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 8 January 2026

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 Energy is transferred between trophic levels.

(a) There is a relationship between gross primary productivity (GPP), net primary productivity (NPP) and respiration (R).

(i) In a food chain, GPP is 20 810 kJ m^{-2} $year^{-1}$ and R is 11 977 kJ m^{-2} $year^{-1}$.

Which is the value of NPP in kJ m^{-2} $year^{-1}$?

(1)

☒ **A** 0.58

☒ **B** 1.74

☒ **C** 8 833

☒ **D** 32 787

(ii) Which is correct for this relationship?

(1)

☒ **A** It only applies to trophic level 1

☒ **B** It only applies to trophic level 2

☒ **C** It only applies to the highest trophic level

☒ **D** It applies to all trophic levels

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(b) When an organism dies, the molecules in the biomass are released into the environment due to the action of microorganisms.

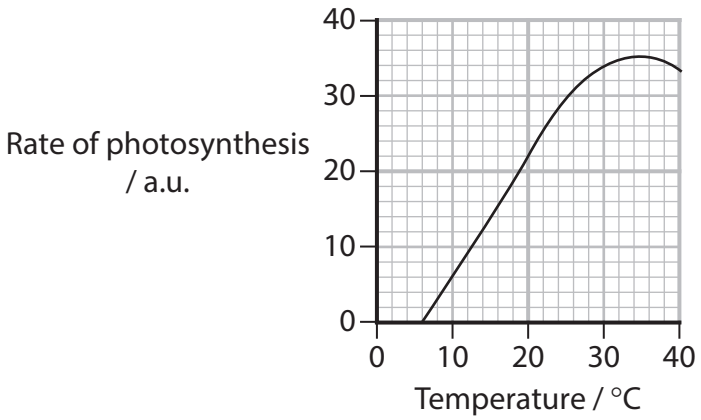
Describe how microorganisms release these molecules.

(3)

(Total for Question 1 = 5 marks)

2 The rate of photosynthesis is affected by temperature.

The graph shows the effect of temperature on the rate of photosynthesis.



(a) Explain how a temperature increase from 10 °C to 35 °C affects the **rate of photosynthesis**.

(4)

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(b) The Q_{10} for the reactions in photosynthesis can be calculated using the formula:

$$Q_{10} = \frac{R_{t+10}}{R_t}$$

Which is the Q_{10} when R_t is the initial rate of reaction at 20 °C shown in this graph?

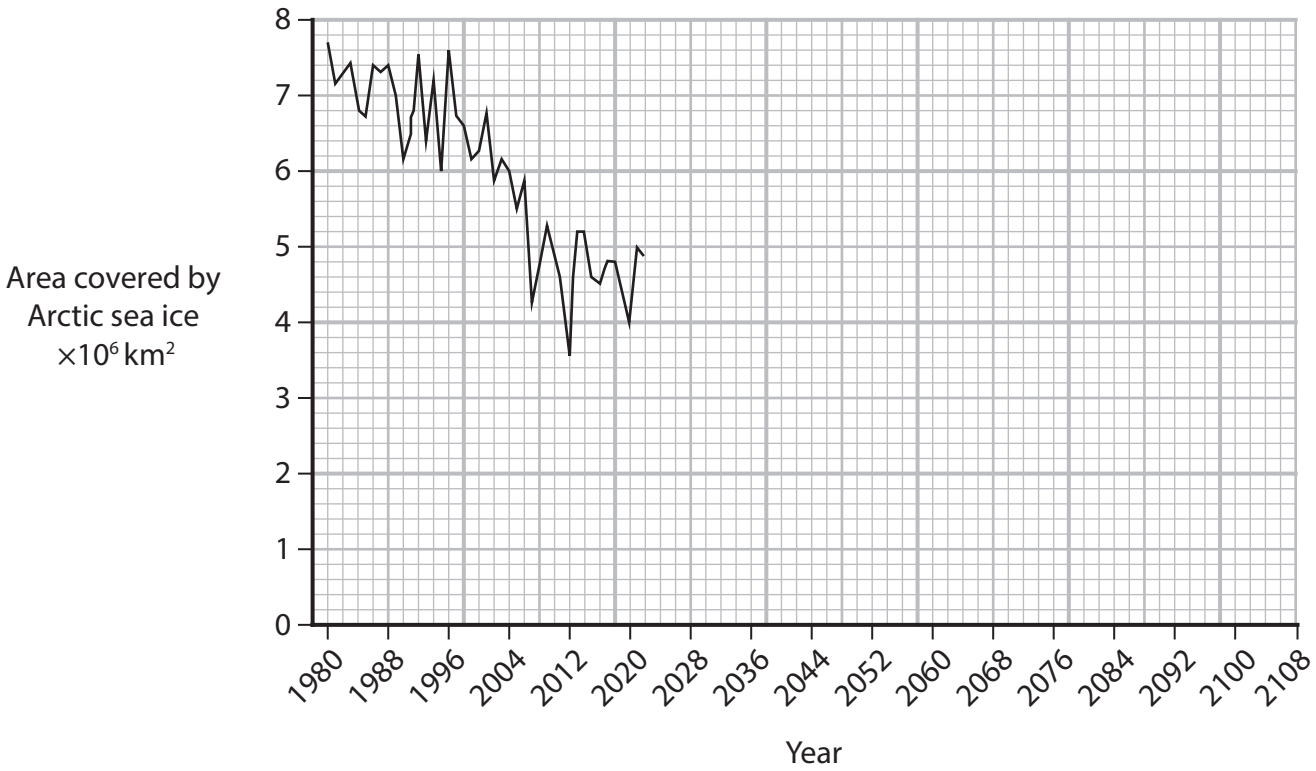
(1)

