

1 Bacteria are found in a wide range of habitats. Some bacteria can cause harm whilst others are useful to humans.

(a) During the testing of a new anti-bacterial drug, a double blind trial may be used. Explain what is meant by a **double blind trial** and suggest why it is important.

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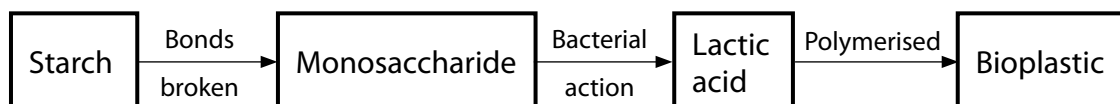
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(b) Bacteria can be used in the production of bioplastic from starch. Bioplastic is a more sustainable form of packaging than oil-based plastics. Part of the conversion process is shown below.



(i) Name the bond that is broken to convert starch into its monosaccharide building blocks.

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(ii) Name the monosaccharide formed when the bonds in starch are broken.

(1)

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(iii) Suggest why bioplastic is described as a more sustainable form of packaging than oil-based plastics.

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(iv) Bioplastic is biodegradable. Suggest **one** environmental advantage of using biodegradable packaging.

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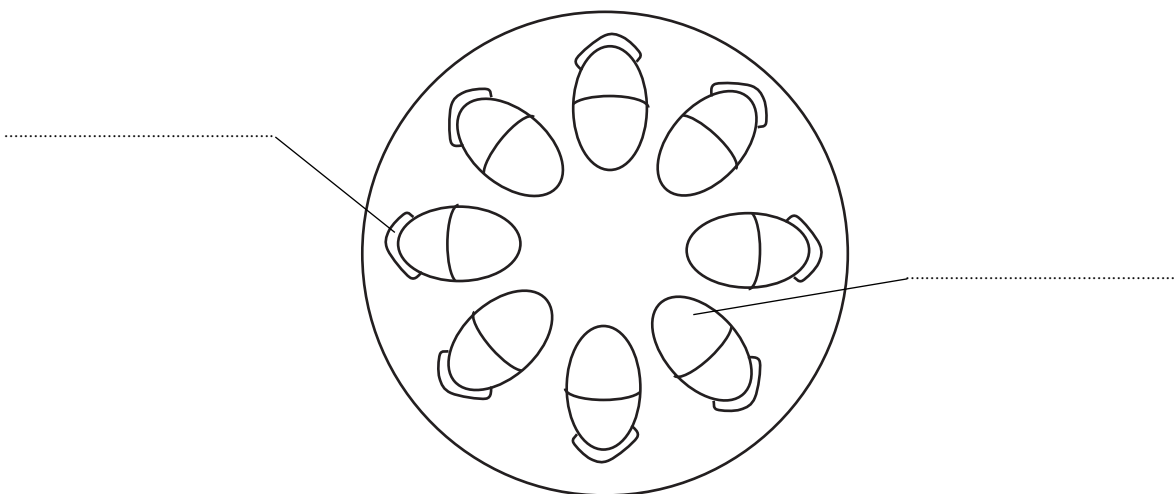
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(c) As well as starch, plants supply other useful products such as plant fibres.

The diagram below shows a transverse section of a stem. Complete the diagram by writing the correct name for each of the parts of the stem alongside the lines on the diagram.

(2)



**(Total for Question 1 = 10 marks)**

- 2 The black-footed ferret, shown in the photograph below, is one of North America's most endangered species. In 1986, only 18 individuals were living in the wild. These were used to start a captive breeding programme. Six zoos are now involved in this programme.



Black-footed ferret  
Magnification  $\times 0.1$

- \*(a) Suggest how this captive breeding programme in the six zoos ensures that genetic diversity is maintained in this species.

