

Please check the examination details below before entering your candidate information

Candidate surname					Other names				
Centre Number					Candidate Number				

Pearson Edexcel International Advanced Level

Thursday 1 June 2023

Morning (Time: 1 hour 45 minutes) **Paper reference** **WBI14/01**

Biology

International Advanced Subsidiary / Advanced Level

UNIT 4: Energy, Environment, Microbiology and Immunity

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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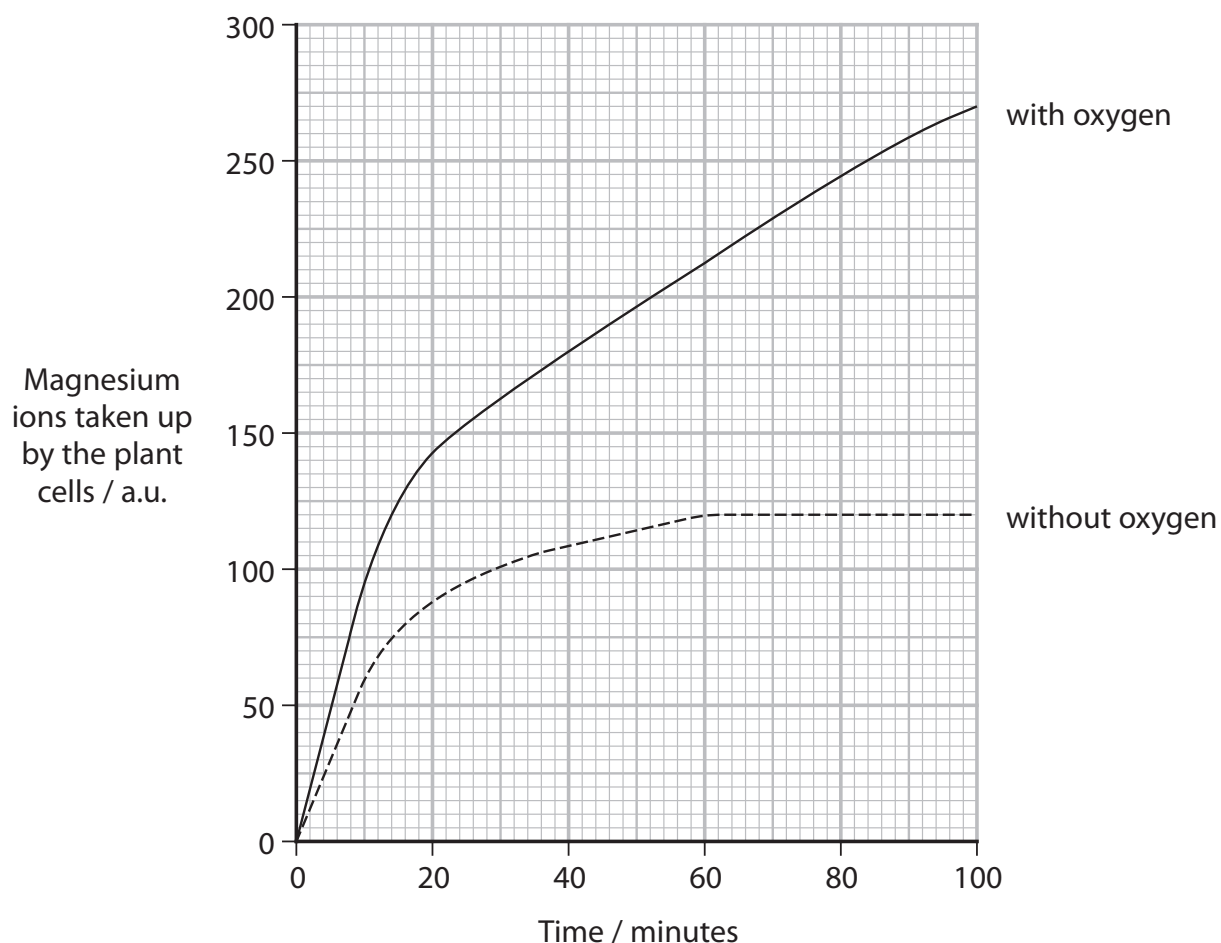
Answer ALL questions.

Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

- 1** A student investigated the uptake of magnesium ions by some plant cells in the presence and absence of oxygen.

