Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number	Candidate Number

Time 1 hour 45 minutes

Paper reference **WBI14/01**

Biology

International Advanced Level
Unit 4: Energy, Environment, Microbiology and Immunity

You must have:
Scientific calculator, ruler, HB pencil

Total Marks

Instructions

- Use **black** ink or **black** 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.*
- **Show all your working in calculations and include units where appropriate.**

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.
- Good luck with your examination.

Turn over ▶

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Pearson

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 ☒.

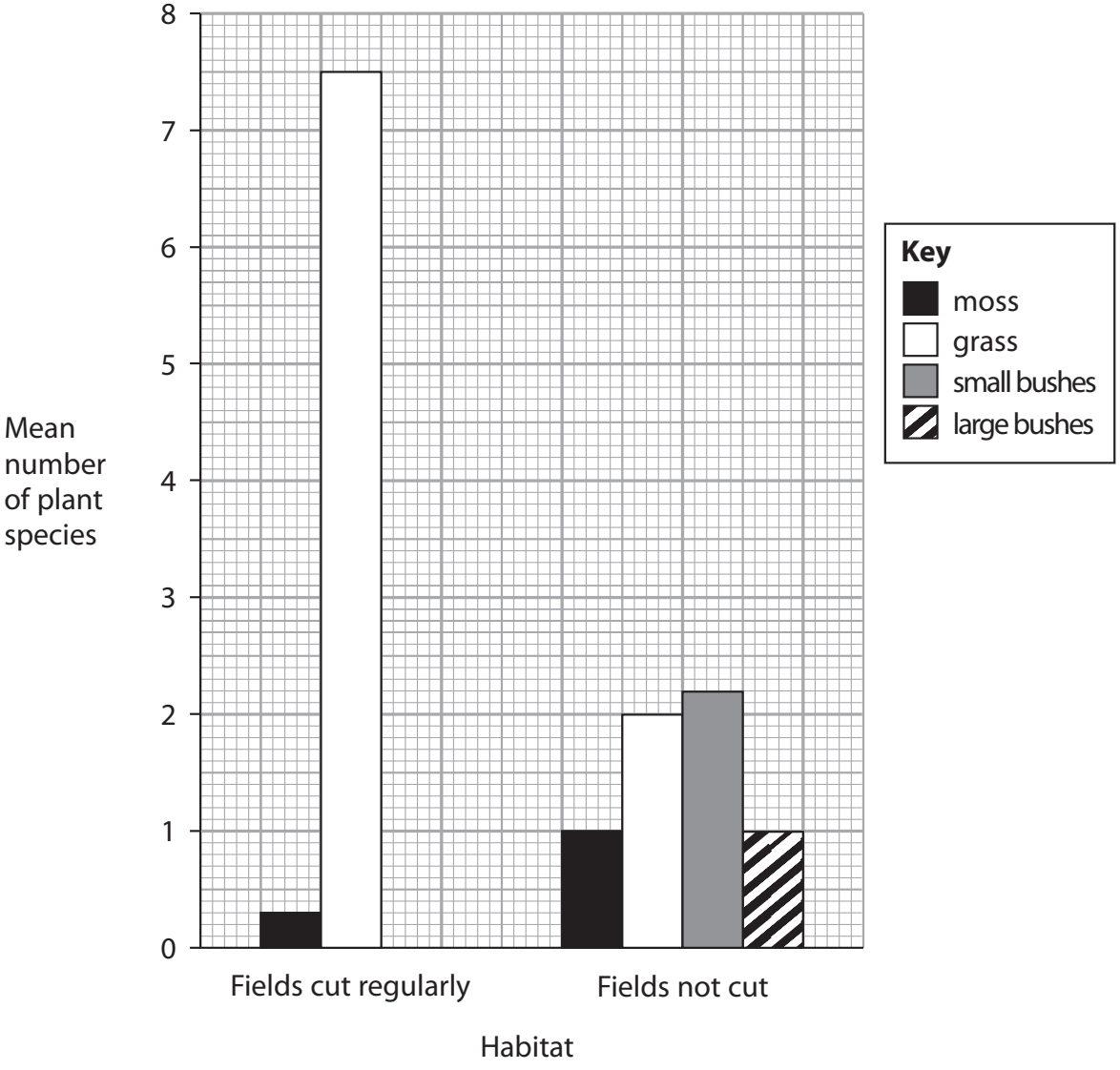
1 Mosses are species of plants that have genomes that enable them to survive in their habitats.

(a) A group of students investigated the mean number of plant species in four habitats.

The habitats that they investigated were:

- fields that were cut regularly
- fields that were not cut
- the middle of woods
- the edge of woods.

The graph shows some of the results from this investigation.



