Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Tuesday 27 May 2025

Morning (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.*

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 Redonda is a small island in the Caribbean.

It is the remains of an extinct volcano. Over thousands of years, it became home to wildlife including species of lizards only found on this island.

Following the introduction of rats and goats onto the island, the wildlife was destroyed and the island was reduced to bare rock again.

A conservation project started in 2016 to remove all the rats and goats from the island and now the biodiversity is increasing.

The photographs show some goats and some rats.



(Source: © Ian West / Alamy Stock Photo)



(Source: © Ernie Janes / Alamy Stock Photo)

(a) Which term describes the events that took place to change the extinct volcano into a habitat for many species?

(1)

- ☒ **A** entomology
- ☒ **B** evolution
- ☒ **C** speciation
- ☒ **D** succession

(b) Which term describes the species of lizards found only on Redonda?

(1)

- ☒ **A** Archaea
- ☒ **B** endemic
- ☒ **C** epigenetic
- ☒ **D** sustainable

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(c) Suggest how the rats and goats destroyed the wildlife.

Use the information in the photographs to support your answer.

(2)

(d) Describe how to determine the biodiversity of Redonda to show the effectiveness of the conservation project.

(3)

(Total for Question 1 = 7 marks)

2 Treatment of patients with antibiotics can affect the composition of their gut flora.

(a) Gut flora are important as they help protect the body from pathogens.

State the meaning of the term **pathogen**.

(1)

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(b) State the meaning of the term **antibiotic**.

(1)

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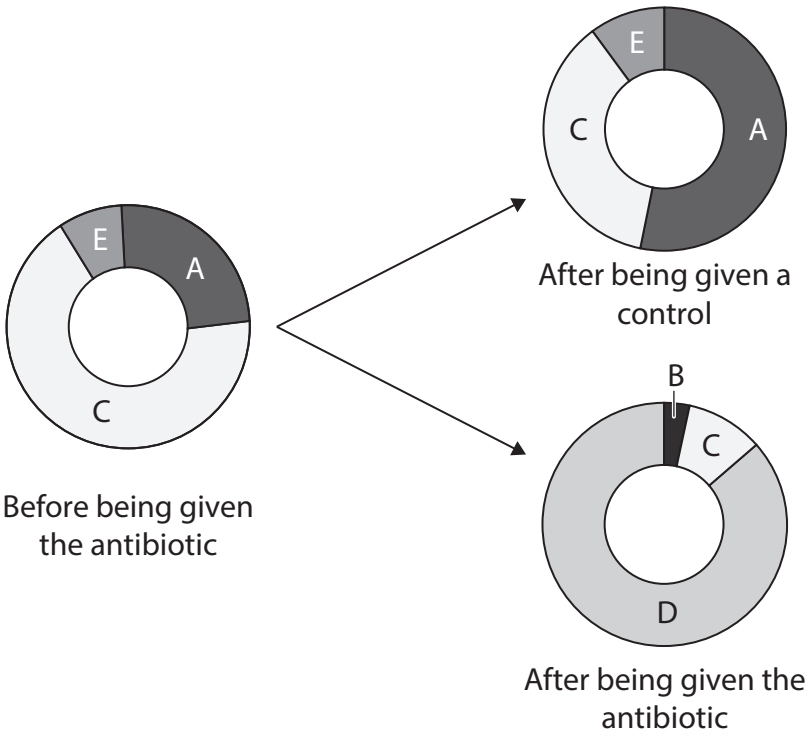
(c) The effect of an antibiotic on the proportion of different types of bacteria, A, B, C, D and E, in gut flora was investigated:

Step 1 – The types of bacteria in the gut flora of a group of people were determined.

Step 2 – Half the group was then given a dose of the antibiotic and the other half was given a control.

Step 3 – The types of bacteria in the gut flora were again determined.

The diagram shows the proportions of the types of bacteria in the gut flora.



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(i) State **one** conclusion about the effect of the control on the **variety** of bacteria in the gut flora.

(1)

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(ii) Estimate the decrease in the proportion of bacteria type C in the group given the antibiotic.

(1)

Answer .....

(iii) Explain how treatment with antibiotics can affect the gut flora.

