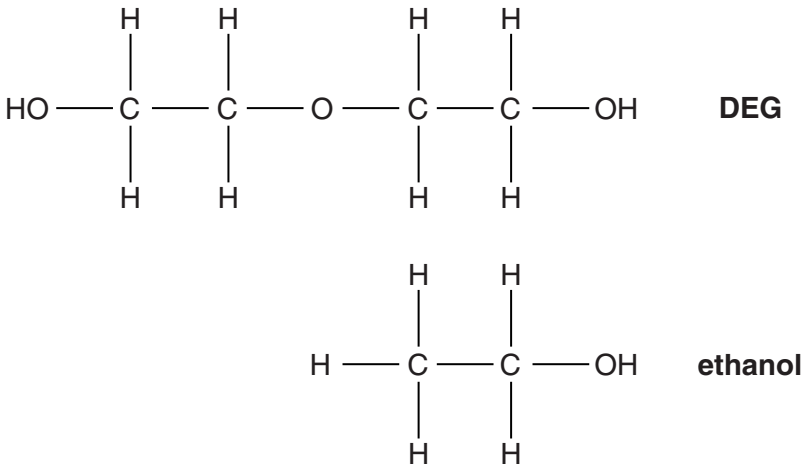

Fig. 2.1

(i) Using the information in Fig. 2.1, explain why alcohol dehydrogenase is able to break down **both** ethanol and DEG.

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

(ii) Suggest why DEG-contaminated wines with a high ethanol content may result in less DEG poisoning than contaminated wines with a low ethanol content.

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

[Total: 7]

3 **(a)** Phagocytes form part of the body's non-specific response to disease.

Fig. 3.1, **on the insert**, shows a photograph of some blood cells.

(i) Identify which of the cell(s) labelled **A, B** and **C**, are phagocytes.

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

(ii) Why are phagocytes described as a secondary defence against pathogens?

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

(iii) Why is the response involving phagocytes regarded as **non-specific**?

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

(iv) Explain how phagocytes, such as those shown in Fig. 3.1, are able to pass from the blood into the tissue fluid.

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

(v) Bacterial pathogens initially attach to receptors on the surface of phagocytes.

Describe the process by which a pathogen is destroyed after it has become attached to the surface of a phagocyte.

In your answer you should describe clearly the sequence of events that takes place.

[7]

(b) The infective agent that causes TB is not easily destroyed by phagocytes.

(i) Name the infective agent that causes TB.

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

(ii) Describe how the infective agent that causes TB is transmitted from one individual to another.

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

(c) The World Health Organisation (WHO) collects data about diseases worldwide.

Table 3.1 shows data published by the WHO about the incidence of TB in the years 2000 and 2008 for four different income groups.

Income group	Incidence of TB per 100 000 population	
	In 2000	In 2008
Low	280	280
Lower middle	150	150
Upper middle	100	110
High	17	14

Table 3.1

(i) Using the information in Table 3.1, compare the data for 2000 and 2008 in the four income groups.

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

(ii) The highest incidence of TB is associated with the low income group.

Suggest **three** reasons why the incidence of TB is higher in the low income group.

1 .....

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2 .....

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3 .....

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[3]

[Total: 21]

4 On a biology field trip, a pair of students collected some data about plant species in an area of ash woodland. Their results are shown in Table 4.1.

Species	**Number of individuals (*n*)**	***n*/*N***	**$(n/N)^2$**
Dog's mercury	40		
Wild strawberry	13	0.13	0.0169
Common avens	43		
Wood sorrel	4		
	N =		$\Sigma(n/N)^2$ =
			$1-(\Sigma(n/N)^2)$ =

Table 4.1

(a) (i) Use the information in the table to work out the Simpson's Index of Diversity (D) for the area of woodland sampled using the formula:

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

Where: n = number of individuals of a particular species.
N = total number of individuals in all species.
Σ = sum of.

Complete Table 4.1.

You may use the space below for your working. **[3]**

(ii) Simpson's Index of Diversity takes into account both species richness and species evenness.

In a school exercise book a student wrote the following definitions:

> Species richness is a measure of the amount of species in an area.
>
> Species evenness shows how many individuals there are of a species in an area.

The teacher did not award a mark for either of these statements.

Suggest how each statement could be improved.

Species richness .....

.....

Species evenness .....

.....

[2]

(iii) If the value for Simpson's Index of Diversity is high, this indicates that the biodiversity of the habitat is high.

Outline the **implications** for a habitat if the Simpson's Index of Diversity is **low**.

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

(b) When collecting data on the field trip, the students placed quadrats in 15 locations and calculated a mean number of plants for each species.

Suggest two **other** steps they could have taken to ensure that their value for Simpson's Index of Diversity was as accurate as possible.

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2 .....

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[2]

[Total: 9]

5 **(a)** Fig. 5.1 shows part of a DNA molecule.