(i) Which row of the table shows the type of factor that affected the plant species in two of these habitats?

(1)

	Cutting the field regularly	Competition with trees for water
☒ **A**	abiotic factor	abiotic factor
☒ **B**	abiotic factor	biotic factor
☒ **C**	biotic factor	abiotic factor
☒ **D**	biotic factor	biotic factor

(ii) What is the percentage increase in the number of species of moss between the fields cut regularly and the fields not cut?

(1)

☒ **A** 23.3

☒ **B** 70.0

☒ **C** 233.3

☒ **D** 333.3

(iii) Suggest reasons for the differences in the mean number of plant species in fields cut regularly and in fields not cut.

(2)

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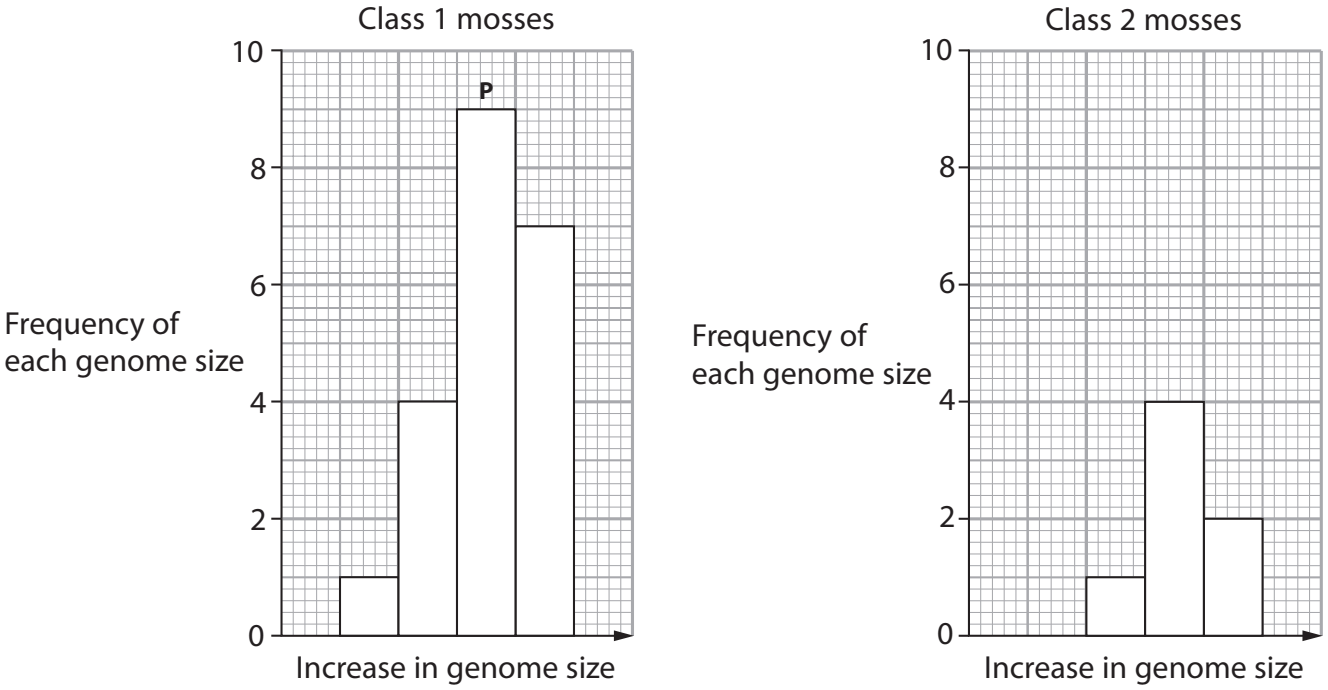
(b) In another investigation, the genome size of 30 species of moss was determined. Each species of moss belonged to one of two classes of moss.

The graphs show the frequency of each genome size in the class 1 mosses and some of the class 2 mosses.



(i) Which does **P** represent?

(1)

- ☒ **A** the maximum genome size on a bar chart
- ☒ **B** the maximum genome size on a histogram
- ☒ **C** mode genome size on a bar chart
- ☒ **D** mode genome size on a histogram

(ii) One genome size is missing from the graph for class 2 mosses.

Calculate the frequency of this genome size.

(1)

Answer .....

(iii) The mean value for the genome size of class 1 mosses was 0.449 a.u. and the mean value for class 2 mosses was 0.920 a.u.

Calculate the ratio of the genome size of class 1 mosses to the genome size of class 2 mosses.

(1)

Answer .....

(iv) It was suggested that the chromosomes in class 2 mosses were found in pairs.

Give the evidence that supports this suggestion.

