Name _____

Date _____

Attempt/Time taken _____

GCSE
BIOLOGY

Topic Paper: 7 The environment (Ecology)
Part 1

Time allowed: 60 minutes

Materials
For this paper you must have:
- the Periodic Table/Data Sheet, provided as an insert (enclosed)
- a ruler with millimetre measurements
- a calculator, which you are expected to use where appropriate.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The Periodic Table/Data Sheet is provided as in insert.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions you need to make sure that your answer:
    - is clear, logical, sensibly structured
    - fully meets the requirements of the question
    - shows that each separate point or step supports the overall answer.

51 Marks

Q1.   The diagram shows the mass of carbon exchanged between carbon reservoirs and the atmosphere. The pie chart in the diagram shows the mass of carbon in three reservoirs: oceans, soils and fossil fuels. The figures are in billions of tonnes of carbon per year.
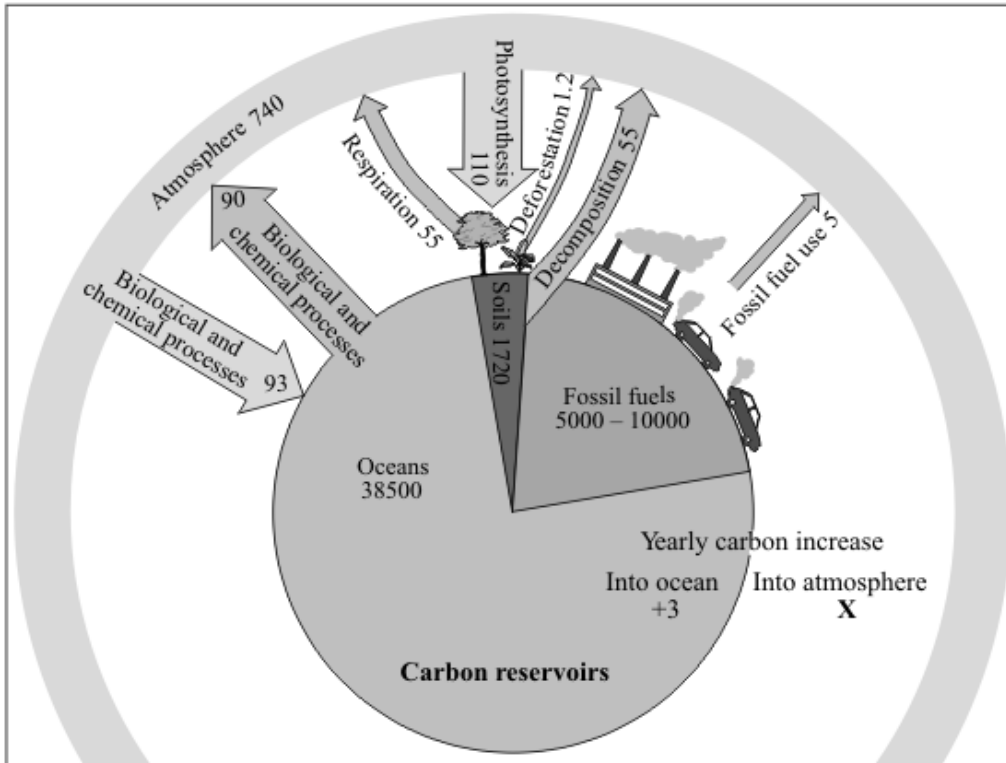
Reproduced by permission of Philip Allan Updates

(a)   Calculate **X** (the yearly carbon increase into the atmosphere).

Show all your working.

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X = ... billion tonnes of carbon

(2)

(b)   Give **one** reason why deforestation increases the carbon dioxide concentration of the atmosphere.

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(1)
(Total 3 marks)