- ☒ **A** 0.65
- ☒ **B** 0.67
- ☒ **C** 0.69
- ☒ **D** 1.55

(Total for Question 2 = 5 marks)

3 The melting of sea ice is one effect of climate change.

(a) The graph shows the area covered by Arctic sea ice in each year from 1980 to 2022.



The Arctic will be considered ice-free if the area of sea ice is less than one million km^2.

(i) Predict when the Arctic could be ice-free, using this graph.

(1)

Answer .....

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(ii) Some scientists are predicting that by 2050 the Arctic will be ice-free.

Suggest why this prediction for an ice-free Arctic is sooner than a prediction made from this graph.

(2)

(iii) Some people argue that global warming is not affecting the melting of sea ice.

They have used the data presented in this graph from 2007 to 2020 to support this argument.

Explain why this data can be interpreted in two different ways.

Use the information in this graph to support your answer.

(2)

(b) Polar bears are facing starvation as the sea ice melts.

Polar bears feed on the fat of seals that they hunt on the ice.

The polar bears are now feeding on berries and grass on the land or swimming greater distances to find seals.

These polar bears are losing weight.

Suggest **two** reasons why these polar bears are losing weight.

(2)

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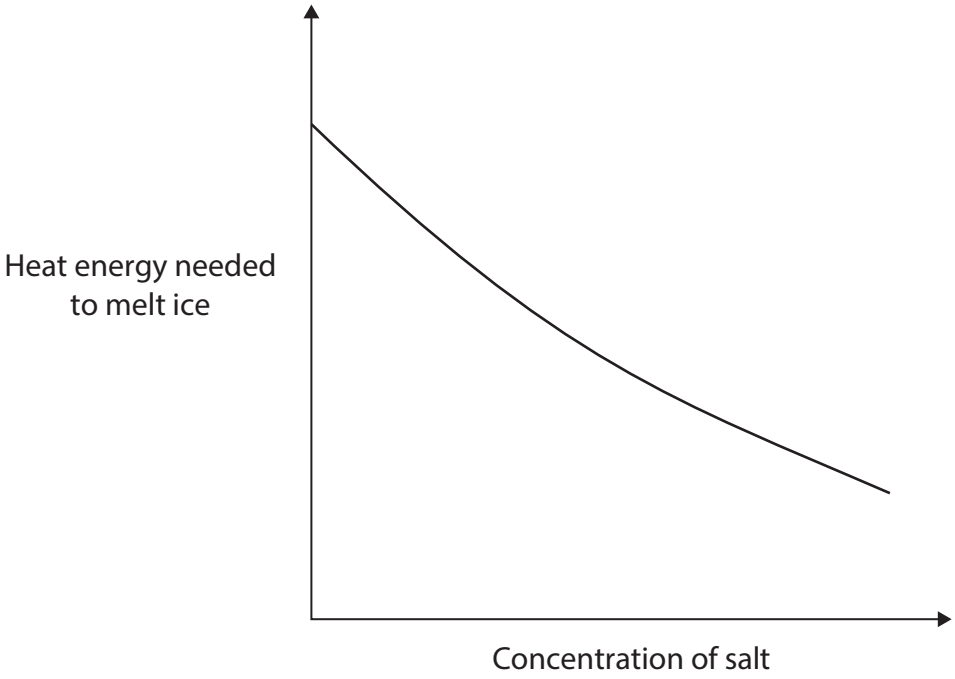
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(c) One group of scientists is trying to increase the thickness of sea ice by pumping seawater across the surface of the ice.

Seawater has more salt in it than sea ice.

One concern is that the new ice that is made from the seawater will melt more quickly than the naturally-formed ice.

The graph shows the heat energy needed to melt ice containing different concentrations of salt.



Explain why the new ice will melt more quickly than the naturally-formed ice.

(2)

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(Total for Question 3 = 9 marks)

4 Forensic methods are used to reduce the illegal wildlife trade (IWT).

Important steps in tracing IWT networks and therefore protecting wildlife include:

- identifying the species being poached and traded
- knowing the time and cause of death of the animal
- knowing where the poaching is taking place.