(1)

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(Total for Question 1 = 8 marks)

2 Chloroplasts and mitochondria are two organelles found in some plant cells.

(a) Compare and contrast the structure of a chloroplast with the structure of a mitochondrion.

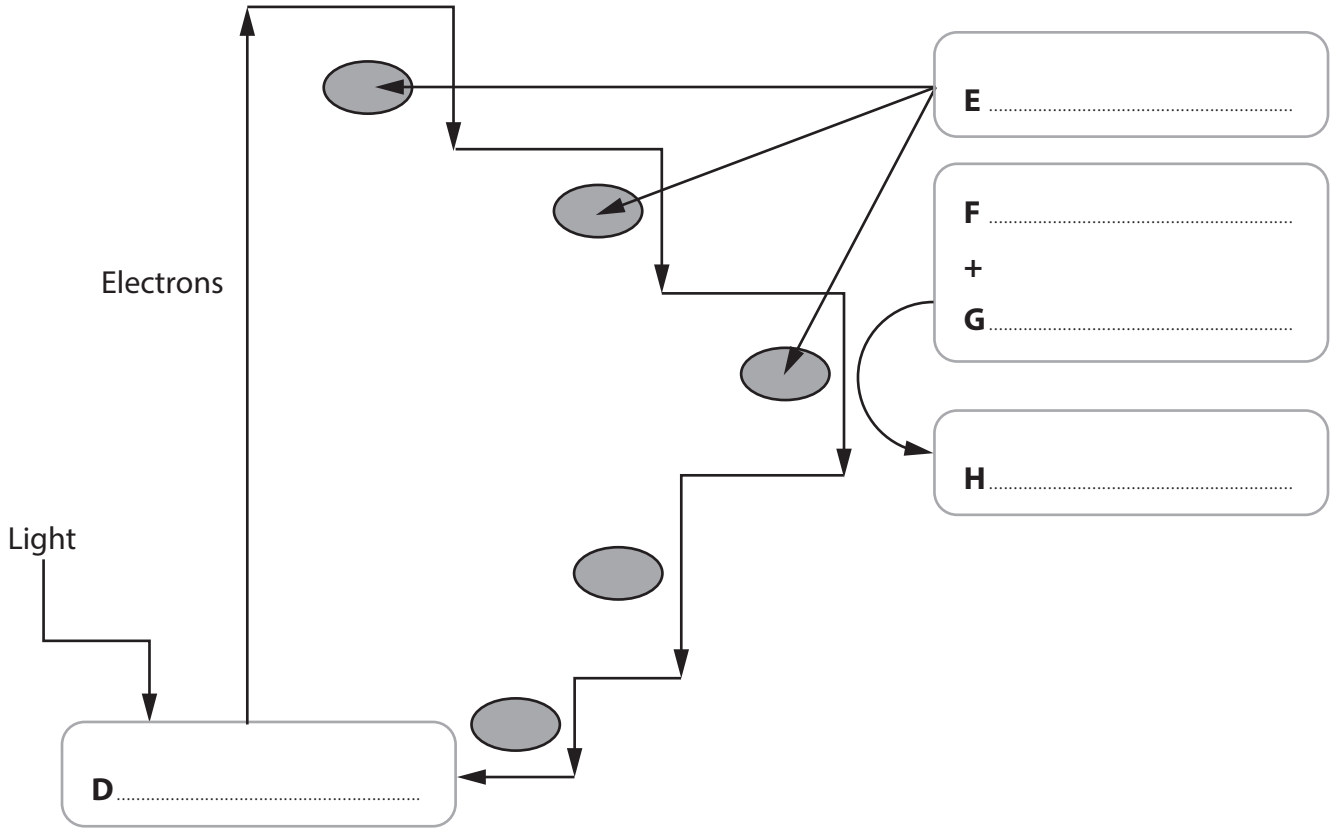
(3)

(b) The light-dependent reactions of photosynthesis can result in either cyclic or non-cyclic photophosphorylation.

(i) The diagram shows cyclic photophosphorylation.

Complete the diagram by writing the correct word or words on the dotted lines, labelled D, E, F, G and H.

(3)



(ii) Name **one** molecule that is produced in non-cyclic photophosphorylation that is **not** produced in cyclic photophosphorylation.

(1)

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(iii) Describe the role of photolysis in non-cyclic photophosphorylation.