The graph shows the results of this investigation.



- (a) Explain the importance of magnesium ions to a plant.

(2)

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(b) The student suggested that magnesium ions are taken up by active transport.

Explain why the student came to this conclusion.

Use the information in the graph to support your answer.

(4)

(Total for Question 1 = 6 marks)



- 2 The photograph shows a black bear.



(Source: © Cindy Hopkins/Alamy Stock Photo)

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Most black bears have a diet consisting of ants and berries, and hibernate during the winter months.

One very large male black bear, called Hank, was suspected of raiding nearly 40 homes in the Lake Tahoe region of America for food. Some of these raids took place during the winter months.

- (a) Hank weighed 227 kg, which is 1.7 times more than the mean mass of a typical large black bear and 5 times more than the mass of a typical small black bear.
- (i) Calculate the difference in mass between a typical large black bear and a typical small black bear.

(2)

Answer kg

- (ii) Explain why Hank was much larger than typical black bears.

(2)

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- (b) Samples of DNA were collected from the homes that Hank was suspected of raiding.

Analysis of the DNA showed that some of the raids were by two unrelated, female black bears.

- (i) Which two procedures could have been used to analyse the DNA?

(1)

- ☐ **A** electron microscopy followed by PCR
- ☐ **B** entomology followed by electron microscopy
- ☐ **C** gel electrophoresis followed by entomology
- ☐ **D** PCR followed by gel electrophoresis

- (ii) Describe how analysis of the DNA would show that these two other bears were female, and not related to each other or to Hank.

(3)

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(Total for Question 2 = 8 marks)



3 Tetracycline is a bacteriostatic antibiotic and vancomycin is a bactericidal antibiotic.

(a) Compare and contrast bacteriostatic antibiotics with bactericidal antibiotics.

(2)

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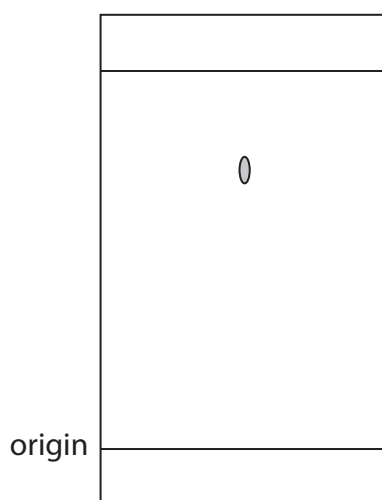
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(b) Antibiotics can be identified using Rf values obtained from chromatography.

The table shows the Rf values for tetracycline and vancomycin, obtained using two different chromatography methods.

Antibiotic	Rf value	
	Method 1	Method 2
Tetracycline	0.51	0.75
Vancomycin	0.09	0.29

The diagram shows a chromatogram for one of these antibiotics using one of the methods.



(i) Describe how this chromatogram could be produced.

(3)

(ii) Which identifies the antibiotic in the diagram and the method used?

(1)

- ☐ **A** tetracycline, using method 1
- ☐ **B** tetracycline, using method 2
- ☐ **C** vancomycin, using method 1
- ☐ **D** vancomycin, using method 2

(iii) Explain why the four values in the table are all different from each other.

(2)

(Total for Question 3 = 8 marks)



- 4 The photograph shows a young giant panda feeding on bamboo.



(Source: © Cheryl Schneider/Alamy Stock Photo)

Giant pandas have evolved the ability to eat bamboo.

Genes that code for enzymes that digest the cellulose in the bamboo are not present in the genome of the giant panda.

The giant pandas depend on microorganisms in their intestines to produce enzymes that can digest the cellulose.

- (a) Which type of glycosidic bonds are broken in the digestion of cellulose?

(1)

- ☐ **A** α 1-4
- ☐ **B** α 1-6
- ☐ **C** β 1-4
- ☐ **D** β 1-6

- (b) The microorganisms in the intestines of giant pandas include both bacteria and fungi.

Fungi are eukaryotic organisms.

Put one cross [x] in the appropriate box, in each row, to show if genes are found in each of the structures in these microorganisms.