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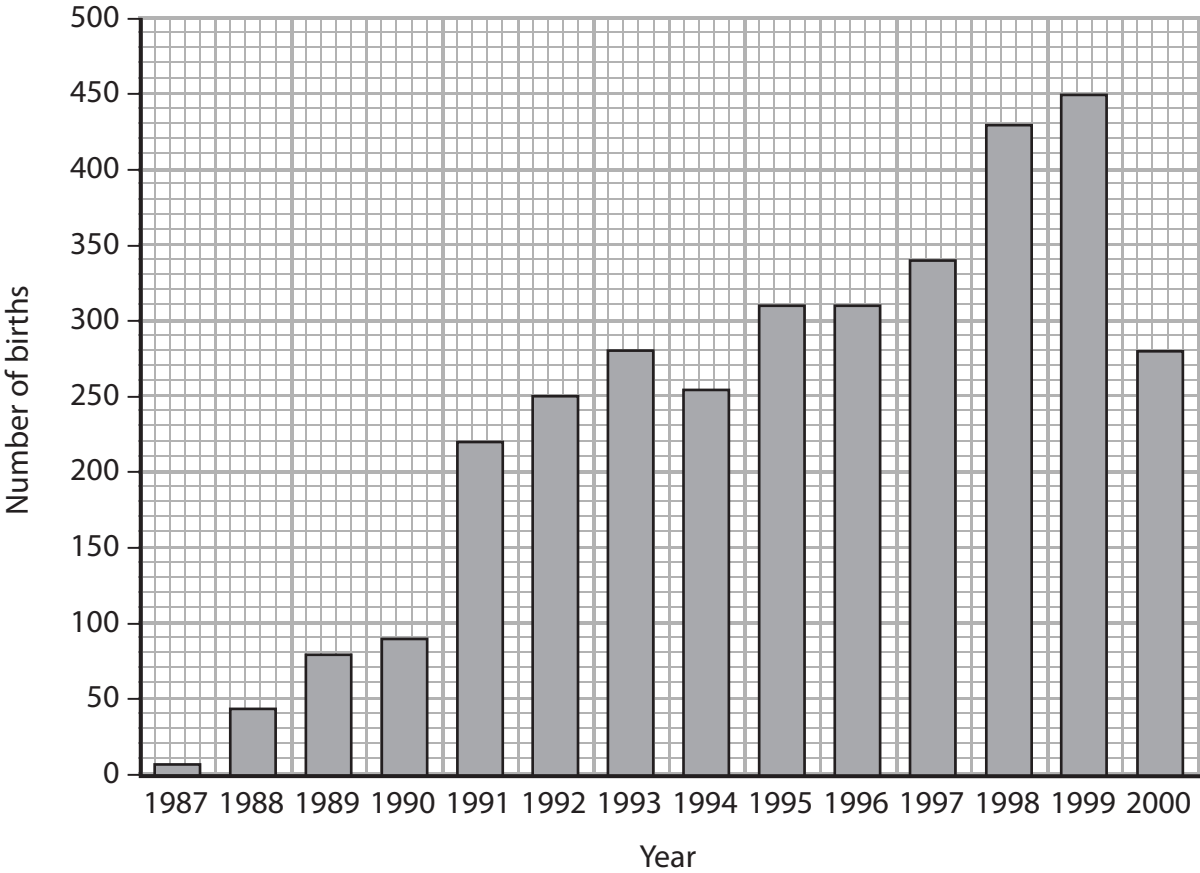
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(b) The graph below shows the number of black-footed ferrets in captivity born each year from 1987 to 2000.



(i) Each year since 1991, 200 black-footed ferrets have been released into the wild.  
Suggest why no black-footed ferrets were released into the wild before 1991.

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(ii) Using the information in the graph, suggest how effective the captive breeding programme was between 1991 and 2000.

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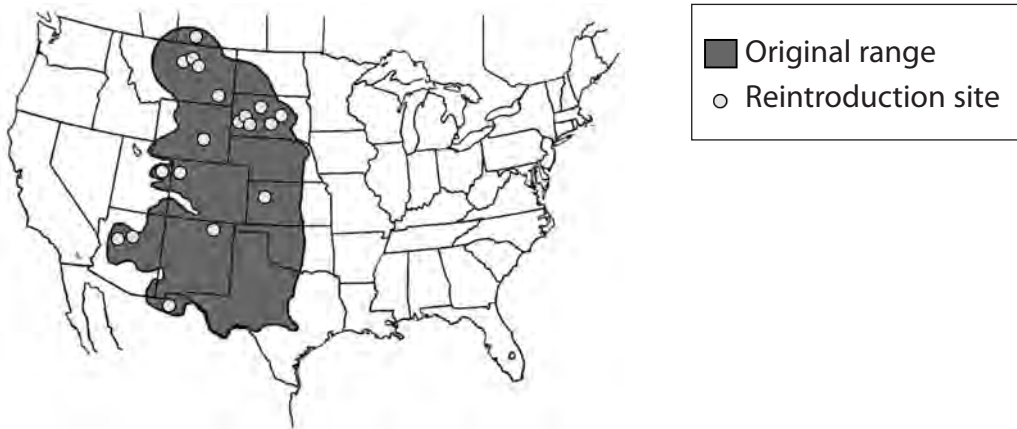
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(c) The map of the USA below shows the original range of the black-footed ferrets and the sites where they have been reintroduced. Their natural habitat is prairie, which is a type of grassland.