(2)

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(Total for Question 2 = 9 marks)

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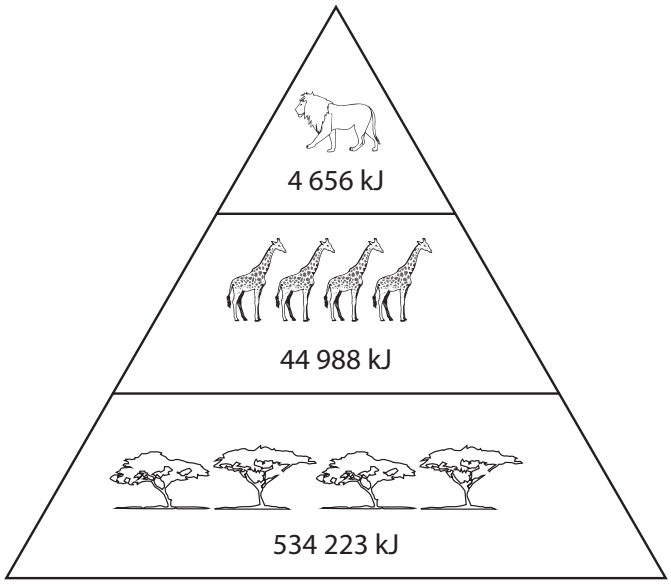
3 Lions, giraffes and acacia trees are found on the African Plains.

The diagram shows the energy in the trophic levels that these organisms occupy.



(a) Give the meaning of each of the following terms, using the information in the diagram to illustrate your answer.

(i) Habitat

(2)

(ii) Population

(2)

(iii) Community

(2)

(iv) Niche

(2)

(b) Calculate the efficiency of energy transfer between trophic level one and trophic level two.

(1)

Answer ..... %

(Total for Question 3 = 9 marks)

4 Madagascar is a large island off the southeast coast of mainland Africa.

Lemurs are endemic to Madagascar.

(a) There are many different species of lemur, all of which evolved from one common ancestor. This common ancestor is thought to be a primate that was carried across the sea from mainland Africa on a raft of vegetation.

The photographs show two different species of lemur, Sifaka and Indri, found in the same region of Madagascar.

Sifaka

Indri

The diet of Sifakas is mostly seeds but also includes fruits, flowers and some types of leaves. The diet of Indri is mainly leaves.

Explain the types of speciation that have taken place in the evolution of Sifakas and Indri in this region of Madagascar.

(4)

(b) Lemurs have been found on another island close to Madagascar.

Scientists have used DNA profiling to show that these lemurs originated from those on Madagascar.

(i) Explain the role of the polymerase chain reaction (PCR) in DNA profiling.

(2)

(ii) Explain how DNA profiling could show that these lemurs originated from the lemurs on Madagascar.

(2)

(Total for Question 4 = 8 marks)

5 The time of death of a person can be estimated in a number of ways.

(a) The time of death can be estimated using the length of insect larvae.

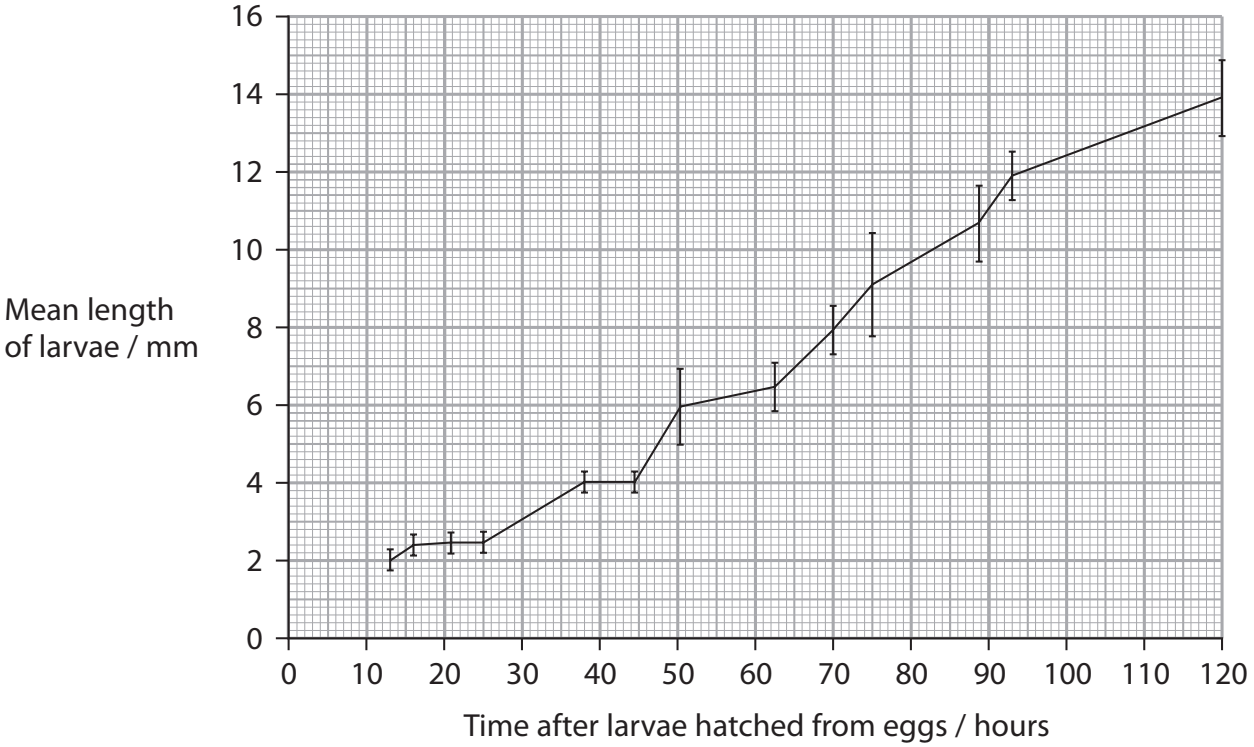
What is the name of the method that uses insect larvae to estimate the time of death?