(3)

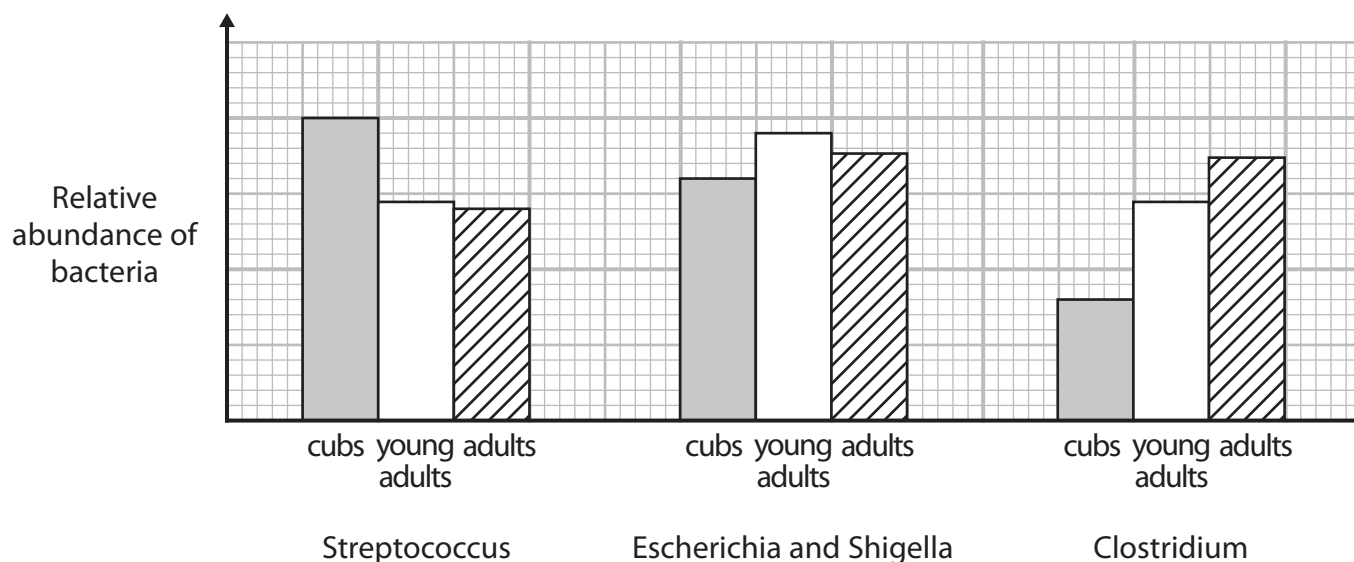
Structure	Microorganism			
	Bacteria only	Fungi only	Both bacteria and fungi	Neither bacteria nor fungi
mitochondria	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
nuclei	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
70S (small) ribosomes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



- (c) In one study, the succession of bacteria in the intestines of developing giant pandas was determined.

Three stages of development were studied: cubs, young adults and adults.

The graph shows the relative abundance of four types of bacteria in the three developmental stages of the giant panda.



- (i) Which sequence shows the succession of bacteria during the development of a giant panda?

(1)

- ☐ **A** Clostridium → Streptococcus → Escherichia and Shigella
- ☐ **B** Escherichia and Shigella → Clostridium → Streptococcus
- ☐ **C** Escherichia and Shigella → Streptococcus → Clostridium
- ☐ **D** Streptococcus → Escherichia and Shigella → Clostridium



- (ii) Describe one method that could be used in this study to determine the relative abundance of *Streptococcus* in a giant panda.

(4)

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(Total for Question 4 = 9 marks)