2

Q2. The diagram shows a fermenter. This fermenter is used for growing the fungus *Fusarium* which is used to make mycoprotein.
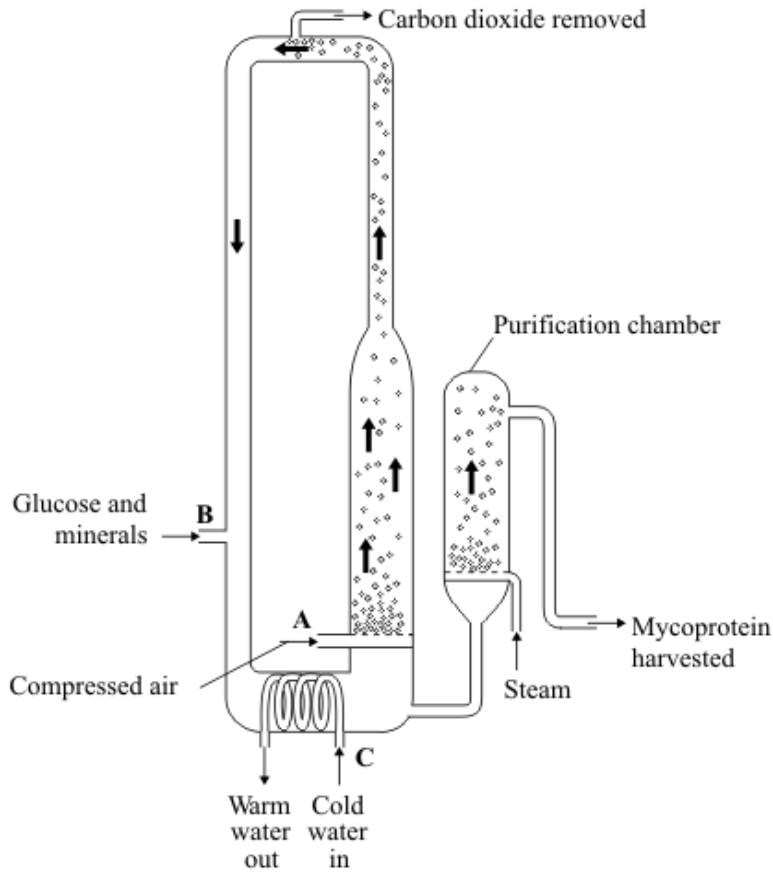
(a) Bubbles of air enter the fermenter at **A**.

Give **two** functions of the air bubbles.

1 ....

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2 ....

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(2)

(b) Glucose is added to the fermenter at **B**.

Explain why glucose is added.

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(1)

(c) The fermenter is prevented from overheating by the cold water flowing in through the heat exchanger coils at **C.**

Explain what causes the fermenter to heat up.

....

....

(1)

(d) It is important to prevent microorganisms other than *Fusarium* from growing in the fermenter.

(i) Why is this important?

....

....

(1)

(ii) Suggest **two** ways in which contamination of the fermenter by microorganisms could be prevented.

1 ....

....

2 ....

....

(2)

(e) Human cells cannot make some of the amino acids which we need. We must obtain these amino acids from our diet.

The table shows the amounts of four of these amino acids present in mycoprotein, in beef and in wheat.

Name of amino acid	Amount of amino acid per 100 g in mg			Daily amount needed by a 70 kg human in mg
	Mycoprotein	**Beef**	**Wheat**	
Lysine	910	1600	300	840
Methionine	230	500	220	910
Phenylalanine	540	760	680	980
Threonine	610	840	370	490

A diet book states that mycoprotein is the best source of amino acids for the human diet.

Evaluate this statement.

Remember to include a conclusion in your evaluation.

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(4)
(Total 11 marks)

Q3. In this country most tomatoes are grown in greenhouses.
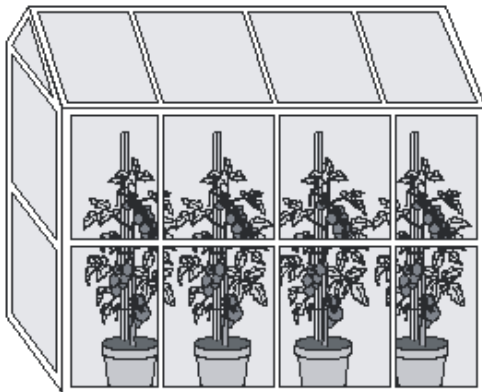
(a) Suggest **one** way in which a grower could increase the yield of tomatoes from plants growing in his greenhouse.

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(1)

(b)   Large supermarkets often import tomatoes from overseas.

(i)   Suggest **two** reasons why a supermarket might decide to import tomatoes rather than buy them from British growers.

1 ....

....

2 ....

....

(2)

(ii)   Importing tomatoes may be more damaging to the environment than selling tomatoes grown in this country.

Explain why.

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(2)
(Total 5 marks)

Q4.   Read the following passage carefully.

Petrol is a mixture which includes small amounts of nitrogen and sulfur compounds. Gasohol, a blend of ethanol with petrol, can be used in most car engines.

