Please check the examination details below before entering your candidate information

| Candidate surname | Other names |
|---|---|
| | |

Centre Number | Candidate Number

# Pearson Edexcel International Advanced Level

**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 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 out** 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.

*Turn over* ▶

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Q:1/1/1/1/1/1/

P 7 0 9 6 3 A 0 1 3 2

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** Bacteriostatic and bactericidal antibiotics are used to treat bacterial infections.

(a) Give the meaning of the term **bactericidal antibiotic**.

**(1)**

(b) State why antibiotics affect bacteria and usually not the person taking them.

**(1)**

(c) Codes of practice advise doctors and patients about the use of antibiotics.

Describe **two** pieces of advice given to patients.

**(2)**

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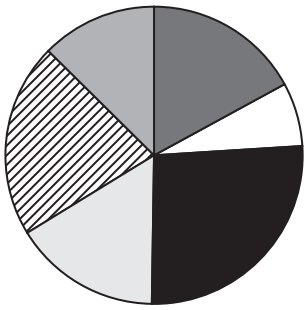
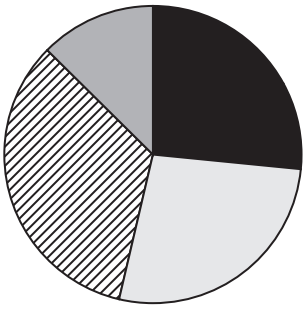
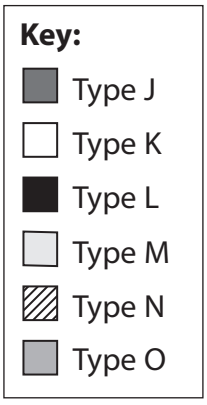
(d) The charts show the types of bacteria present in the throat of a patient, before and after treatment with an antibiotic.



Before treatment with antibiotic



After treatment with antibiotic




Describe the effects of this antibiotic on the bacteria present in the throat.

**(3)**

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**(Total for Question 1 = 7 marks)**

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**2** A student grew a bacterial culture in a liquid medium for 20 hours.

Every hour, a sample of the culture was removed.

This sample was added to some fresh medium and mixed thoroughly.

This mixture was spread onto agar in a Petri dish, so that the number of bacteria in the culture could be determined.

(a) Which method is being used to determine the number of bacteria in this culture?