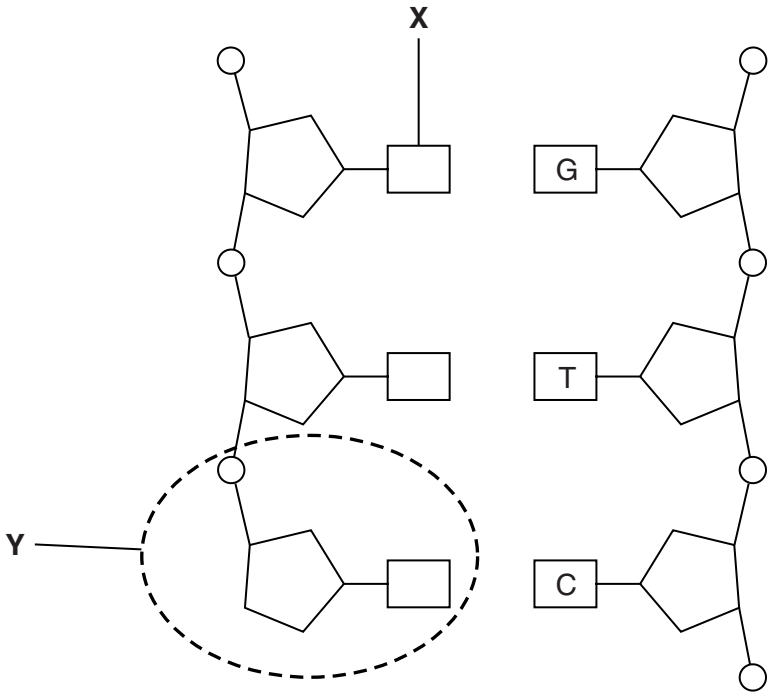

Fig. 5.1

(i) Name the parts of the molecule represented by the letters **X** and **Y**.

X .....

Y .....

[2]

(ii) **Complete the diagram in Fig. 5.1** by drawing hydrogen bonds to connect the two strands.

The hydrogen bonds should be drawn on Fig. 5.1. **[2]**

(iii) Complete the following paragraph by using the most appropriate term(s).

A gene is a section of DNA that codes for the production of a ..... .

The molecule that copies a gene and carries the information to a .....

is called RNA. **[2]**

(iv) State **two** ways in which a diagram of part of an RNA molecule would appear different from the DNA molecule shown in Fig. 5.1.

1 .....

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2 .....

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[2]

(b) DNA replication takes place during interphase of the cell cycle. It occurs by a semi-conservative mechanism.

(i) Explain why DNA replication is considered to be semi-conservative.

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

(ii) Explain why complementary base-pairing is important in DNA replication.

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

Question 5(c) begins on page 14

(c) In 1958, two scientists, Meselson and Stahl, conducted an investigation into DNA replication.

- Bacteria were grown in a food source that contained only the 'heavy' isotope of nitrogen, ^{15}N. After many generations, the bacterial DNA contained only the 'heavy' form of nitrogen.
- Some of the bacteria were then transferred to another food source containing only the normal, 'lighter' form of nitrogen, ^{14}N.
- DNA was extracted from the bacteria and centrifuged. (When a solution is centrifuged, the heavier, more dense molecules tend to settle nearer the bottom of the tube.)

Some of the results from the experiment are shown in Fig. 5.2.

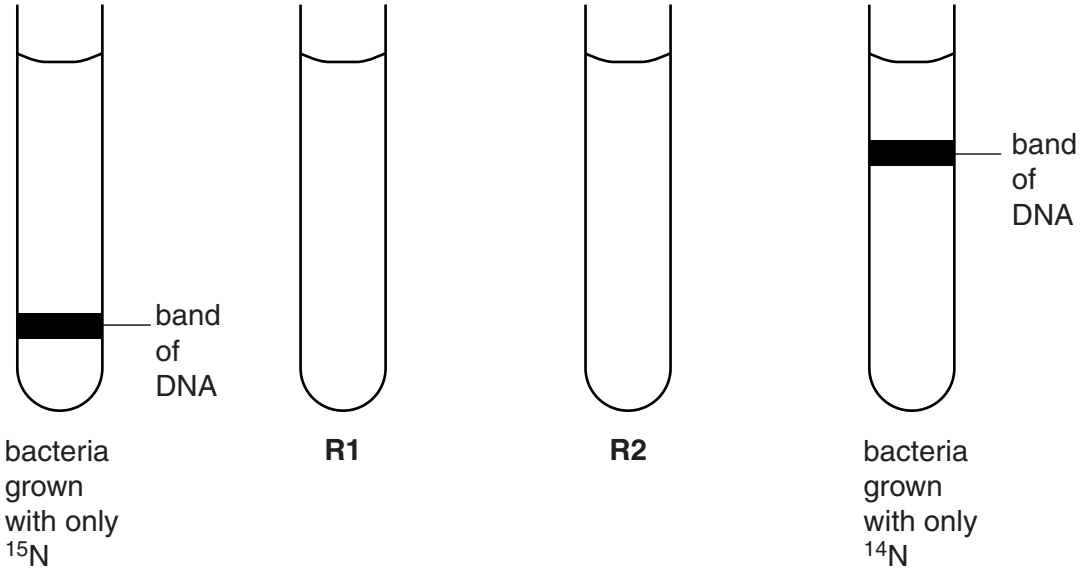

Fig. 5.2

(i) In Fig. 5.2, the tube labelled **R1** represents the results for DNA extracted from bacteria that had been **transferred** from the ^{15}N to the ^{14}N food source and left long enough for their DNA to replicate **once** only.