Brazil is the world's leading producer of gasohol, using mainly ethanol from sugar cane. Other countries make use of maize or various crop wastes, such as shoots and leaves. Ethanol evaporates more readily than petrol. It releases 23.5 megajoules of energy per litre compared with 34.8 megajoules for petrol. Burning either petrol or ethanol releases carbon dioxide and water vapour into the air. But using gasohol reduces emissions of carbon monoxide and hydrocarbons. The hydrocarbons from exhaust fumes sometimes react with sunlight to form 'photochemical smog'.

Opponents of the use of ethanol in motor fuel claim that it increases emissions of oxides of nitrogen from cars, but this effect has not been observed by air quality monitoring. Opponents also claim that ethanol takes more energy to produce than it releases. But other scientists report that making ethanol from sugar cane yields 8 units of energy for each unit used in production, while ethanol from maize gives 1.34 units.

Evaluate the scientific basis for and against the blending of ethanol with petrol.

Use information from the passage and your own knowledge of biology.

Remember to give a conclusion to your evaluation.

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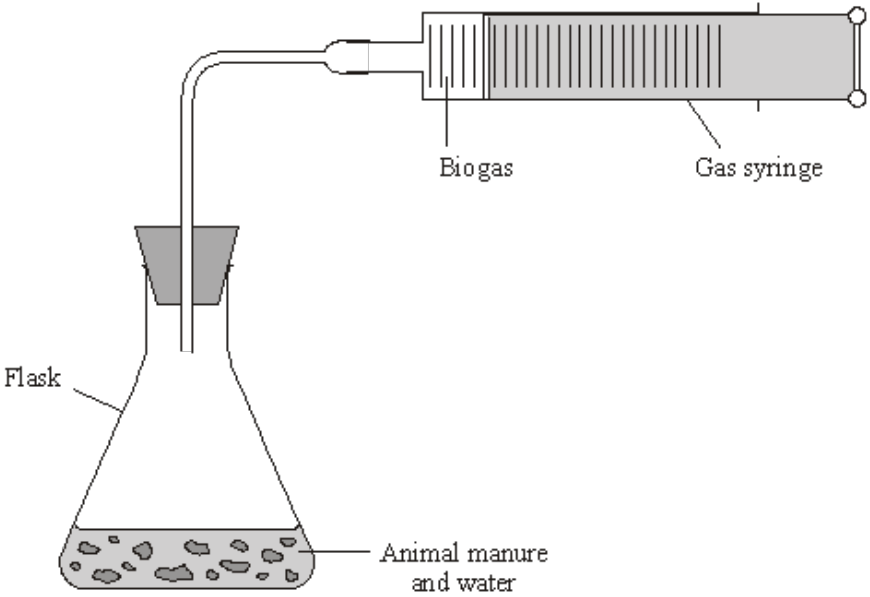
(Total 5 marks)

Q5.   Some students investigated the production of biogas from animal manure.

They used the apparatus shown in the diagram.

In their first investigation, the students collected the biogas in the gas syringe.

The table shows the percentage composition of the biogas.

Gas	Percentage composition
Methane	55
Carbon dioxide	40
Water vapour	5

(a)   To make the biogas a more efficient fuel, the percentages of two of the gases in the table should be reduced.

Which **two** gases should these be?

1 ....

2 ....

(1)

(b)   The students then used the apparatus for a second investigation.

They bubbled oxygen through some fresh manure and water for one hour.
They then set up the apparatus again and collected a second sample of biogas in the gas syringe.

Predict the effect of this procedure on the composition of the second sample of biogas.

Explain your answer.

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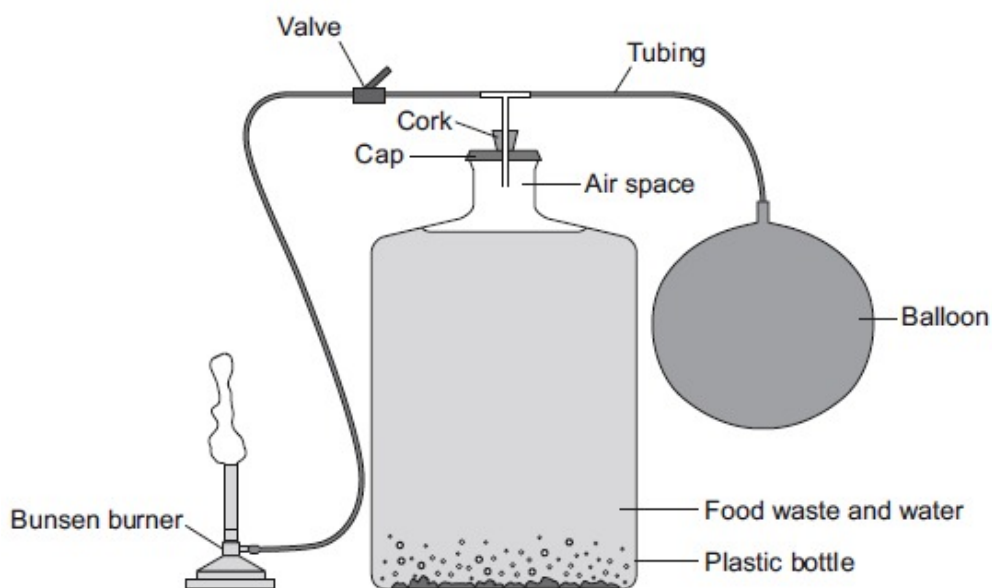
(4)
(Total 5 marks)