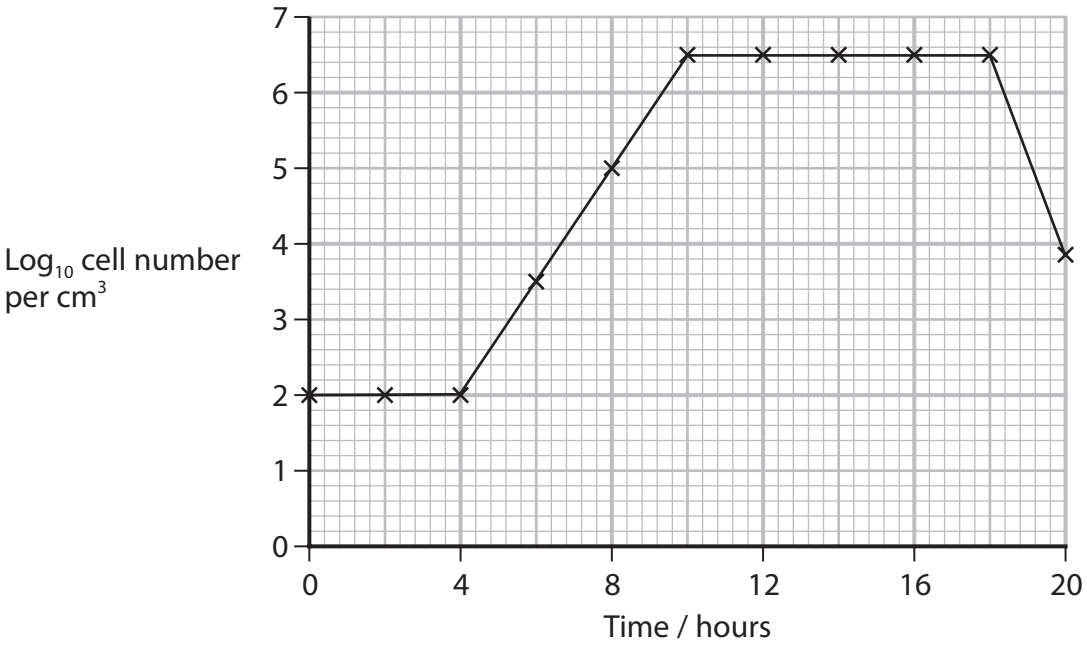
**(1)**

- ☒ **A** dilution plating
- ☒ **B** latency
- ☒ **C** mass method
- ☒ **D** optical method (turbidity)

(b) Explain how the Petri dish should have been sealed after the mixture was spread onto the agar.

**(2)**

(c) The graph shows the bacterial growth curve for this culture.

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(i) Which shows the order of the phases of a bacterial growth curve?

**(1)**

☒ **A** exponential → lag → death → stationary

☒ **B** lag → stationary → death → exponential

☒ **C** lag → exponential → stationary → death

☒ **D** stationary → exponential → lag → death

(ii) The bacteria were not growing at their fastest rate in the conditions the student used.

How many of the following changes could result in a faster growth rate?

- decrease in pH
- decrease in temperature
- increase in pH
- increase in temperature

**(1)**

☒ **A** 1

☒ **B** 2

☒ **C** 3

☒ **D** 4

(iii) Calculate the growth rate constant (*k*) of these bacteria between 4 hours and 10 hours.

**(2)**

Use the equation: $$k = \frac{\log_{10} N_t - \log_{10} N_0}{0.301 \times t}$$

Give your answer to two decimal places.

Answer .....

**(Total for Question 2 = 7 marks)**

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**3** The presence of skin flora is one way that the skin protects the body from infection.

(a) (i) Describe how skin flora protect the body from infection.

**(2)**

(ii) Give **one** other way in which the skin protects the body from infection.

**(1)**

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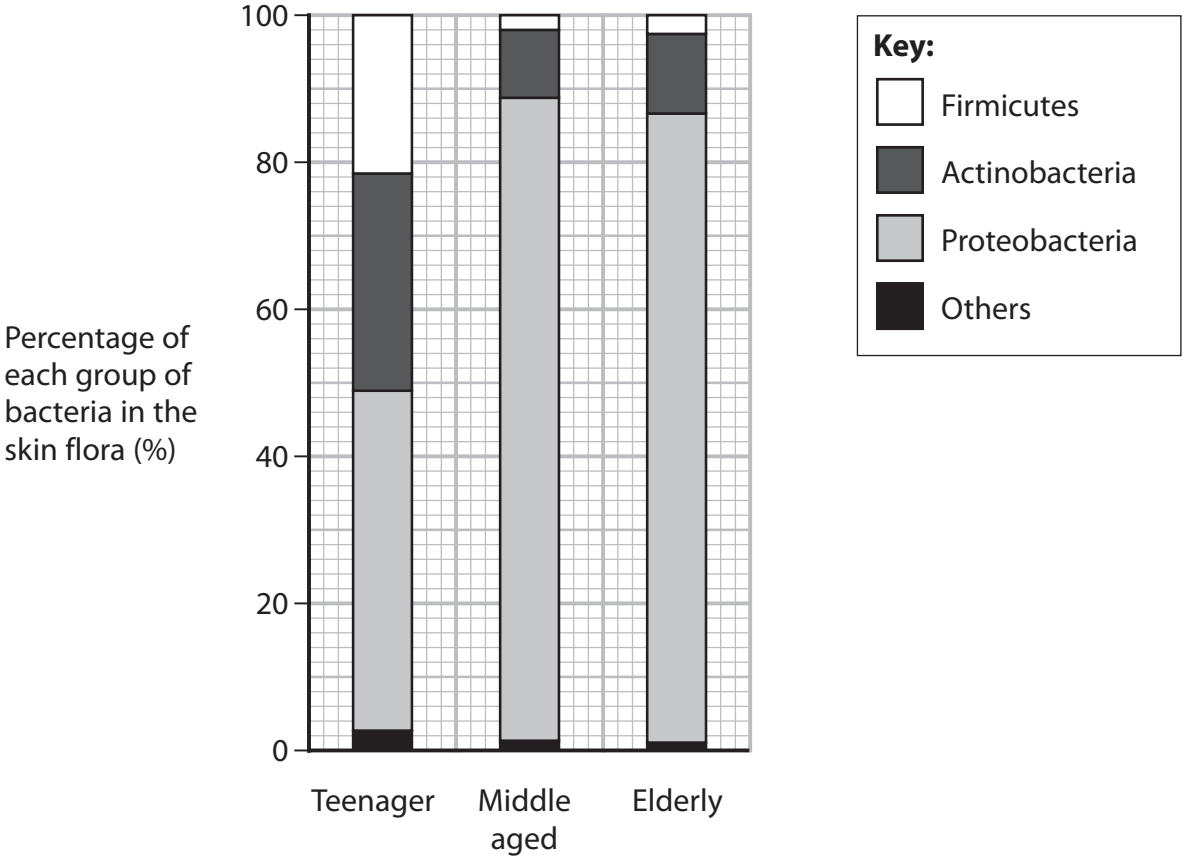
(b) The groups of bacteria present on the skin of men of different ages was investigated.