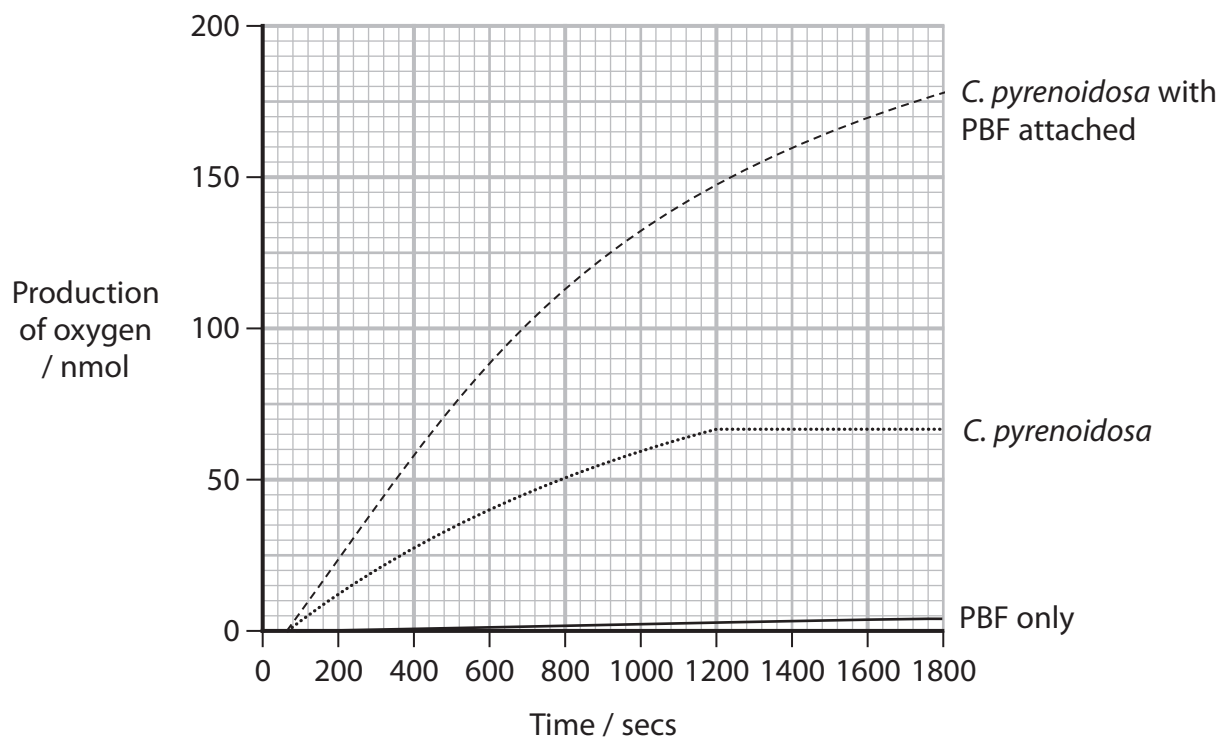


- 5 (a) In an investigation, scientists attached a molecule called PBF to the cell surface of a species of green algae, *C. pyrenoidosa*.

These algae are photosynthetic organisms and PBF absorbs green light.

The scientists measured the production of oxygen by *C. pyrenoidosa*, *C. pyrenoidosa* with PBF attached and PBF only.

The graph shows the results of this investigation.



- (i) Calculate the rate of production of oxygen at 1 200 seconds for *C. pyrenoidosa* with PBF attached.

(3)

Answer nmol secs⁻¹



(ii) Explain the effect PBF has on the production of oxygen.

(3)

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(b) These scientists also measured the mass of *C. pyrenoidosa*, with and without PBF attached, after a 20-day period.

They found that the increase in mass of *C. pyrenoidosa* with PBF attached was greater than the increase in mass of *C. pyrenoidosa* without PBF attached.

Explain these findings.

(3)

(Total for Question 5 = 9 marks)



- 6 Malaria is a life-threatening disease caused by the pathogen *Plasmodium*.

Plasmodium is transmitted into the blood plasma of a person through the bite of an infected mosquito.

The *Plasmodium* is a sporozoite that travels to the liver cells.

This sporozoite produces merozoites that infect red blood cells.

- (a) State the meaning of the term **infection**.

(1)

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- (b) In 2019, there were an estimated 229 million cases of malaria worldwide.

The number of deaths was estimated at 4.09×10^5 per year.

- (i) Which is the approximate death rate from malaria in 2019?

(1)

- ☐ A 1 in 180
- ☐ B 1 in 600
- ☐ C 1 in 1 800
- ☐ D 1 in 6 000

- (ii) In 2019, 274 000 young children died from malaria.

Which is the ratio of deaths in young children to deaths in other age groups?

(1)

- ☐ A 0.7:1.0
- ☐ B 1.0:0.5
- ☐ C 1.0:1.5
- ☐ D 2.0:1.0

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(c) Scientists are trying to develop vaccines to protect against malaria.

One vaccine uses living sporozoites.

(i) Suggest why sporozoites are used in a vaccine against malaria.

(3)

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- (ii) In clinical trials of this vaccine, people were injected with the vaccine and two chemicals.

One chemical kills sporozoites and the other kills merozoites.