(a) Wild cats in India are a common target of the IWT.

Analysis of DNA from mitochondria (mtDNA) is being used to identify species of wild cats and their family relationships to build up a wild cat DNA database.

Tissue samples are taken and the mtDNA amplified using the polymerase chain reaction (PCR).

(i) Explain why **all** the cells in these tissue samples will contain mtDNA that is from the mother cat **only**.

(2)

(ii) Explain why the number of copies of mtDNA increases exponentially during PCR.

(2)

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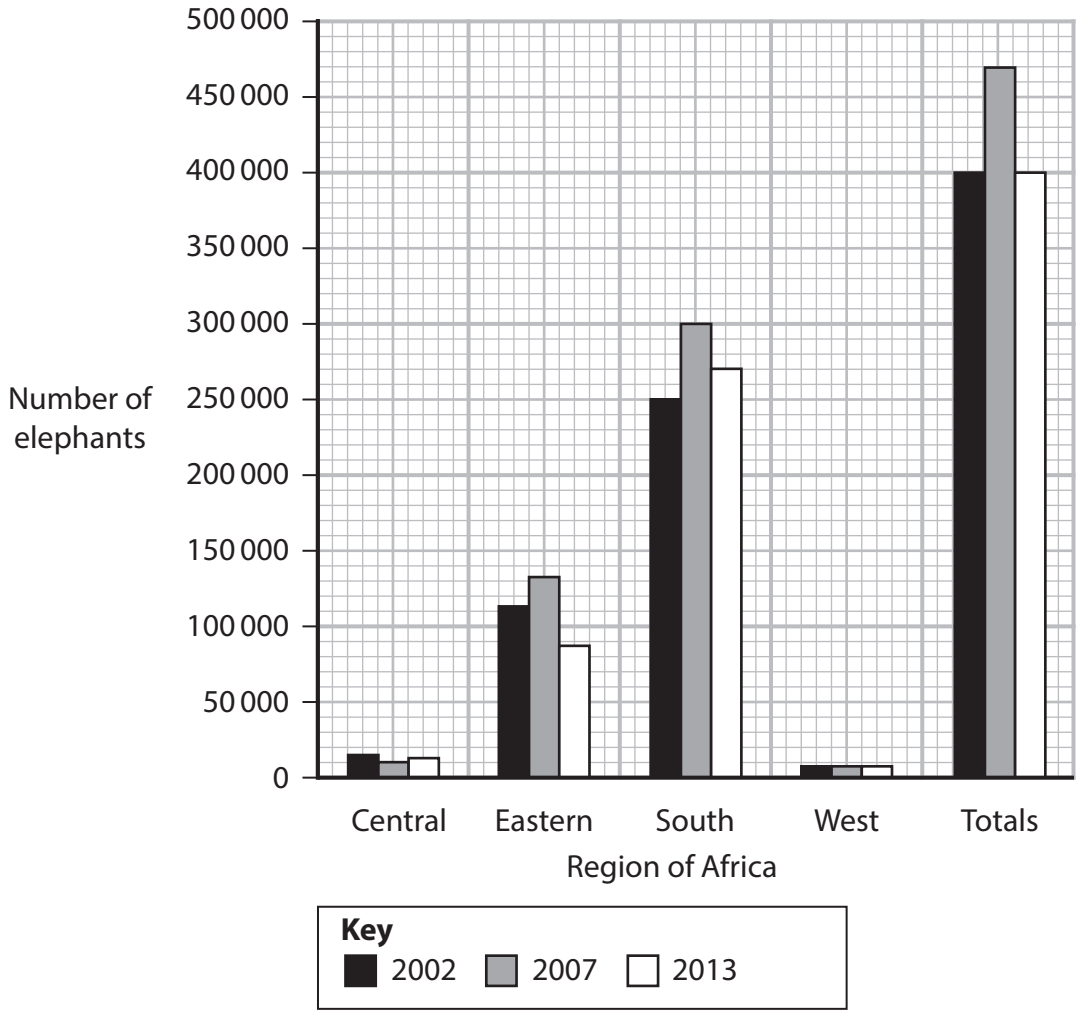
(b) Forensic entomology can be used in the investigation of suspected animal poaching.

Explain how forensic entomology can provide information about the death of an animal.

(4)

(c) Elephant tusk ivory is another target of the IWT.

(i) The graph shows the numbers of elephants in four regions of Africa in 2002, 2007 and 2013. It also shows the total numbers of elephants.



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Comment on the changes in the numbers of elephants in Africa from 2002 to 2013.