The graph shows some of the results of this investigation.




(i) Describe **three** conclusions that could be made from this graph.

**(3)**

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(ii) Describe how this study should have been designed to collect valid data.

**(2)**

(c) Some bacteria can get through the skin.

(i) Describe the role of macrophages in the non-specific response of the body to these bacteria.

**(2)**

(ii) Describe the role of macrophages in the immune response of the body to these bacteria.

**(2)**

**(Total for Question 3 = 12 marks)**

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**4** The photograph shows a regent honeyeater.



(Source: © Dave Watts / Alamy Stock Photo)

(a) Regent honeyeaters are critically endangered, with fewer than 300 birds left in the wild.

A study found that a large proportion of the male birds no longer sing the characteristic songs of their own species.

Some of the birds had learnt the songs of other species.

(i) Suggest why a large proportion of these male birds no longer sing the characteristic songs of regent honeyeaters.

**(1)**

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(ii) Explain the effect that this could have on the future of this species.

**(3)**

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(iii) Suggest how zoos could increase the number of birds in the wild that can sing the songs characteristic of this species.

**(2)**

(b) Genetic studies indicate that the regent honeyeater is related to wattlebirds.

Describe how genetic studies could show this.

**(4)**

**(Total for Question 4 = 10 marks)**

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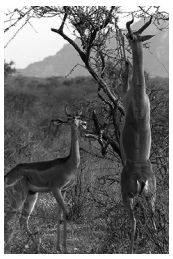
**5** The table shows the energy content in the three trophic levels of a food chain from an African plain.

| Trophic level | Organism | Energy content |
|---|---|---|
| 3 | Lion  | 920 |
| 2 | Gerenuk  | 8 825 |
| 1 | Tree  | 90 480 |

(a) (i) Which are the units for the energy content of these organisms?

**(1)**

☒ **A** $kJ\,m^{-1}\,year^{-1}$

☒ **B** $kJ\,m^{-1}\,year^{-2}$

☒ **C** $kJ\,m^{-2}\,year^{-1}$

☒ **D** $kJ\,m^{-2}\,year^{-2}$

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(ii) The energy content of the tree is the net primary productivity (NPP).

What is the relationship between NPP, gross primary productivity (GPP) and respiration (R)?