(2)

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(Total for Question 2 = 6 marks)

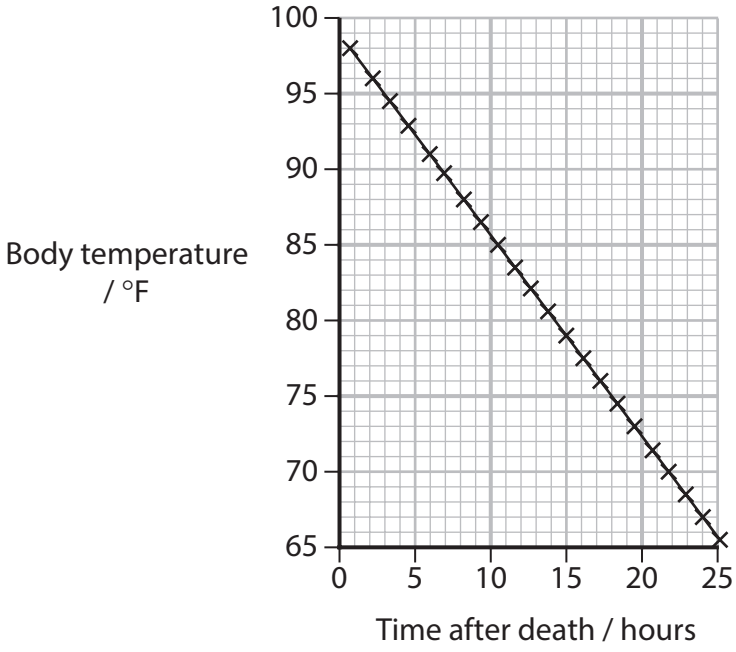
3 The time of death of a mammal can be determined by measuring the body temperature of the corpse.

(a) Which of the following can also be used to determine the time of death of a mammal?

(1)

- ☒ **A** dendrochronology and degree of muscle contraction
- ☒ **B** degree of muscle contraction and extent of decomposition
- ☒ **C** extent of decomposition and polymerase chain reaction
- ☒ **D** polymerase chain reaction and dendrochronology

(b) The graph shows a cooling curve that can be used to determine the time of death of a mammal.



(i) A mammal had been dead for 15 hours.

Calculate the body temperature of this mammal in °C.

Use the formula:

$$\text{Temperature in °C} = \frac{5 \times (\text{temperature in °F} - 32)}{9}$$

Give your answer to **one** decimal place.

(2)

Answer ..... °C

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(ii) Explain how this cooling curve would change if the mammal had more body fat.

(3)

(iii) The equation for the cooling curve shown in the graph can be used to determine the time of death.

Write the equation for this cooling curve, using the format:

$$y = mx + c$$

(3)

Answer .....

(Total for Question 3 = 9 marks)

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4 Tigers are on the verge of extinction, despite a recent increase in numbers.

In 2010 there were 3 200 tigers and in 2023 there were an estimated 5 574 tigers in the world.

The Bengal tiger is the most abundant with approximately 3 100 animals in India and its neighbouring countries in 2023.

The photograph shows a Bengal tiger.



(Source: © Zoonar GmbH / Alamy Stock Photo)

(a) (i) Calculate the percentage increase in the total number of tigers in the world from 2010 to 2023.

(1)

Answer ..... %

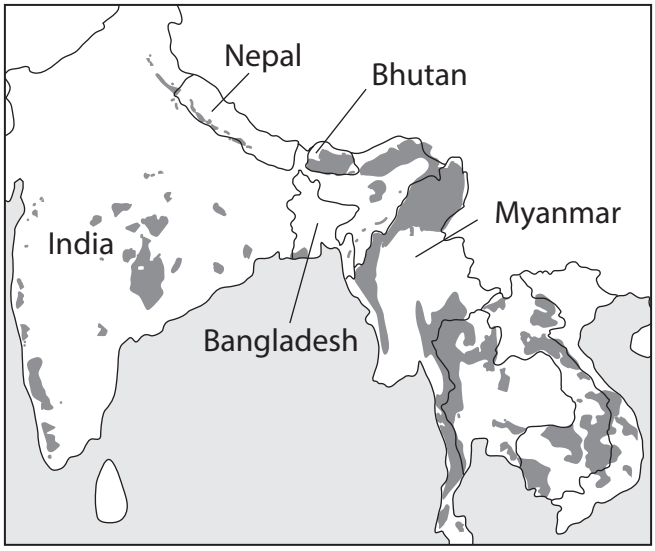
(ii) Which is the ratio of Bengal tigers to other types of tigers in the world in 2023?