(1)

- ☒ **A** dendrochronology
- ☒ **B** epigenetics
- ☒ **C** forensic entomology
- ☒ **D** species diversity

(b) The larvae of one species of blowfly can be used to estimate the time of death.

The graph shows the mean length of larvae from this species incubated at 10.62 °C.



(i) Calculate the mean growth rate of these larvae from 25 to 120 hours.

Include the units with your answer.

(2)

Answer .....

(ii) Comment on the suitability of using this data to estimate the time of death.

Use the information in the graph to support your answer.

(3)

(iii) Describe how the data shown in this graph could have been collected.

(3)

(c) The time of death can be estimated using the body temperature of the corpse.

Evaluate the use of the body temperature of a corpse to estimate the time of death.

(4)

(Total for Question 5 = 13 marks)

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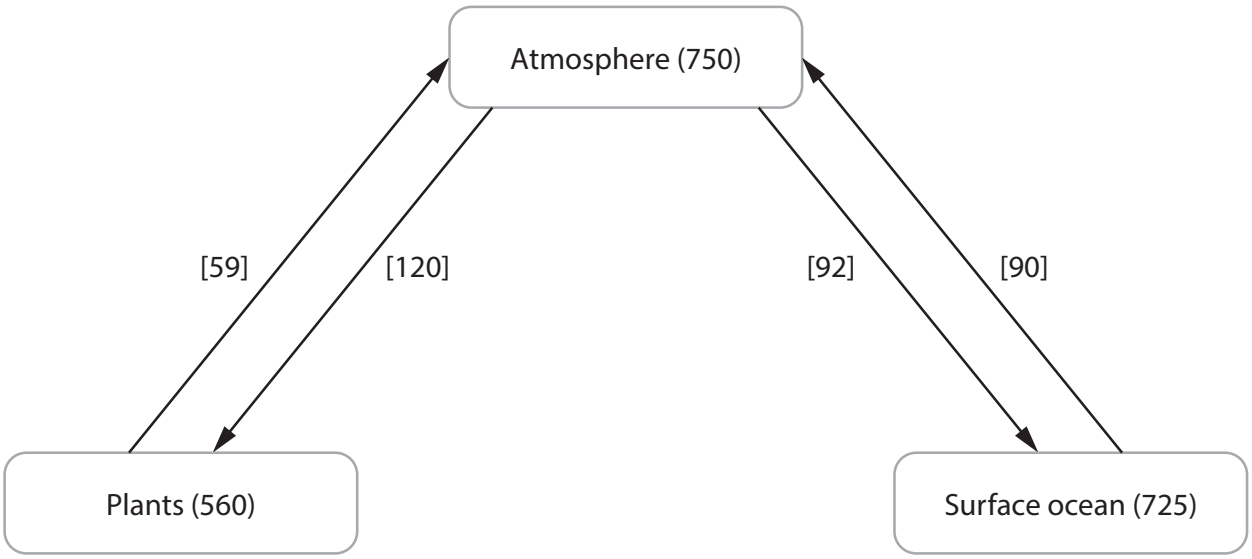
6 The diagram shows part of the carbon cycle.



Key

The numbers in smooth brackets ( ) show the mass of carbon in petagrams found in either the atmosphere, plants or surface ocean.

The numbers in square brackets [ ] show the mass of carbon in petagrams transferred between the atmosphere and the plants or surface ocean per year.

A petagram is equal to 10^{15} grams.

(a) Carbon is found in carbohydrates.

The table shows some carbohydrates that may be found in plants and animals.

For each carbohydrate, put **one** cross ☒ in the appropriate box, in each row, to show where these carbohydrates are produced.