**(1)**

☒ **A** NPP = GPP + R

☒ **B** NPP = GPP – R

☒ **C** NPP = GPP × R

☒ **D** NPP = GPP ÷ R

(iii) Calculate the ratio of the energy contents shown in these trophic levels:

trophic level 1 : trophic level 2 : trophic level 3

**(1)**

Answer .....

(iv) Explain why there is no fourth trophic level in this food chain.

**(2)**

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(v) Describe the role of microorganisms in recycling carbon present in this food chain.

**(3)**

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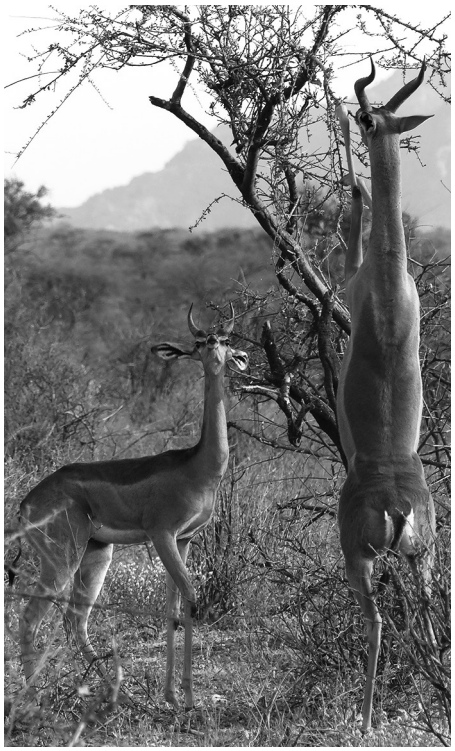
*(b) The photographs show gerenuk and a springbok to the same magnification.



gerenuk



(Source: © David Havel / Alamy Stock Photo)

springbok

The table gives some information about gerenuk and springbok.

| Information | Gerenuk | Springbok |
|---|---|---|
| Diet | leaves from a range of different trees, often spiny trees, up to 2 m from the ground | short grass and bushes |
| Water requirements | met by water content of food | will drink water when available |
| Height / cm | 80 to 105 | 69 to 87 |
| Mass / kg | male 45<br>female 30 | male 41<br>female 37 |
| Colour of fur | light brown with a white underbelly | light to mid brown with large areas of white |
| Length of horns / cm | 25 to 44 in males only | 35 to 49 in both males and females but narrower horns in females |

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Gerenuk and springbok evolved from a common ancestor.

Deduce how the gerenuk evolved to occupy a different niche from a springbok.

Use the information in the table and the photographs to support your answer.

**(6)**

**(Total for Question 5 = 14 marks)**

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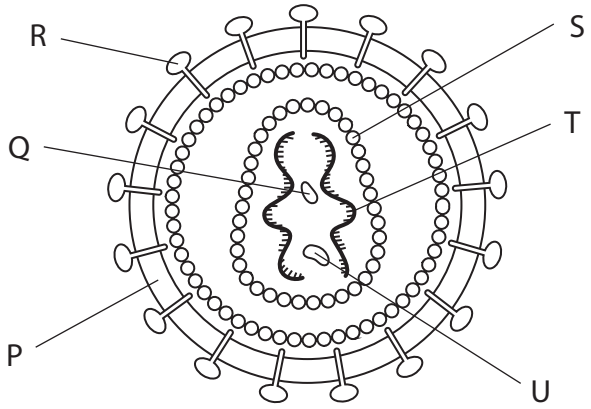
**6** The diagram shows a human immunodeficiency virus (HIV).




(a) (i) Which structure is RNA?

**(1)**

- ☒ **A** R
- ☒ **B** Q
- ☒ **C** S
- ☒ **D** T

(ii) How many of the following structures contain protein?

- structure Q
- structure R
- structure S

**(1)**

- ☒ **A** 0
- ☒ **B** 1
- ☒ **C** 2
- ☒ **D** 3

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(iii) Which virus has structure P and contains RNA?