(1)

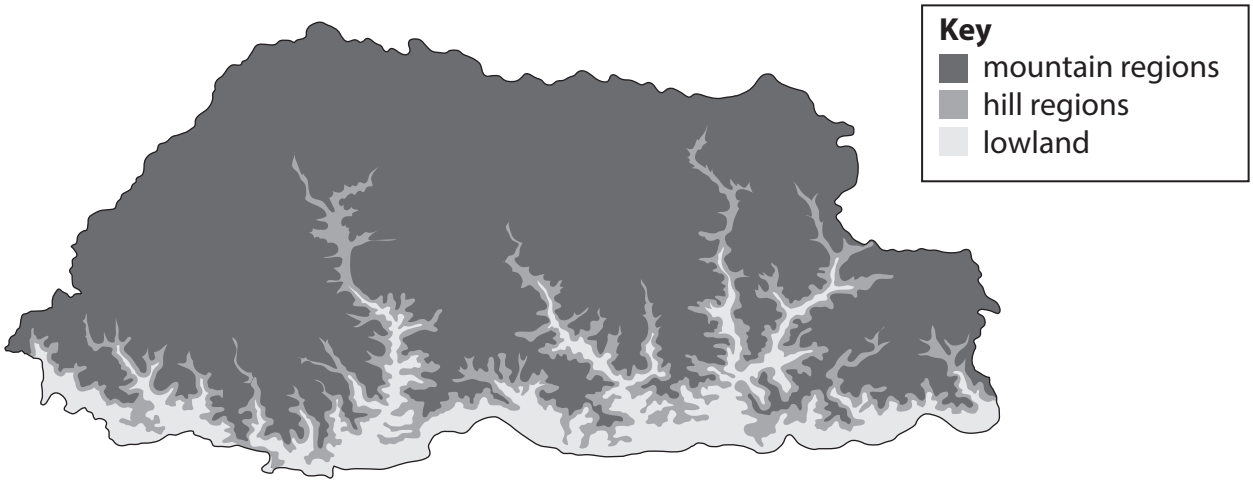
- ☒ **A** 0.556 : 1
- ☒ **B** 0.798 : 1
- ☒ **C** 1.253 : 1
- ☒ **D** 1 : 1.798

(b) The first map shows the distribution of Bengal tigers in India and its neighbouring countries.

The dark-shaded areas are where the tigers are found.



The second map shows the mountain regions and hill regions in Bhutan.



In 2018, the Tiger Action Plan for Bhutan was started by the Royal Government of Bhutan.

Conservation groups and the government were hoping to increase the number of tigers in Bhutan. This would establish Bhutan as a tiger corridor to link tiger populations in the neighbouring countries.

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(i) Before the Tiger Action Plan was started, conservation groups had to prove that tigers were present in Bhutan, especially in the mountain regions shown in the second map.

Give **two** reasons why this was important.

(2)

(ii) Deduce the importance of establishing a tiger corridor in Bhutan for a greater increase in the number and diversity of tigers.

Use the information in the first map to support your answer.

(4)

(Total for Question 4 = 8 marks)

5 Antibodies are produced by the immune system and play an important role in the destruction of pathogens by macrophages.

(a) Which types of immunity result in the production of antibodies?

(1)

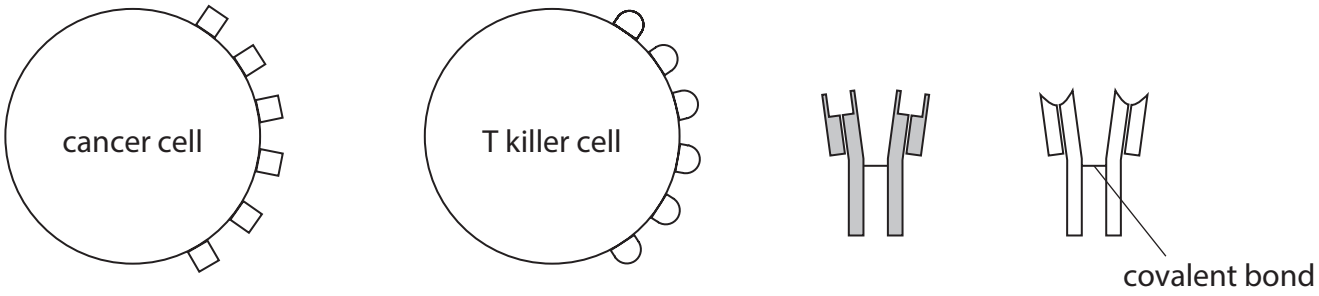
- ☒ **A** artificial active and natural active
- ☒ **B** artificial active and natural passive
- ☒ **C** artificial passive and natural active
- ☒ **D** artificial passive and natural passive

(b) Cells called T killer cells are involved in destroying cells infected with viruses.

These cells can also destroy cancer cells in a similar way.

Scientists have made a new single antibody that can bind to both cancer cells and T killer cells.

The diagrams show the antigens on a cancer cell, the antigens on a T killer cell and two different antibodies.



(i) Explain why a **single** antibody had to be made by the scientists.

Use the information in the diagrams to support your answer.

(2)

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(ii) Suggest how the scientists could make this single antibody.