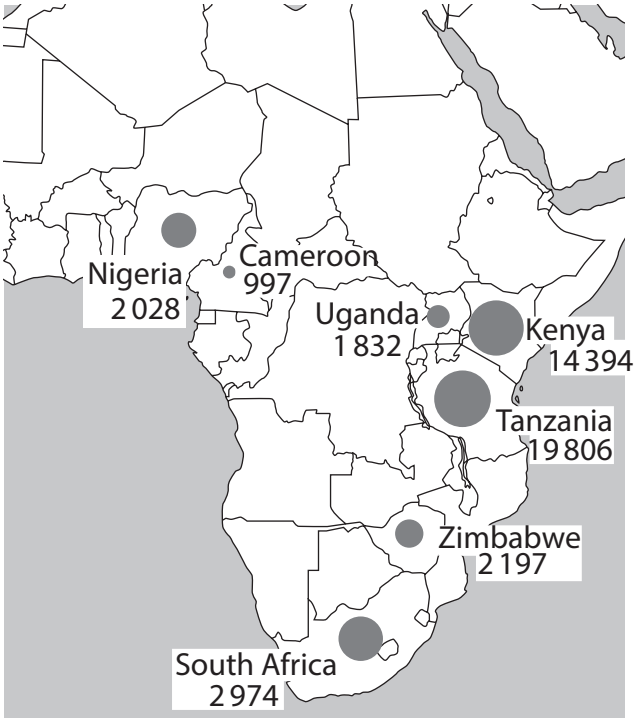
Use the information shown in this graph to support your answer.

(3)

(ii) Databases of DNA have also been established for elephants in Africa.

These databases can be used to identify the regions in Africa that the ivory was taken from.

The map shows the mass of ivory, in kg, taken from each country.



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The table shows the mass of illegal ivory found in six other countries.

Country	Mass of ivory / kg
A	10 312
B	7 961
C	6 356
D	5 595
E	4 861
F	4 006

The DNA in the illegal ivory is analysed and the database used to identify the region in Africa that this ivory was taken from.

Deduce how this information could help to reduce the poaching of elephants.

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

(3)

(Total for Question 4 = 14 marks)

5 Most fuel used by aeroplanes is kerosene. Kerosene is produced from crude oil.

Aeroplanes release a number of greenhouse gases into the atmosphere.

These greenhouse gases contribute to climate change.

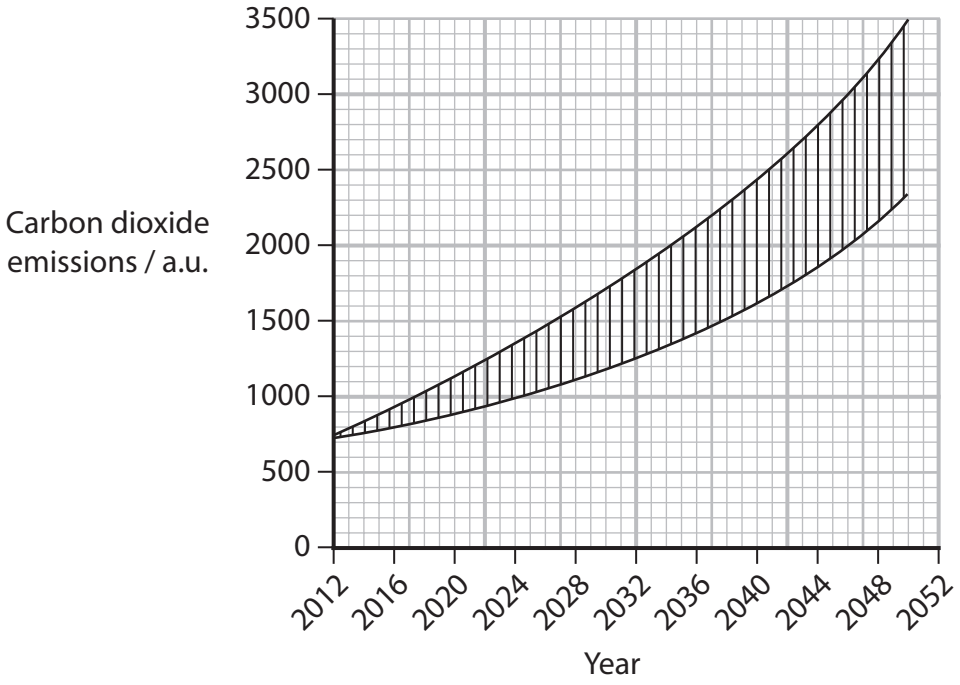
(a) Which are greenhouse gases?

(1)

- ☒ **A** methane and water vapour
- ☒ **B** methane and nitrogen
- ☒ **C** nitrogen and oxygen
- ☒ **D** oxygen and water vapour

(b) In 2012, the future range for carbon dioxide emissions from aeroplanes was predicted.

The graph shows these predictions up to 2050.



Calculate the mean rate of increase in carbon dioxide emissions between 2012 and 2050.

Give your answer as a whole number.

(2)

Answer ..... a.u. per year

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(c) Scientists are developing ways to produce biofuels from other materials such as plant oils.