**(1)**

- ☒ **A** Ebola virus only
- ☒ **B** Ebola virus and tobacco mosaic virus (TMV)
- ☒ **C** Tobacco mosaic virus (TMV) only
- ☒ **D** Neither Ebola virus nor tobacco mosaic virus (TMV)

(iv) The diameter of HIV is 120 nm.

Which is the approximate magnification of this drawing?

**(1)**

- ☒ **A** × 500
- ☒ **B** × 5 000
- ☒ **C** × 50 000
- ☒ **D** × 500 000

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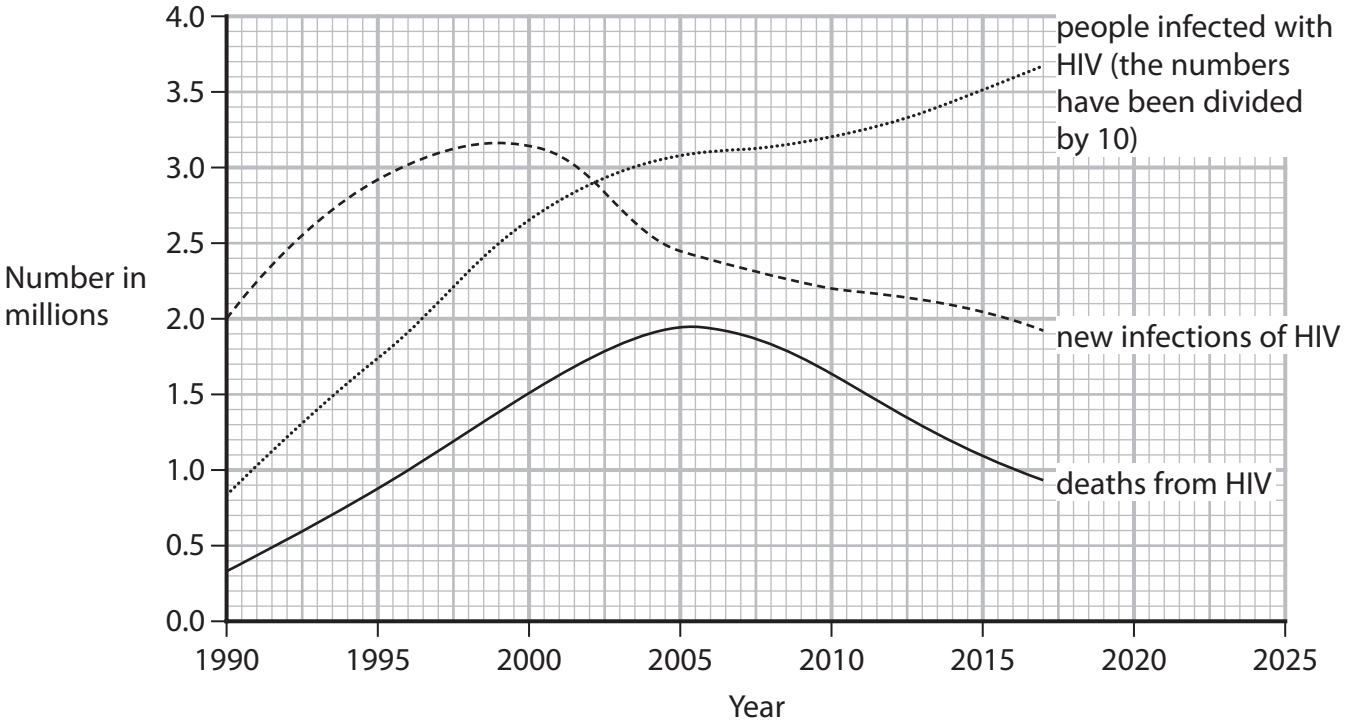
(b) The graph shows the number of HIV infections and the number of deaths from HIV in the world from 1990 to 2017.