Deduce why these two chemicals were injected with the vaccine in these clinical trials.

(3)

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- (iii) Later in the clinical trials, people were infected with one of two strains of sporozoites, three months after the vaccination.

One strain was identical to the one used in the original vaccine and the other strain was a different one.

The trials found that the vaccine was effective against both strains.

Explain these findings.

(3)

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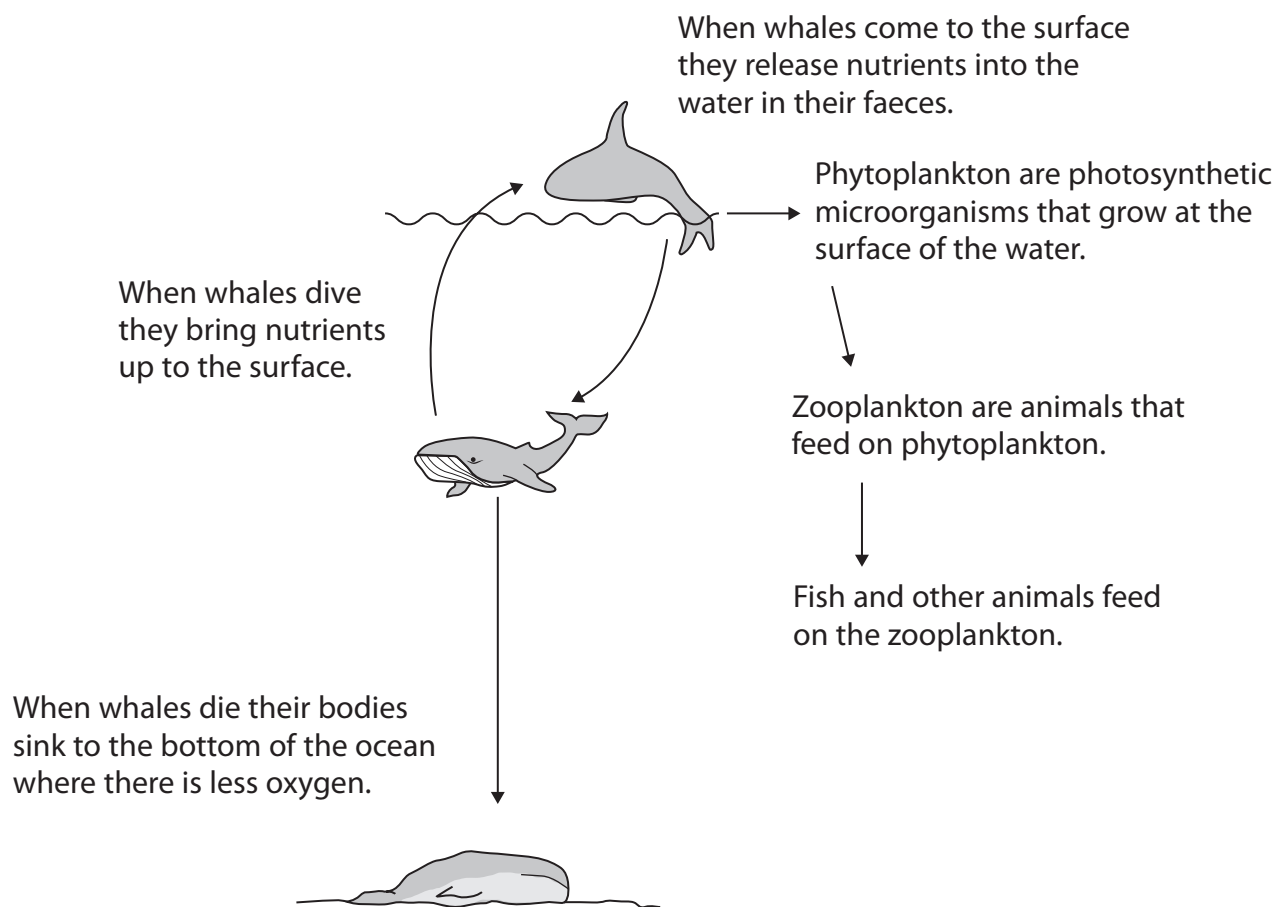
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(Total for Question 6 = 12 marks)



7 Commercial whaling has resulted in a large decrease in the number of whales.

The diagram shows the relationships between whales and some other organisms in the ocean.