Use the information in the diagram to support your answer.

(3)

(iii) Explain how this single antibody helps the body destroy cancer cells.

(2)

(Total for Question 5 = 8 marks)

6 Chloroplasts contain their own DNA.

(a) (i) Where in the **chloroplast** is this DNA located?

(1)

- ☒ **A** intergranal membrane
- ☒ **B** matrix
- ☒ **C** stroma
- ☒ **D** thylakoid space

(ii) Which other structures in a plant cell contain DNA?

(1)

- ☒ **A** amyloplast and mitochondria
- ☒ **B** mitochondria and nucleus
- ☒ **C** nucleus and vacuole
- ☒ **D** vacuole and amyloplast

(b) The DNA in a chloroplast contains 150 000 **base pairs** in the 105 regions that code for proteins.

(i) Which is the **mean** number of bases in the template (antisense) strand of one region that codes for a protein?

(1)

- ☒ **A** 239
- ☒ **B** 476
- ☒ **C** 714
- ☒ **D** 1 429

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(ii) Suggest **two** reasons why this DNA contains more than 150 000 base pairs.

(2)

(iii) Describe the roles of the proteins:

- RNA polymerase
- ribosomal protein
- RUBISCO
- ATP synthetase.

(4)

(Total for Question 6 = 9 marks)

7 Beta-carotene is a pigment produced by plants.

It can be harvested from plants and used as an antibacterial agent, as an antioxidant and as an ingredient in foods.

Bacteria called *C. parietis* produce beta-carotene.

Scientists experimented to find the culture conditions required for *C. parietis* to produce the maximum yield of beta-carotene.

(a) *C. parietis* growing on nutrient agar were used to inoculate a liquid broth.

The liquid cultures were then shaken in an incubator.

The diagram shows this procedure.



Colonies of *C. parietis* growing on nutrient agar

C. parietis in a liquid culture

Liquid culture of *C. parietis* shaken in an incubator

(i) Describe how to inoculate the liquid broth using the colonies growing on nutrient agar.

(3)

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(ii) Suggest why these liquid cultures were shaken in an incubator.

(2)

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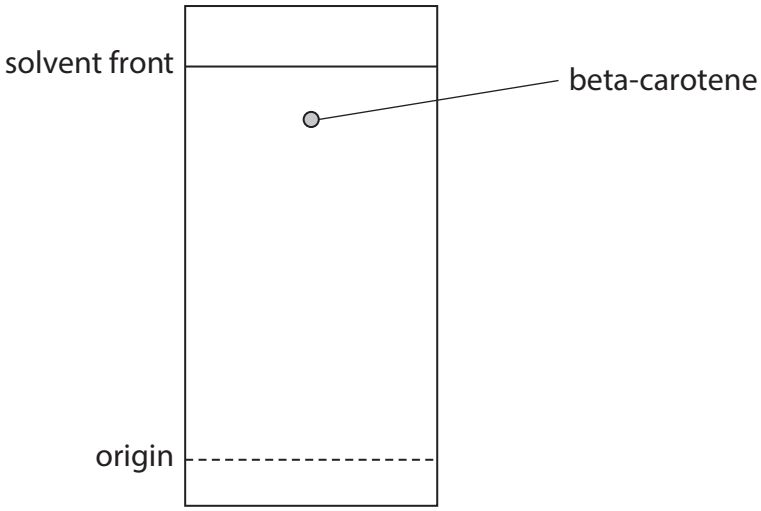
(b) The beta-carotene could be identified using chromatography.

The diagram shows a chromatogram of beta-carotene.



(i) Which is the Rf value for beta-carotene in this chromatogram?

(1)