(i) The data plotted for the number of people infected with HIV has been divided by 10.

Explain why these numbers were divided by 10.

**(2)**

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(ii) Calculate the mean rate of increase in the number of people infected with HIV from 2005 to 2010.

Express your answer in standard form to an appropriate number of significant figures.

**(2)**

Answer ..... mean number of infections year$^{-1}$

(iii) Explain why the number of people infected with HIV is going up although the number of new infections and deaths is going down, after 2005.

**(2)**

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(iv) State how the graph can be used to estimate the number of deaths in 2025.

**(1)**

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(v) Explain why this estimate would be lower if a vaccine for HIV became available in 2023.

**(3)**

**(Total for Question 6 = 14 marks)**

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**7** The photograph shows a Tasmanian devil.



(Source: © Walter 64 / Alamy Stock Photo)

Tasmanian devils are found in Tasmania.

The population of Tasmanian devils has fallen drastically due to a fatal cancer. This cancer first appeared in the mid-1990s.

There are only a few regions in Tasmania left where healthy Tasmanian devils can still be found.

(a) The number of Tasmanian devils is estimated to have fallen from 150 000 in the mid-1990s to 25 000 in 2020.

Calculate the percentage decrease in the number of Tasmanian devils from the mid-1990s to 2020.

**(1)**

Answer .....%

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(b) Tasmanian devils feed on the dead bodies of animals (carcasses) and scare off other scavengers.

Scientists have studied the scavenging of carcasses in two regions of Tasmania: one region where all Tasmanian devils were healthy and one region where the cancer was common.

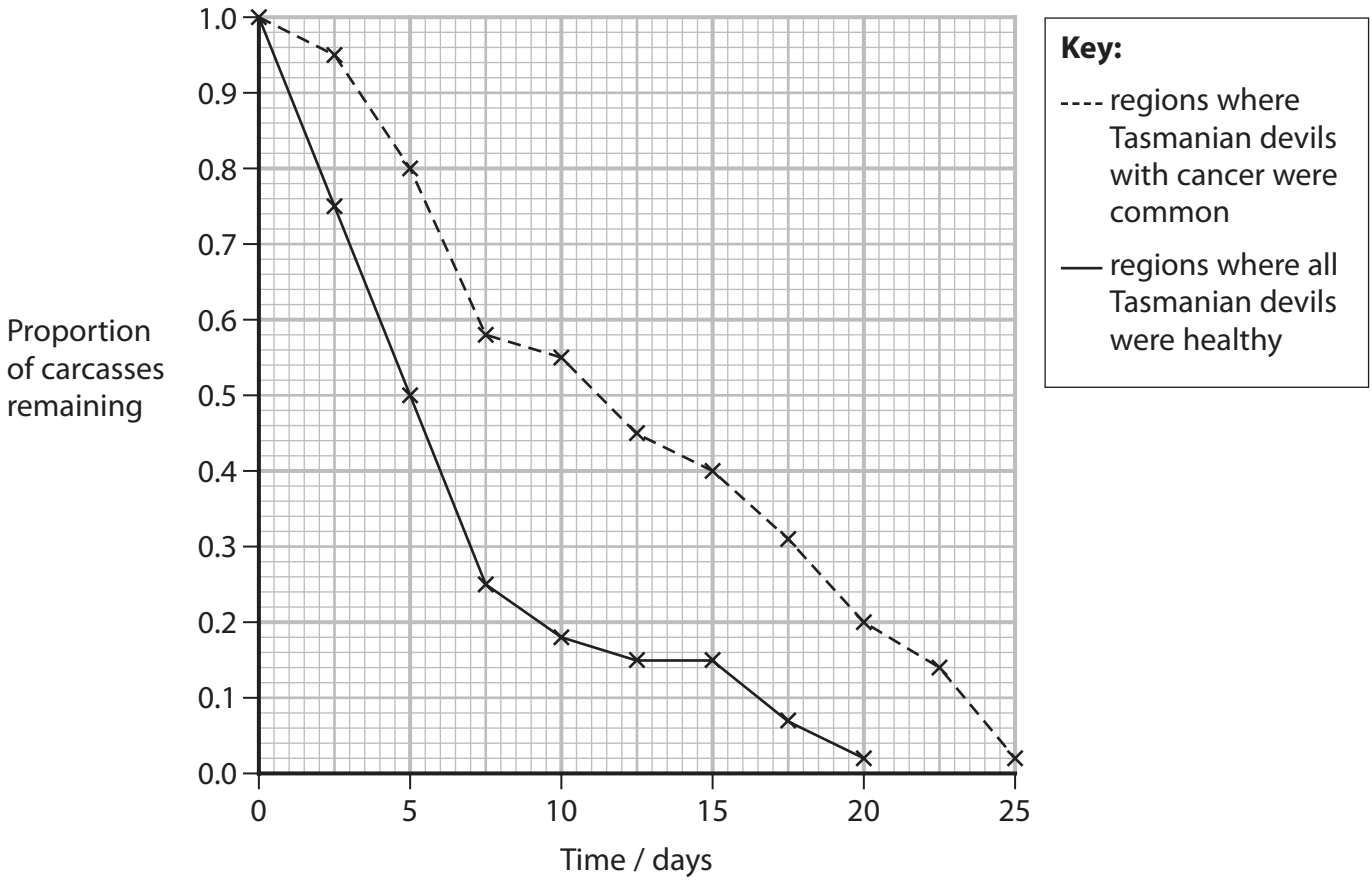
The length of time Tasmanian devils and three other scavenging animals spent feeding on carcasses was investigated.