(a) Whale faeces add nutrients containing nitrogen to the water.

- (i) There are 345 Right whales in the Gulf of Maine and together they release 15.9 kg of nitrogen per day.

Calculate the mass of nitrogen released by one Right whale in a year.

(1)

Answer kg per year



- (ii) Nitrates contain nitrogen.

Describe the importance of nitrates to plants.

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- (b) There are 1.3 million whales in the oceans.

Scientists believe that if the number of whales could be restored to their original numbers, this would have a significant effect on climate change.

- (i) There were approximately 5 million whales before modern commercial whaling.

Calculate the percentage decrease in the number of whales due to commercial whaling.

(1)

Answer %

- (ii) Calculations have shown that if numbers could be restored, 1.7×10^9 US tons of carbon dioxide could be removed from the atmosphere per year.

A US ton is equivalent to 907 kg.

Calculate the mass of carbon dioxide, in kg, that could be removed from the atmosphere in one year.

Give your answer in standard form.

(1)

Answer kg



- * (iii) Discuss the possible effects of increasing the number of whales on climate change.

Use the information in the diagram and the data given in this question to support your answer.

(6)

(Total for Question 7 = 11 marks)



- 8** Reforestation is an example of effective management of conflicts between human needs and conservation.

Organisations have put together a list of rules for responsible reforestation. These rules aim to improve absorbing and storing atmospheric carbon dioxide, biodiversity and human livelihoods.

Four of the rules are:

1. Protect existing forests first
2. Work together with local people
3. Select appropriate areas for reforestation
4. Select species to maximise biodiversity.

- (a) Explain the importance of protecting existing forests first (rule 1).

(2)

- (b) Suggest why it is important that organisations involved in reforestation work with the local people (rule 2).

(2)

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(c) Explain **two** reasons why previously forested areas should be selected for reforestation instead of other wild areas (rule 3).

(4)

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(d) Explain why a mixture of native species, including endangered and genetically diverse species, should be introduced (rule 4).

(4)

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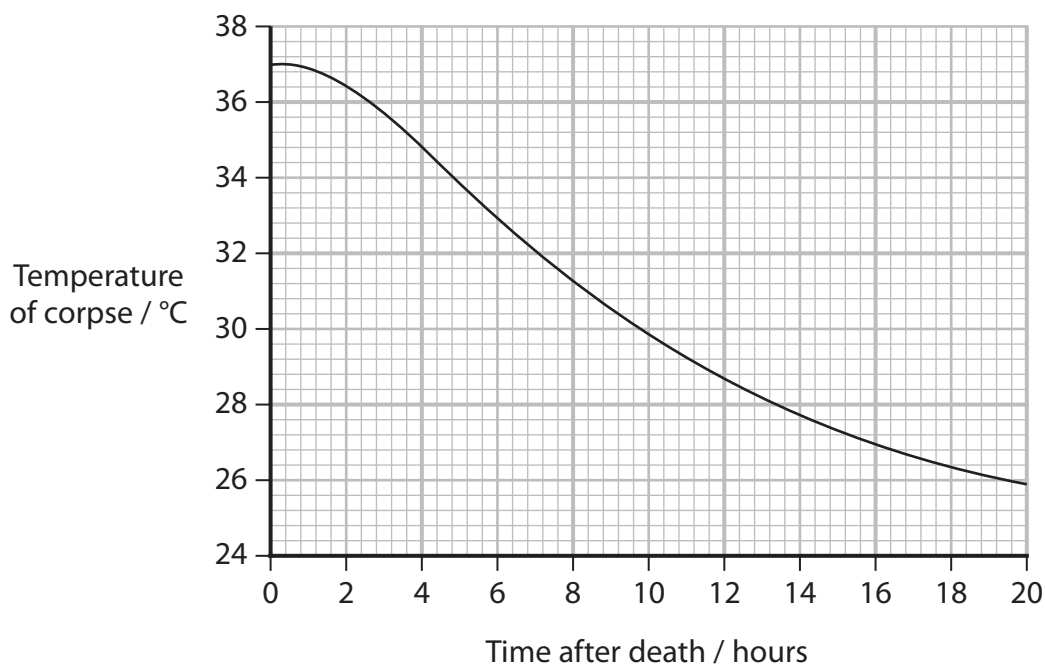
(Total for Question 8 = 12 marks)



9 The time of death of a mammal can be estimated in a number of ways.

- (a) Measuring the body temperature of a corpse is one method used to estimate the time of death.