(4)

Carbohydrate	**Carbohydrate produced by**			
	both plants and animals	plants but **not** animals	animals but **not** plants	neither plants nor animals
Amylose	☒	☒	☒	☒
Glucose	☒	☒	☒	☒
Glycogen	☒	☒	☒	☒
Starch	☒	☒	☒	☒

(b) The mass of carbon recycling between the atmosphere and the plants, and the atmosphere and the oceans, are roughly balanced.

(i) State how carbon is exchanged between the atmosphere and the oceans.

(1)

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(ii) Calculate the increase in the mass of carbon in plants as a result of carbon exchange between the plants and the atmosphere in one year.

Give your answer in kilograms.

(1)

Answer ..... kg

(iii) Describe how the carbon present in sugars in the plants is returned to the atmosphere in the carbon cycle.

(3)

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(c) Anthropogenic climate change is a result of an increase in the mass of carbon in the atmosphere.

(i) State what is meant by the term **anthropogenic climate change**.

(2)

(ii) Explain **one** way in which the effects of anthropogenic climate change can be reduced.

(2)

(Total for Question 6 = 13 marks)

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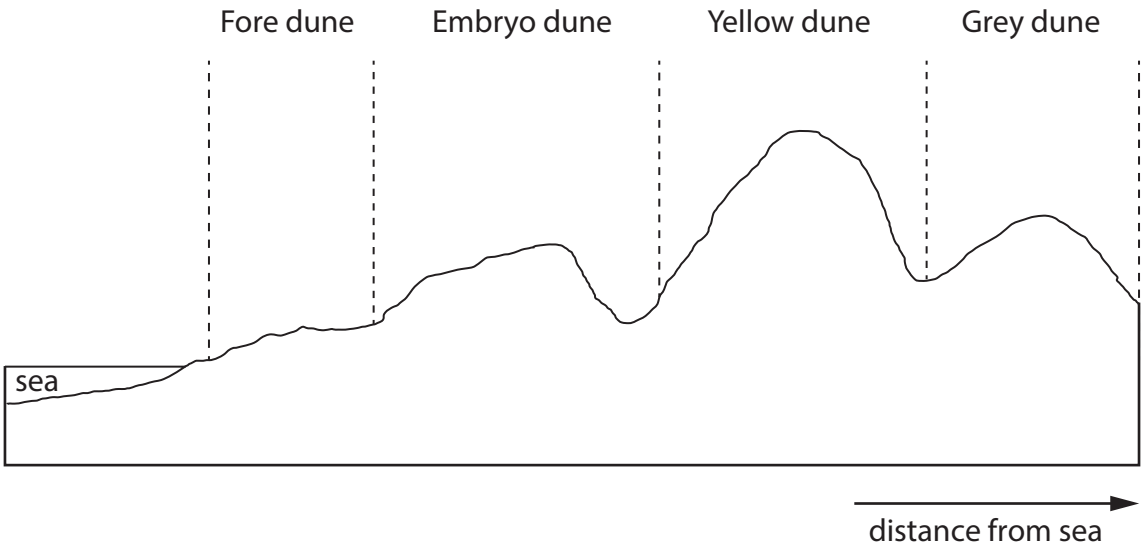
7 Stages of succession can be seen on different parts of a sand dune system.

The greater the distance of the sand dune from the sea, the later the stage of succession.

The diagram shows a sand dune system and the table gives some information about the different types of sand dune in this system.



Information	Fore dune	Embryo dune	Yellow dune	Grey dune
Soil depth / cm	<0.5	0.5	1.0	8.0
Percentage of organic matter (%)	<1.0	1.0	2.5	5.0
pH	8.5	8.0	7.0	6.5
Percentage of bare ground (%)	>97	97	70	10
Number of different plant species	2	3	6	15
Typical plant species	sea rocket saltwort	sea couch grass lyme grass marram grass	marram grass red fescue grass sea holly	range of different meadow plants

(a) (i) The pH of a solution is a measure of the concentration of hydrogen ions in that solution.

It is a log scale e.g. a solution of pH 5 contains 10^{-5} mol dm^{-3} of hydrogen ions.

What is the difference in concentration of hydrogen ions in a fore dune compared with a grey dune?

(1)

☒ **A** a fore dune has 2 times more hydrogen ions than the grey dune

☒ **B** a fore dune has 2 times fewer hydrogen ions than the grey dune

☒ **C** a fore dune has 100 times more hydrogen ions than the grey dune

☒ **D** a fore dune has 100 times fewer hydrogen ions than the grey dune

(ii) Calculate the percentage increase in the number of plant species on the grey dune compared with the fore dune.