The results are shown in the table.

| Region | Proportion of time the scavengers spent feeding on each carcass | | | |
|---|---|---|---|---|
| | Tasmanian devil | Forest raven | Spotted-tailed quoll | Feral cat |
| Where all Tasmanian devils were healthy | 0.76 | 0.13 | 0.06 | 0.05 |
| Where Tasmanian devils with cancer were common | 0.26 | 0.38 | 0.20 | 0.16 |

The length of time it took for the carcasses to be completely eaten was also investigated.

The results are shown in the graph.

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*(i) Explain the results of these two studies.

Use the information in the table and the graph to support your answer.

**(6)**

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(ii) Explain what other **biotic** factors could have affected the results from the two different regions of Tasmania, in the second investigation.

**(4)**

**(Total for Question 7 = 11 marks)**

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**8** The eruption of a volcano can devastate the surrounding countryside and cause climate change.

(a) The photograph shows the devastation that can result from a volcanic eruption.



(Source: © Zoonar GmbH / Alamy Stock Photo)

Succession occurs in the devastated areas.

Pioneer species are the first to colonise these areas.

Several stages follow, which may result in a climax community.

(i) Describe **three** characteristics of pioneer species.

**(3)**

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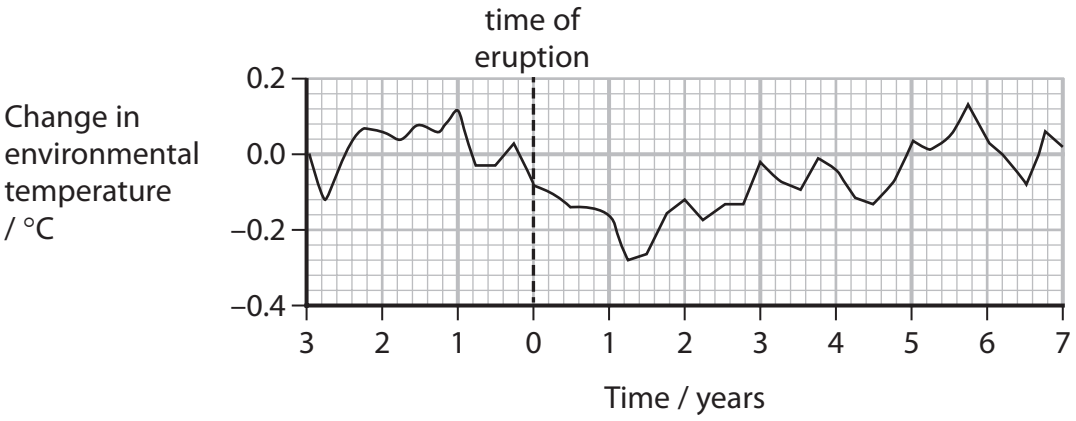
(ii) Explain why succession occurs in stages.