Aeroplanes using these fuels will emit as much carbon dioxide as aeroplanes using kerosene.

Scientists consider that this is an 80 to 90 % reduction on fossil fuel emissions.

Explain why these fuels are sustainable and will contribute less to climate change than fuels from crude oil.

(3)

*(d) Plant material that we eat but which cannot be digested passes out of our bodies as faeces.

This organic waste can be used to make another biofuel that could be used to fuel aeroplanes.

The scientists have estimated that the waste produced by 10 000 people in one year will supply enough fuel to fly an aeroplane from London to New York.

Discuss the arguments for and against the scientists continuing to develop the production of biofuel from this waste.

(6)

(Total for Question 5 = 12 marks)

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6 Porcine circovirus (PCV) is a virus that infects pigs.

It causes a disease called post-weaning multisystemic syndrome (PWMS).

(a) The PCV is a single-stranded DNA virus that has an icosahedral capsid and no envelope.

(i) This DNA is a circular structure.

Which holds the DNA strand in a circular structure?

(1)

☒ **A** hydrogen bonds between complementary base pairs

☒ **B** hydrogen bonds between mononucleotides

☒ **C** phosphodiester bonds between complementary base pairs

☒ **D** phosphodiester bonds between mononucleotides

(ii) Which other virus has an icosahedral capsid?

(1)

☒ **A** Ebola virus

☒ **B** human immunodeficiency virus (HIV)

☒ **C** lambda phage (λ phage)

☒ **D** tobacco mosaic virus (TMV)

(iii) Which pair of viruses have **no envelope**?

(1)

☒ **A** Ebola virus and human immunodeficiency virus (HIV)

☒ **B** human immunodeficiency virus (HIV) and lambda phage (λ phage)

☒ **C** lambda phage (λ phage) and tobacco mosaic virus (TMV)

☒ **D** tobacco mosaic virus (TMV) and Ebola virus

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(b) Following infection of the host cell with PCV, replication of viral DNA and synthesis of viral proteins take place.

(i) In order for the replication of viral DNA to take place, host cell DNA polymerase is needed.

Explain why host cell DNA polymerase is needed in the replication of viral DNA.

(3)

(ii) One PCV gene, ORF1, codes for two different proteins.

Explain how **one gene** can code for two different proteins in eukaryotic cells.

(3)

*(c) Gilts are female pigs that are having their first litter of piglets.

Vaccines against PCV have been developed for gilts.

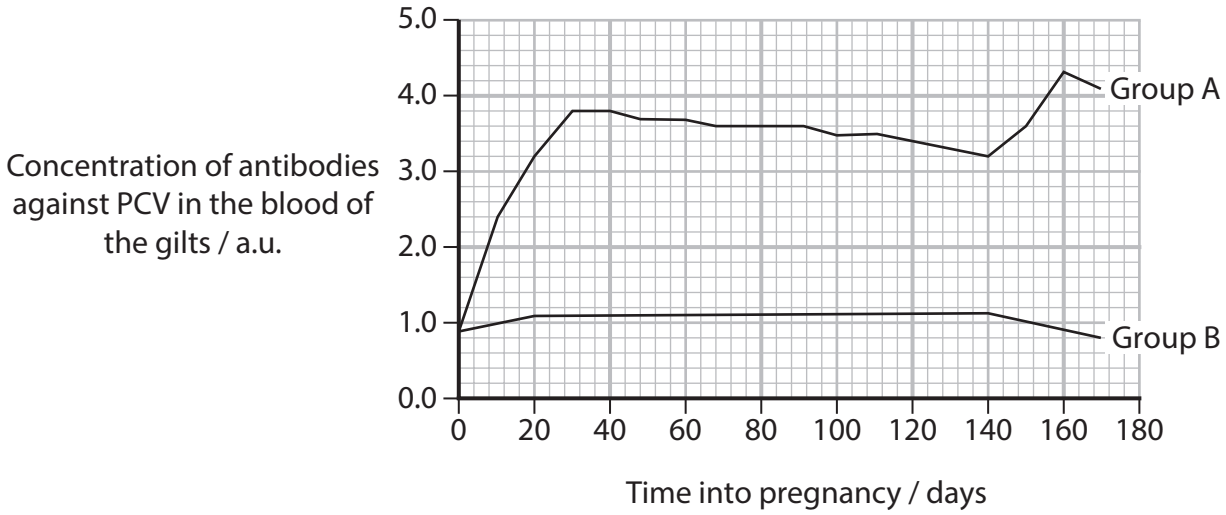
In the development of one of these vaccines, gilts were divided into two groups, group A and group B.

The gilts in group A were vaccinated at the start of their pregnancy (day 0) and again at 20 days and 140 days.

Pregnancy lasts about 160 days.

The gilts in group B were not given the vaccine.

The graph shows the concentration of antibodies against PCV in the blood of the gilts in these two groups.