(1)

Answer.....%

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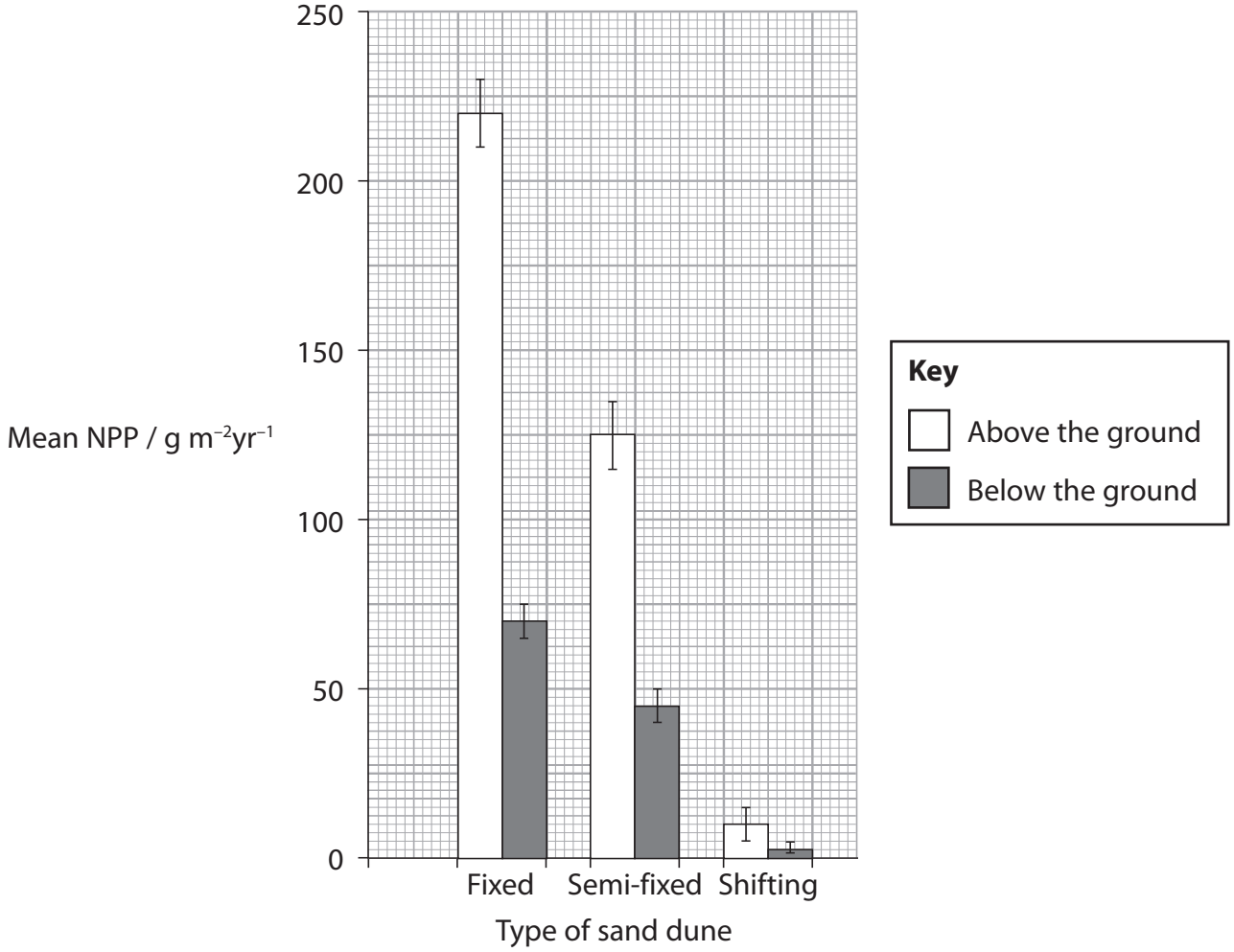
*(iii) Explain the changes in these sand dunes with distance from the sea.

Use the information in the table to support your answer.

(6)

(b) Sand dunes can be classified as fixed dunes, semi-fixed dunes and shifting dunes.

The graph shows the mean net primary productivity (NPP) above the ground and below the ground for these three types of sand dune.



(i) Describe the conclusions that can be drawn from this graph.

(3)

(ii) Explain how the products of the light-independent reactions become NPP below the ground.

(4)

(Total for Question 7 = 15 marks)

8 Patients with cystic fibrosis may develop serious bacterial infections.

A patient with cystic fibrosis developed bacterial infections including *Mycobacterium*.

(a) (i) This patient was given a combination of antibiotics for several months.

Explain why a combination of antibiotics had to be given for several months.

(2)

(ii) This patient did not respond to the combination of antibiotics, and later needed a lung transplant.

Suggest why this patient needed a lung transplant.