Q6. The image below shows a model biogas generator.

Students used the model biogas generator to investigate which type of food waste produces the greatest yield of biogas.

Gas collects in the balloon. The gas is then released through the valve and is burned at the Bunsen burner.

The students:

put 500 g of potato peelings in the plastic bottle with some water and sealed the apparatus

released the gas from the balloon after day two and timed how long the gas burned for

released the gas that had collected in the balloon from day two to day four and timed how long the gas burned for

repeated the investigation using 500 g of cooked rice, then 500 g of cabbage leaves and then 500 g of cooked pasta.

(a) **Table 1** shows the students' results.

Table 1

Type of food waste	Length of time the gas burned in seconds	
	After day two	From day two to day four
Potato peelings	0	175
Cooked rice	0	100
Cabbage leaves	0	150
Cooked pasta	0	160

(i)   Suggest why the gas collected in the balloon and released after day two did not burn.

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....

....

(3)

(ii)   Suggest why potato peelings produced the most biogas.

....

....

(1)

(b)   Scientists investigated the production of biogas from different types of animal manure.

Table 2 shows the scientists' results.

Table 2

Type of mannure	Volume of biogas produced in m^3 per kg of manure	Methane in the biogas as % of total volume
Cow	0.34	65
Pig	0.58	68
Hen	0.62	60
Horse	0.30	66
Sheep	0.61	67

(i)   Calculate the volume of methane produced from 1 kg of cow manure.

....

....

Volume of methane = ... m^3

(2)

(ii) One scientist concluded that it would be better to use sheep manure in a biogas generator than to use cow manure.

What is the evidence for this conclusion?

Use information from **Table 2** in your answer.

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(2)
(Total 8 marks)

Q7. Producing food for humans affects the environment.

(a) Increasing the efficiency of human food production will help to feed an increasing world population.

Give **three** ways in which the efficiency of human food production can be increased.

For each of these ways explain why the efficiency of food production is increased.

1 ....

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2 ....

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3 ....

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(6)

(b) Organic foods have become popular in recent years. They are grown without the use of artificial pesticides and fertilisers.

A government report in 2007 showed that the production of some organic foods is more damaging to the environment than their non-organic equivalents.

However, supporters of organic farming claim that it is better than non-organic farming in conserving biodiversity and is better for the soil.

(i)   What is meant by biodiversity?

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        ....

(1)

(ii)   Why is it important to conserve biodiversity?

        ....

        ....

(1)

(c)   The table compares some of the effects of non-organic and organic food production on the environment.

Environmental effect and units per kilogram of production on farm	Sheep meat		Chicken		Milk	
	Non-organic	Organic	Non-organic	Organic	Non-organic	Organic
Energy used (in MJ)	23	18	12	16	2.5	1.6
Global warming potential (in grams of CO_2 equivalent)	17 400	10 100	4750	6680	1060	1230
Freshwater pollution potential by fertiliser (in grams of phosphate equivalent)	200	584	49	86	6.3	10.3
Land use (in hectares)	0.0014	0.003	0.64	1.4	0.001	0.002

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Use data from the table to answer these questions.

(i)   What additional data is needed to calculate which method of food production is most damaging to the environment?

        ....

        ....

(1)

(ii)   How would a complete change from non-organic to organic farming affect the area of land used for food production.

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(1)

(iii)   Raising sheep has a greater global warming potential than raising chickens, per kilogram of meat produced.

Suggest an explanation for this.

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(2)

(iv)   Give **two** ways in which global warming might affect species on a worldwide scale.

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(2)
(Total 14 marks)