The table shows the concentration of antibodies against PCV in the blood of the piglets produced by the two groups of gilts for 40 days after birth.

Number of days after birth	Concentration of antibodies against PCV in the blood of the piglets / a.u.	
	Group A piglets	Group B piglets
0	3.9	0.7
10	3.2	0.8
20	3.0	2.6
40	2.9	2.9

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Explain the results shown in the graph and the table.

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

(6)

(Total for Question 6 = 15 marks)

7 The photograph shows a bottlenose dolphin.



(Source: Anthony Pierce / Alamy Stock Photo)

Gastrointestinal (gut) inflammatory diseases cause a large number of deaths in bottlenose dolphins.

These diseases are often associated with changes in the gut flora in the dolphins.

(a) (i) Give **two** characteristics of inflammation.

(1)

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(ii) Explain how changes in gut flora can result in gut diseases.

(2)

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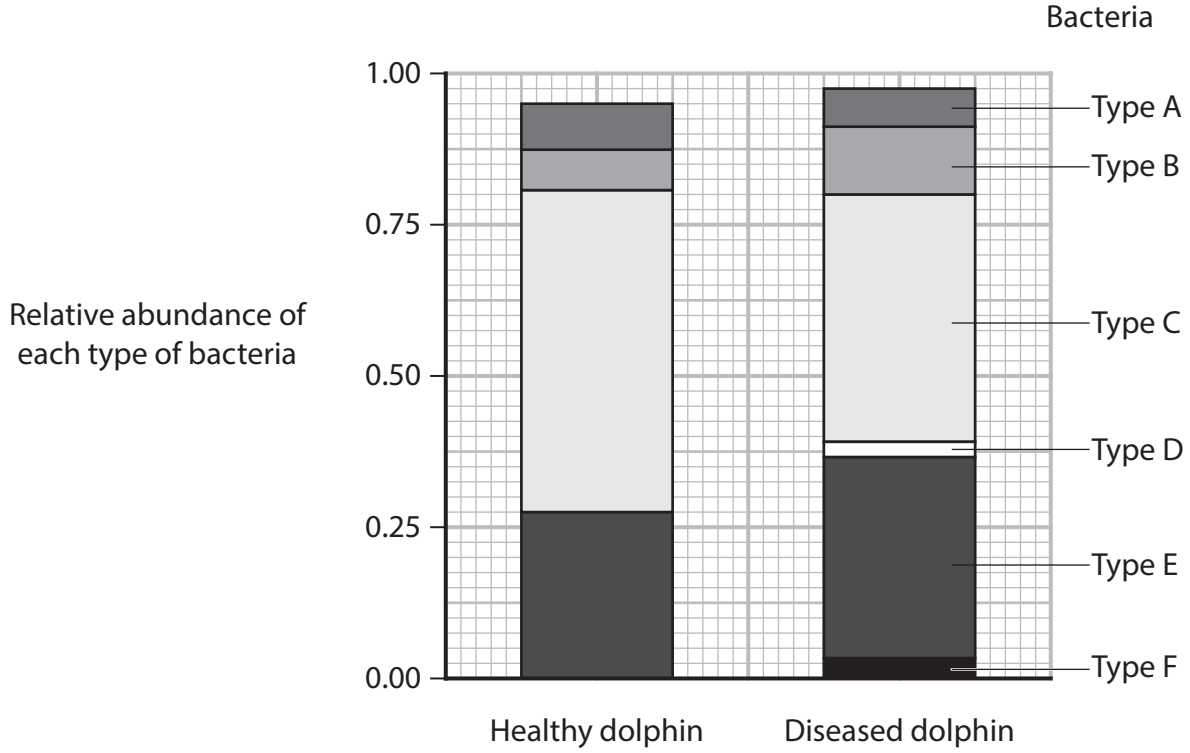
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(b) Scientists have used faecal microbiota transplants (FMTs) to treat these dolphins.

These FMTs are made from the faeces of healthy dolphins and injected into the guts of the diseased animals.

The graph shows the types of bacteria found in the gut of a healthy dolphin and in the gut of a diseased dolphin.



(i) Explain **one** risk to dolphins associated with this procedure.

(2)

(ii) Describe **three** conclusions that can be made about the bacteria found in these two dolphins.

(3)

(iii) Describe how a culturing technique could be used to obtain the data in this graph.

(3)

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(iv) The scientists actually obtained these results using DNA analysis of the bacteria found in the gut.

This method proved more effective than culturing techniques.

Suggest **two** reasons why DNA analysis was a more effective method to obtain the data shown in this graph.

(2)

(v) Treatment of dolphins with gut diseases using FMTs reduces the use of antibiotics.

Explain the importance of reducing the use of antibiotics.

(2)

(Total for Question 7 = 15 marks)

8 Microplastics (MP) are small pieces of plastic that are from 0.1 μm to 5 mm in size.

Microplastics end up in our oceans, damaging the ecosystems and wildlife worldwide.