The graph shows a calibration curve that can be used in this method.



- (i) Describe how the time of death of a person can be estimated using this method.

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(ii) Explain the limitations of this method.

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- (b) Scientists are looking for other methods to estimate the time of death, using the presence of chemicals in the blood.

One study used blood taken from five rat corpses and two pig corpses at intervals after death.

- (i) Suggest why this study used rat and pig corpses instead of human corpses.

(1)

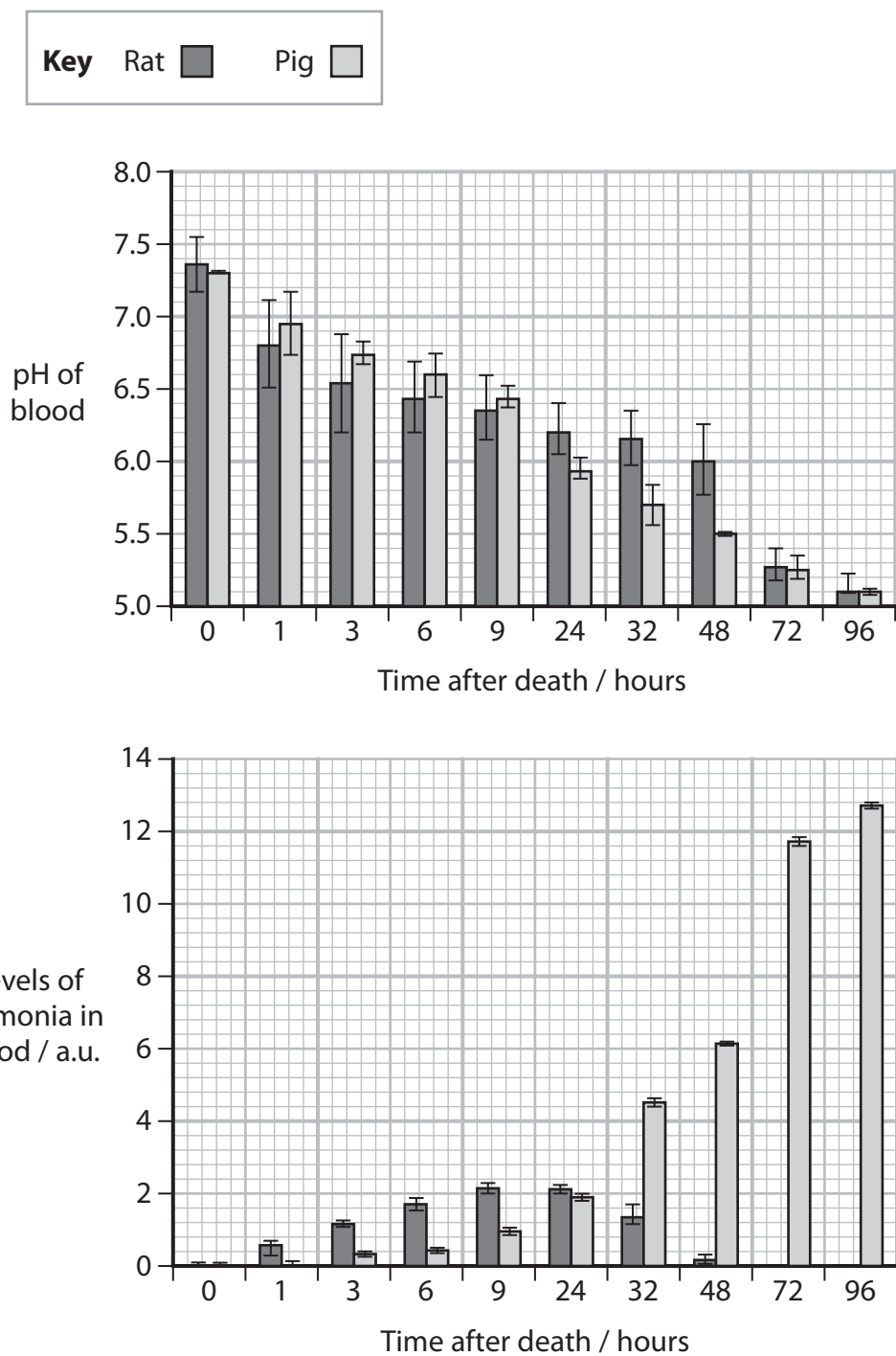
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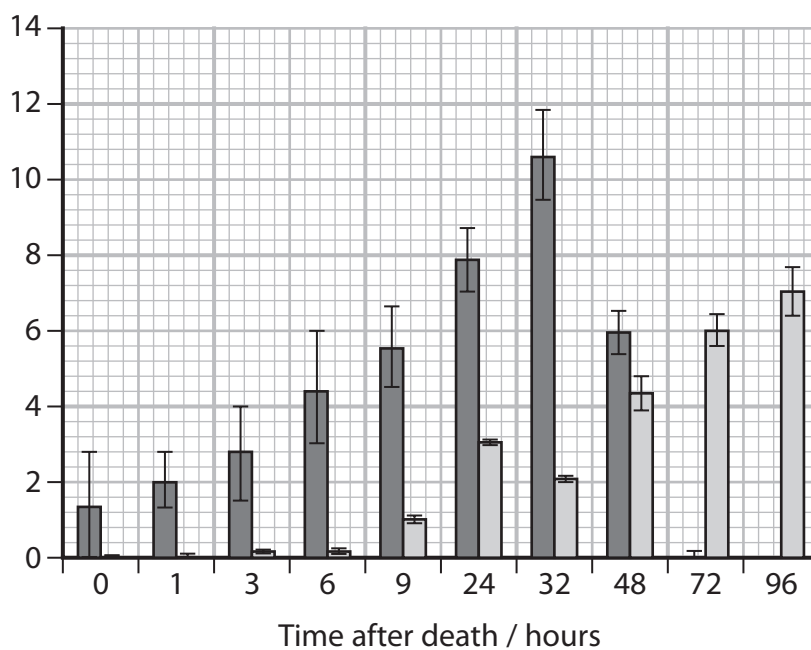