☒ **A** 0.75

☒ **B** 0.87

☒ **C** 1.16

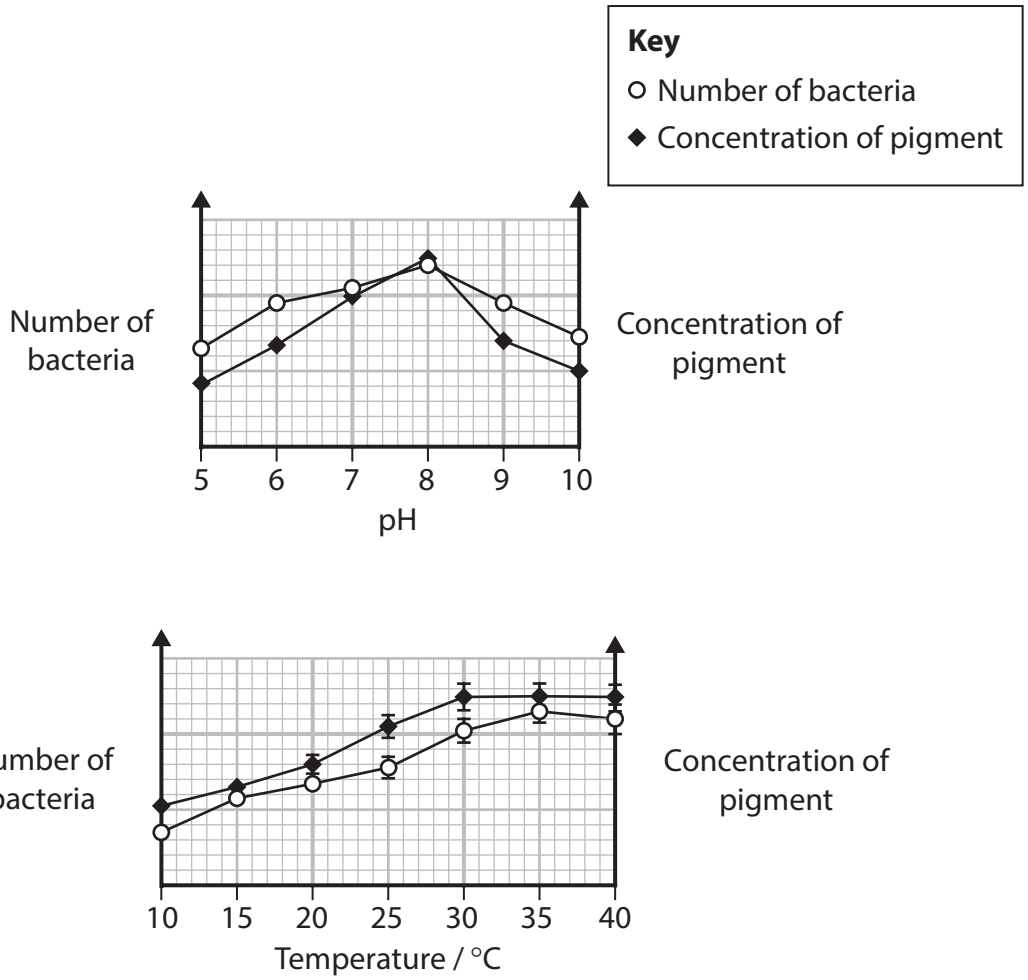
☒ **D** 1.33

(ii) Explain why chromatography can be used to identify beta-carotene.

(2)

(c) The scientists cultured the bacteria at different pHs and different temperatures.

The graphs show the results.



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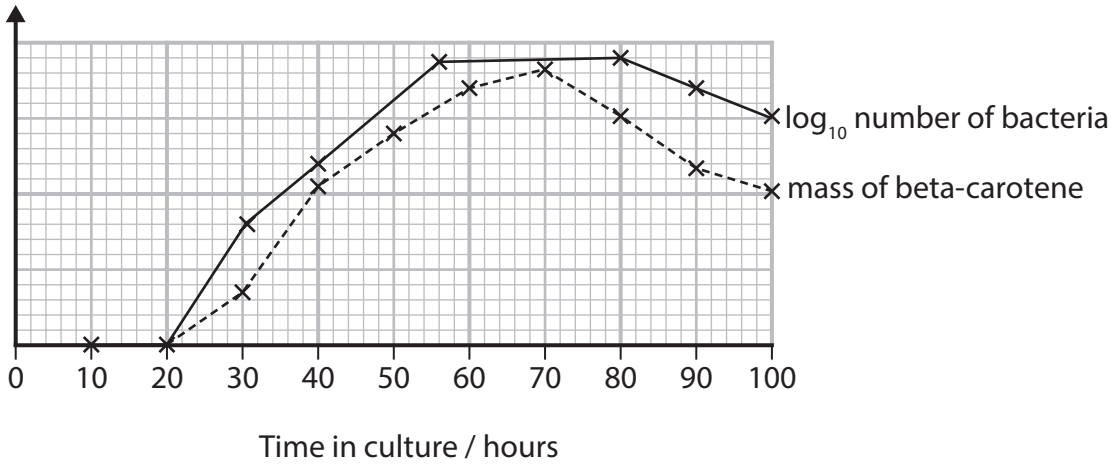
Describe **three** conclusions that can be made from the data shown in these graphs.

(3)

(d) The graph shows the mass of beta-carotene produced and the number of bacteria in the culture as determined by dilution plating.



Explain the changes in the mass of beta-carotene produced by this culture of bacteria.

Use the information in the graph to support your answer.

(4)

(Total for Question 7 = 15 marks)

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8 Many reptiles lay their eggs in the sand.