**(2)**

(b) (i) The graph shows the changes in environmental temperature before and after a volcanic eruption.




Determine the effect of the volcanic eruption on environmental temperature.

Use the information in the graph to support your answer.

**(2)**

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(ii) When this volcano erupted, sulfur dioxide and particles of ash were released into the atmosphere.

Sulfur dioxide and particles of ash cause less light to pass through the atmosphere.

Explain the results shown in the graph.

**(4)**

(iii) The eruption of one volcano resulted in $5 \times 10^7$ metric tons of carbon dioxide entering the atmosphere in one year.

The mass of carbon dioxide released into the atmosphere in one year by anthropogenic activities was $3.5 \times 10^{10}$ metric tons.

Calculate how many volcanic eruptions would need to occur, in one year, to produce as much carbon dioxide as anthropogenic activities.

**(1)**

Answer .....

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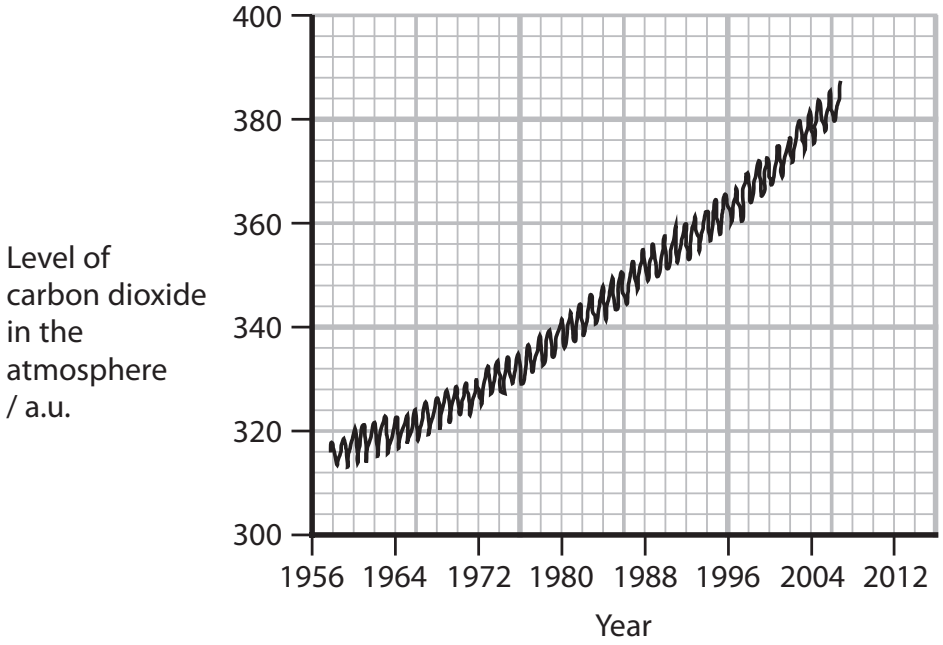
(iv) The graph shows the levels of carbon dioxide in the atmosphere in one region of the world from 1958 to 2004.

During this period there were volcanic eruptions in 1963, 1980, 1982 and 1991, in this region.




Discuss the possible effects of volcanic eruptions on climate change.

Use all the information in part (b) to support your answer.

**(3)**

**(Total for Question 8 = 15 marks)**

**TOTAL FOR PAPER = 90 MARKS**

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