(3)

(iii) Following the transplant, the patient was given immunosuppressive drugs.

Immunosuppressive drugs weaken the immune system. Some of these drugs work by preventing DNA synthesis in the patient.

As a result of the immunosuppressive drug treatment, the infection with *Mycobacterium* developed faster.

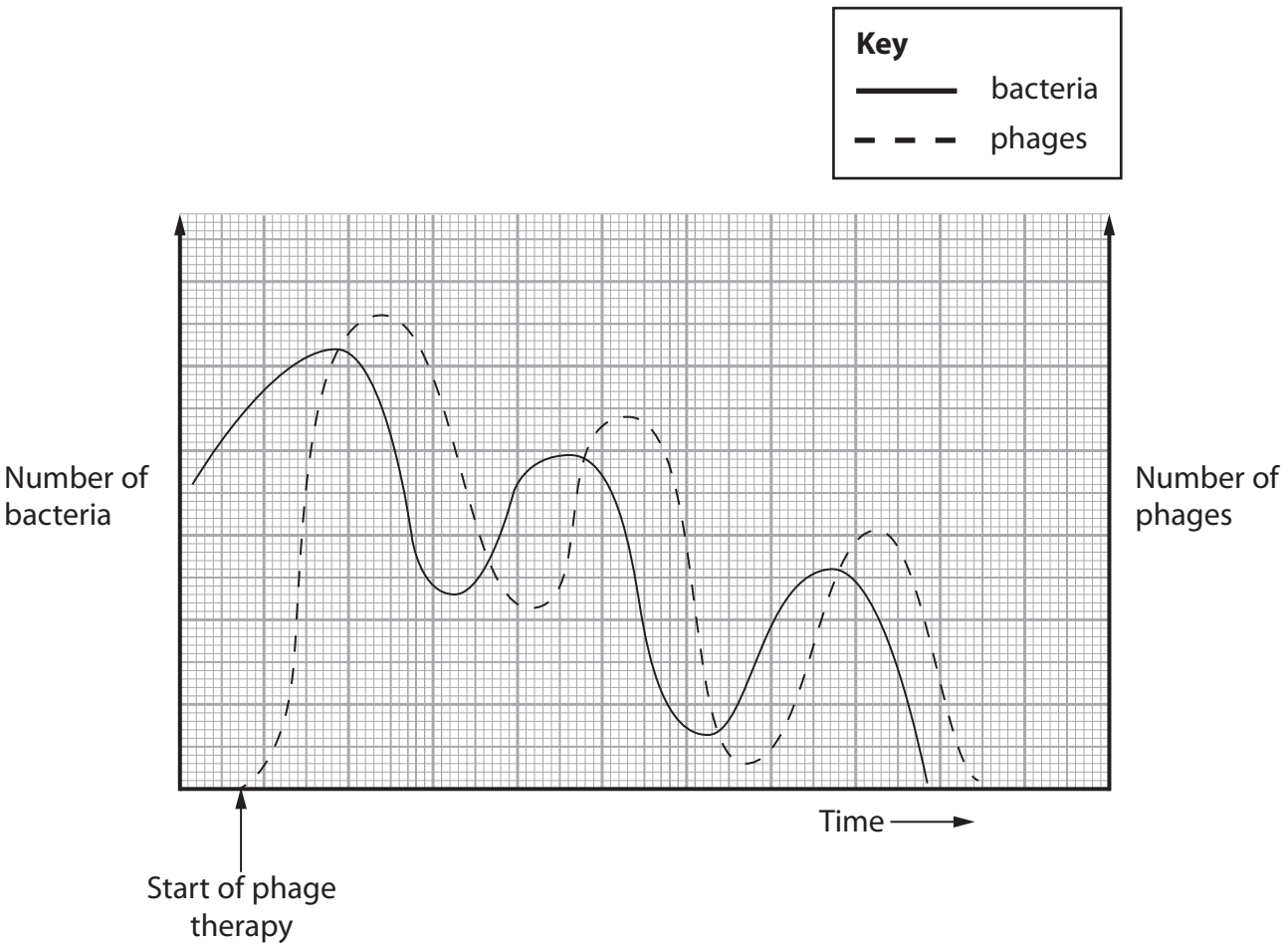
Explain why the infection with *Mycobacterium* developed faster when the patient was taking immunosuppressive drugs.

(4)

*(b) Phage therapy was used to treat the *Mycobacterium* infection in this patient.

Phages are viruses that target bacterial cells.

The graph shows how the number of *Mycobacterium* and the number of phages changed following the start of phage therapy.



Explain the changes in the number of bacteria and phages following the start of the phage therapy.

Use the information in the graph to support your answer.

(6)

(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 90 MARKS

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