The sex of these reptiles is determined by the temperature of the sand surrounding the developing eggs.

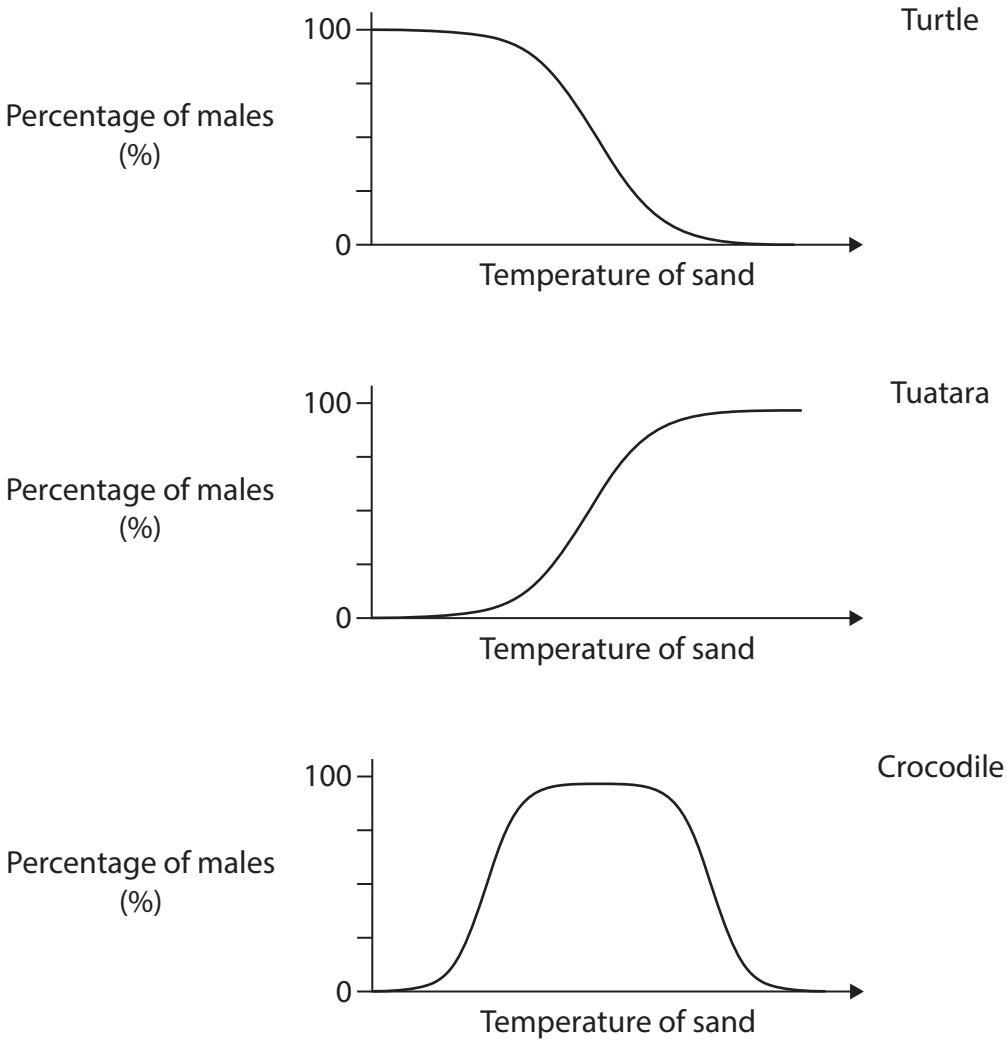
Turtles are one example of these reptiles.

The photograph shows two young turtles, one hatching from an egg.



(Source: © Tierfotoagentur / Alamy Stock Photo)

(a) The graphs show the effect of temperature of the sand on the percentage of males that hatch, in three types of reptiles.



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(i) The pivotal temperature (Tpiv) is the temperature at which equal numbers of males and females are produced.

Label the Tpiv for turtles on the graph.

(1)