*(ii) The graphs show some of the results of this study.



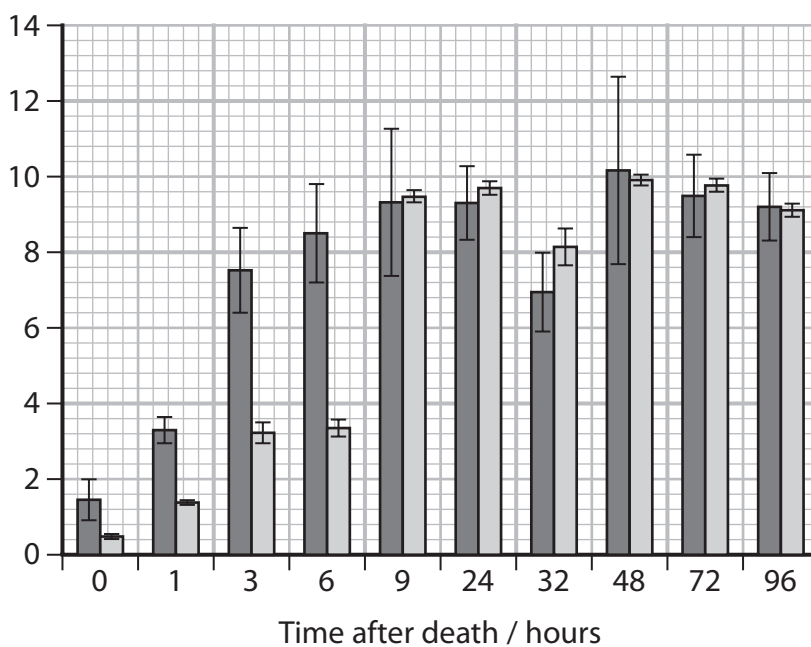
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Levels of
hypoxanthine in
blood / a.u.



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Levels of
lactate in
blood / a.u.



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P 7 1 9 3 7 A 0 2 7 3 2

Comment on the usefulness of using these chemicals for determining the time of death of rats and pigs.

Use the information in the graphs to support your answer.

(6)

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- (iii) Discuss whether these chemical tests are likely to be useful in determining the time of death of a human.

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(Total for Question 9 = 15 marks)

TOTAL FOR PAPER = 90 MARKS

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