Draw **one** band on tube **R1** in the position you would expect the DNA to appear **after** centrifuging.

Draw the band on Fig. 5.2. **[1]**

(ii) In Fig. 5.2, the tube labelled **R2** represents the results for DNA obtained from bacteria that had been **transferred** from the ^{15}N to the ^{14}N food source and left long enough for their DNA to replicate **twice**.

Draw **two** bands on tube **R2** in the positions you would expect the DNA to appear **after** centrifuging.

Draw the bands on Fig. 5.2. **[1]**

(d) The technique of centrifugation used by Meselson and Stahl involves:

- mixing the DNA sample with concentrated sugar solution
- placing the mixture of DNA and sugar solution in test-tubes
- spinning the test-tubes at a very high speed.

Suggest **three** precautions that Meselson and Stahl would have taken in order to ensure that the centrifugation part of their investigation produced valid results.

1 .....

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2 .....

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3 .....

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[3]

[Total: 17]

6 At the beginning of the nineteenth century, one species of squirrel, *Sciurus vulgaris*, the red squirrel, inhabited Great Britain.

In 1879, some individuals of *Sciurus carolinensis*, the grey squirrel, were introduced to southern England from the USA. Since then, the number and range of grey squirrels have increased and the number and range of red squirrels have decreased dramatically.

Grey squirrels are larger, spend more time on the ground and are less frightened of people than red squirrels.

(a) Northumberland is one of the few areas of England that still has a large population of red squirrels.

In an attempt to preserve the population of red squirrels, and the biodiversity of the UK, the government has funded a cull (trapping and killing) of grey squirrels in Northumberland.

(i) Define the term *biodiversity*.

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

(ii) Suggest **two** specific reasons why the government feels it is important to conserve red squirrels in a particular area, such as Northumberland.

1 .....

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2 .....

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[2]

(iii) Some local residents have objected to the culling of grey squirrels.

Give **one** reason why people might disagree with the culling of grey squirrels.

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

(b) Environmental groups have asked members of the public to report sightings of grey and red squirrels. In parts of Northumberland, the **reported number of sightings** of grey squirrels is higher than that of red squirrels.

Suggest **two** reasons why the **actual number** of grey squirrels might **not** be higher than the actual number of red squirrels in these areas.

1 .....

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2 .....

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[2]

(c) In 2010, a company applied for permission to build a wind farm in rural Northumberland. Before permission was granted for the development, an Environmental Impact Assessment (EIA) was carried out by the local authority.

State **three** criteria that would have been considered when the EIA was carried out.

1 .....

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2 .....

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3 .....

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[3]

[Total: 10]

Question 7 begins on page 18

7 In the first half of the nineteenth century, a large proportion of the population of Ireland relied on potatoes as their main source of food.

In 1845, almost the whole of the Irish potato crop became infected with a disease known as potato blight, which ruined the crop and led to widespread starvation.

Some varieties of potato plants, including wild types growing in South America, are unaffected by the disease.

(a) Genetic variation in the Irish potato plant population was very low following years of selective breeding and asexual reproduction.

(i) Suggest why this lack of genetic variation might have contributed to the rapid spread of the disease.

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

(ii) Suggest why, despite the low genetic variation, the average yield of potato plants varied from year to year.

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

(iii) Some potato plants carry a gene that gives the plants resistance to potato blight.

State the most likely cause of this genetic variation.

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

(b) Describe how it is possible to use selective breeding to improve the overall disease resistance of a crop, such as potatoes, in both the short and long term.

In your answer you should include precautions that should be taken to ensure disease susceptibility does not become a problem in the future.

.... **[7]**

[Total: 11]

Question 8 begins on page 20

8 Fig. 8.1, **on the insert**, shows an electron micrograph of an invertebrate known as a 'water bear'.

(a) Complete the following passage about the classification of water bears using the most appropriate terms.

The water bear, *Echiniscus trisetosus* is a member of the genus ..... and the family *Echiniscidae*. This family belongs to the ..... *Echiniscoidea*, which forms part of the class *Heterotardigrada*. Water bears, also known as tardigrades, are classified into a ..... of their own called the *Tardigrada*. Tardigrades form part of the kingdom ..... within the domain ..... . **[5]**

(b) State the meaning of the term *phylogeny* **and** explain how phylogeny is related to classification.

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

(c) Water bears are extremely common in many habitats, including household gardens. However, they were not discovered until approximately 300 years ago.

Suggest reasons why they were not known before this time.

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

[Total: 10]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margins.

ADDITIONAL ANSWER SPACE

ADDITIONAL ANSWER SPACE