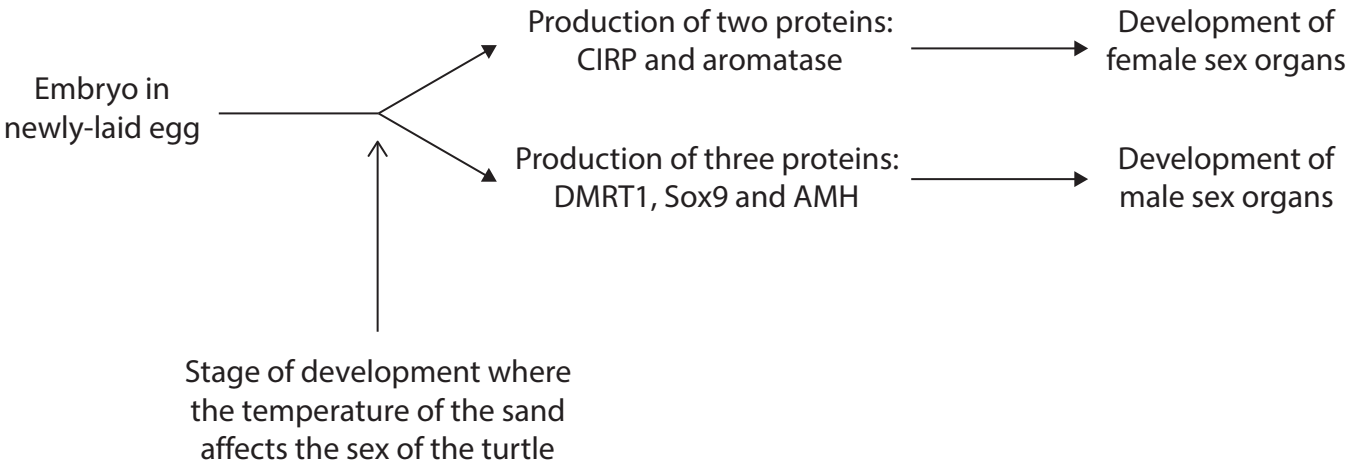
(ii) Describe the effect of the temperature of the sand on the percentage of males produced in these three reptiles.

(3)

(b) The embryos in newly-laid eggs have immature reproductive organs that can develop into either male reproductive organs or female reproductive organs.

In turtles, sex is determined by differential gene expression.

The diagram shows how the sex of a turtle is determined.



Explain how temperature determines the sex of turtles.

Use the information in the graph in part (a) and the diagram to support your answer.

(4)

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(c) Anthropogenic activities such as the use of microplastic can affect the temperature of the sand.

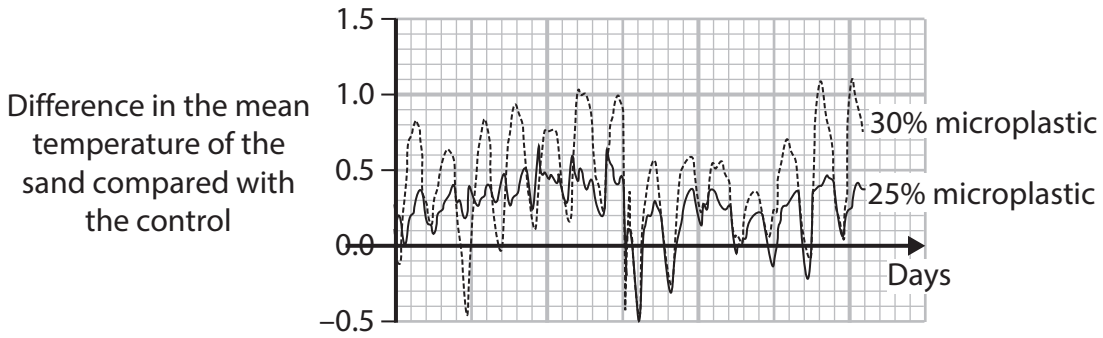
The effect of microplastic on the temperature of the sand was investigated during the breeding time of the turtles.

Several tubs were filled with sand containing two different percentages of microplastic.

Tubs containing sand only were used as controls.

The graph shows the differences in the mean temperatures of the sand containing 25% and 30% microplastic compared with the control.

The table shows the mean temperature of the sand during this investigation.



Content of tubs	Mean temperature / °C	Standard deviation / °C
Control	30.047	3.088
25% microplastic	30.294	3.095
30% microplastic	30.473	3.017

(i) Name **one other** anthropogenic activity that could affect the temperature of the sand.

(1)

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*(ii) The Tpiv for flatback turtles is 29.4 °C.

A temperature of 27.7 °C will result in all males and a temperature of 31.1 °C will result in all females being produced.

The Tpiv for green sea turtles is 30.0 °C.

Discuss whether or not scientists should be concerned that the use of microplastics could be endangering turtles.

Use all of the information in the question and your own knowledge to support your answer.