They are the result of anthropogenic activity.

(a) State the meaning of the term **anthropogenic**.

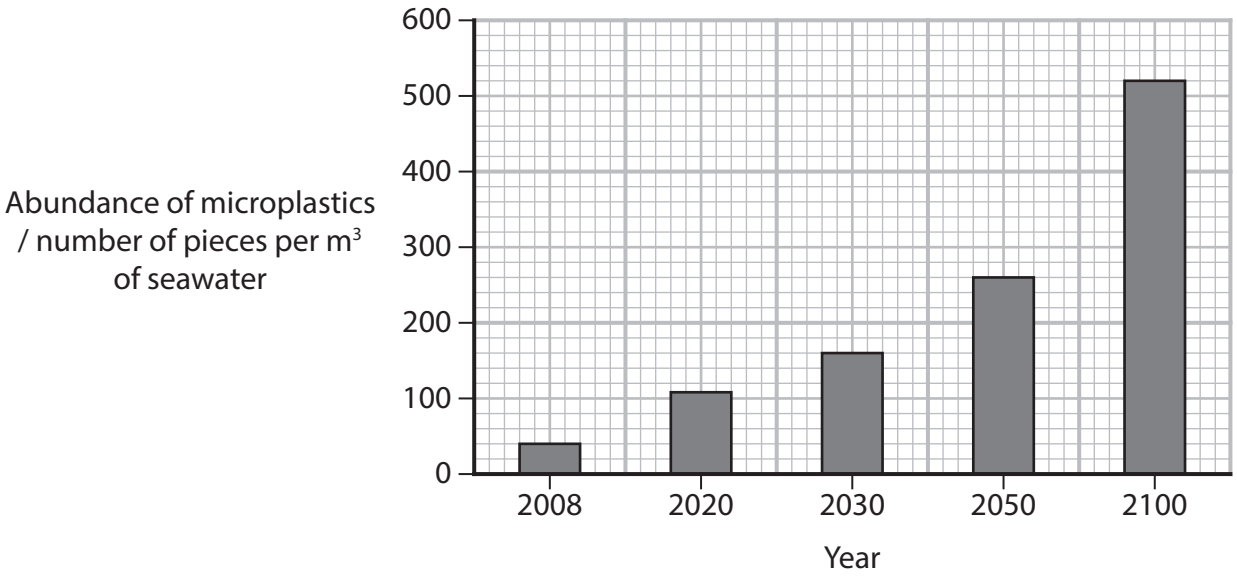
(1)

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(b) The graph shows the abundance of MP in the Eastern Tropical Pacific from 2008 to 2020 and the estimated abundance until the end of the century.



(i) Calculate the mean rate of increase in the number of pieces of MP from 2008 to 2020.

(1)

Answer ..... number of pieces per m^3 $year^{-1}$

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(ii) Determine why the presentation of the data in this graph is misleading.

(2)

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(c) Research groups have reported the presence of MP in seabirds in both the Antarctic and the Arctic regions of the world.

The table shows a summary of some of the data presented in these reports.

Region	Number of species of seabird	Number of birds sampled	Number of birds with at least one piece of MP	Mean number of pieces of MP per bird
Antarctic	43	756	733	1.1
Arctic	64	374	337	7.2

(i) Which is the ratio of the number of species of seabird in the Antarctic to the Arctic?

(1)

☒ **A** 0.67 : 1

☒ **B** 1 : 0.67

☒ **C** 1 : 2.02

☒ **D** 2.02 : 1

(ii) Which is the percentage of seabirds with at least one piece of MP in the **Antarctic**?

(1)