(6)

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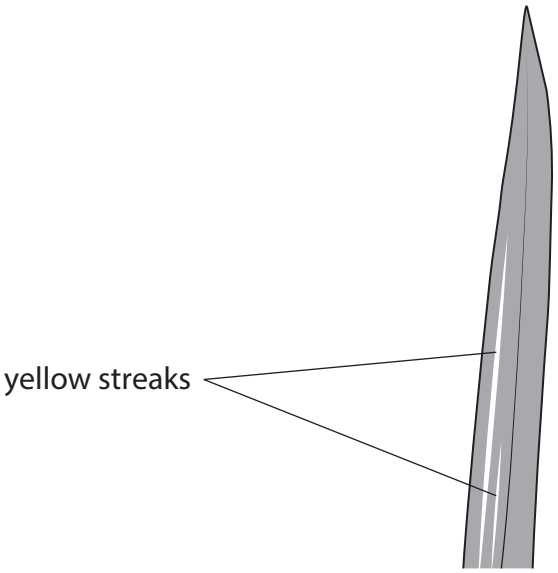
(Total for Question 8 = 15 marks)

9 The rice yellow mottle virus (RYMV) infects species of rice plants grown in Africa.

The leaves of infected rice plants become discoloured with yellow or orange streaks.

The diagram shows a leaf of a rice plant infected with RYMV.



(a) One country in Africa can produce 1.7 million tonnes of rice per year.

Between 20% and 100% of the harvest may be lost due to infection with RYMV.

(i) Calculate how many tonnes of rice are lost if 20% of the harvest is lost.

Give your answer in standard form.

(1)

Answer ..... tonnes

(ii) Explain why it is important to identify rice plants infected with RYMV as early as possible.

(2)

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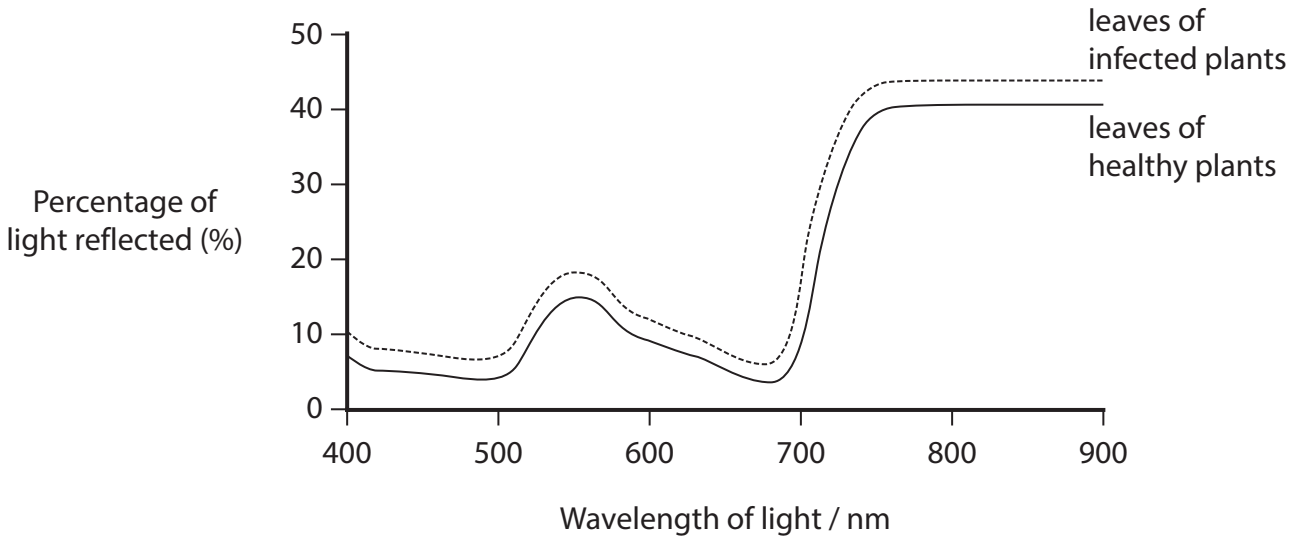
(b) Scientists are trying to develop ways to identify rice plants recently infected with RYMV.

One investigation measured the reflection spectrum of the leaves of infected rice plants and compared this with healthy plants.

Different wavelengths of light were shone onto the leaves of rice plants and the percentage of light reflected at each wavelength was measured.

The graph shows the results of this investigation for healthy plants and plants that had been infected for two days with RYMV.



(i) Suggest why wavelengths of light between 400 nm and 900 nm were used in this investigation.

(1)

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(ii) Explain why the scientists thought that there would be a difference in the reflection spectra for healthy leaves and leaves infected with RYMV.

(2)

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(iii) Discuss the extent to which the results shown in the graph could be useful to farmers in identifying infected plants.

(3)

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(c) The types of rice plants most susceptible to infection with RYMV are those imported from Asia into Africa.

Explain why rice plants from Africa are less susceptible to the virus than those imported from Asia.

(4)

(Total for Question 9 = 13 marks)

TOTAL FOR PAPER = 90 MARKS

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