☒ **A** 46 %

☒ **B** 49 %

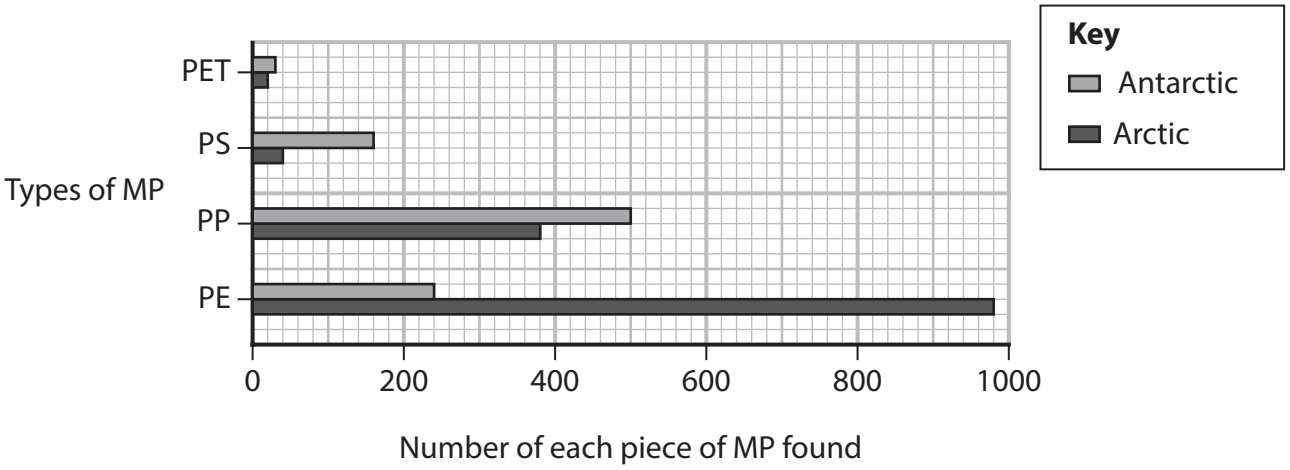
☒ **C** 57 %

☒ **D** 97 %

(iii) Explain how the median number of pieces of MP per seabird can be different to the mean number of pieces of MP.

(2)

(iv) The graph shows the types of MP found in the seabirds in the Antarctic and the Arctic.



Describe **two** conclusions that can be made about the types of MP found in the seabirds of these two regions.

(2)

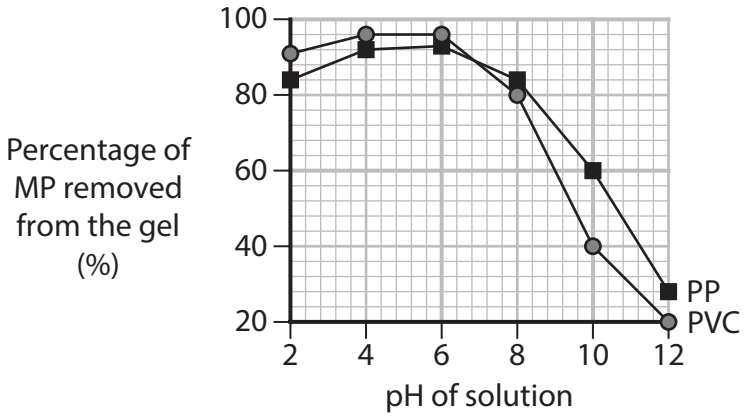
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(d) A gel has been developed that can form bonds with MP, removing the MP from the water.

The MP can then be removed from the gel by washing it in a solution with a pH different from that of the water.

(i) The graph shows the effect of pH on the removal of two types of MP, PVC and PP, from the gel.

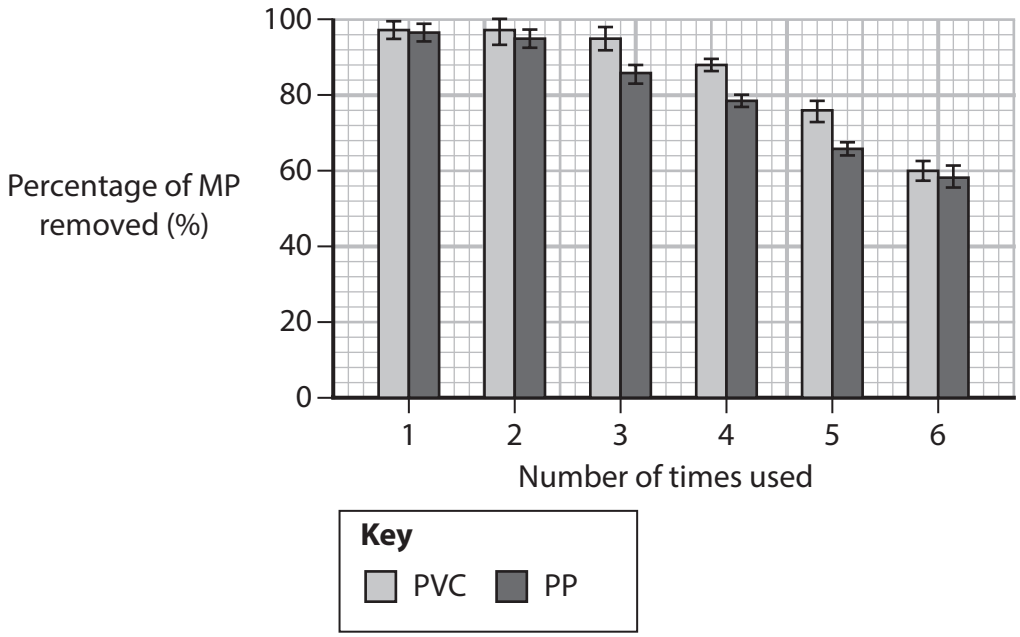


Explain the results shown in this graph.

(2)

(ii) The gel can be reused after the MP have been removed.

The graph shows the percentage of MP that can be removed each time the gel is washed and reused.



Assess the effectiveness of the gel as it is increasingly washed and reused.

(3)

(Total for Question 8 = 15 marks)

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