Only 1% of the prairie remains undisturbed by human activity.

Black-footed ferrets mainly prey on prairie dogs. Prairie dogs are treated as pests by farmers who may use poison to kill them.



Suggest **three** factors that could affect the survival chances of black-footed ferrets when they are reintroduced to the sites shown on the map.

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**(Total for Question 2 = 12 marks)**

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**3** Frogs are ectothermic animals. This means that their body temperature will vary as the environmental temperature varies.

(a) Explain why body temperature affects the rate of development of animals.

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(b) Several species of the frog genus, *Rana*, can be found in North America. Many of these species inhabit areas within a range of latitudes from the colder north to the warmer south.

The table below shows data for four of these species, *R. clamitans*, *R. palustris*, *R. pipiens* and *R. sylvatica*.

Species	Body temperature of frog / °C			
	Lower lethal, below which frog dies	Minimum to start development	Maximum to complete development	Upper lethal, above which frog dies
<i>R. clamita</i>	10.0	11.0	35.0	37.0
<i>R. palustr</i>	5.0	7.0	30.0	31.0
<i>R. pipie</i>	3.0	6.0	28.0	30.0
<i>R. sy atica</i>	0.0	2.0	24.0	25.0

Using the information, suggest why the lower and upper lethal temperatures limit the range of latitudes inhabited by each species of frog.

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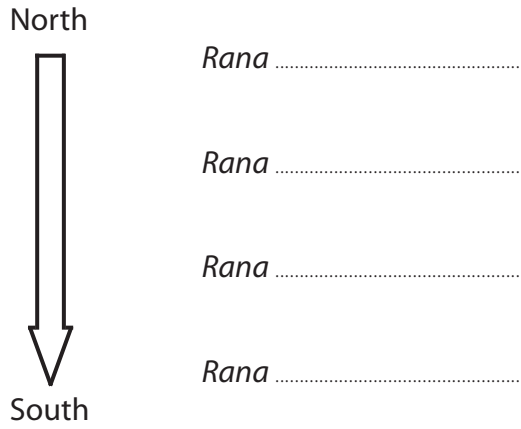
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(c) Complete the species names in the diagram below to show the most likely distribution of *Rana* from north to south.

(2)



(d) Populations of the different species overlap on the boundaries of each latitude range.

Suggest why interbreeding does not take place between these populations.

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(e) Suggest how global warming may affect the distribution of these species of *Rana* in North America.

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**(Total for Question 3 = 13 marks)**

**4** Certain herbivores, such as cows, contain bacteria in their stomachs.

These bacteria produce enzymes that can digest cellulose and other organic compounds in the plant material that the cows eat.

As a result of the bacterial activity, methane and carbon dioxide are released. These gases pass into the atmosphere as the cow burps or exhales.

(a) (i) Place a cross ☒ in the box next to the term used to describe the type of chemical reaction involved in the digestion of cellulose by enzymes.

(1)

- A** autolysis
- B** haemolysis
- C** hydrolysis
- D** photolysis

(ii) Place a cross ☒ in the box next to the most likely product of the digestion of cellulose by the bacteria.

(1)

- A** amino acids
- B** fatty acids
- C** glucose
- D** glycerol

(b) Suggest why these bacteria need to have special adaptations to live in the stomach of a cow.

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- (c) On a farm in Wales, an investigation was carried out to assess the effect of diet on the milk yield and methane production of cows.

A herd of cows was divided into two groups, A and B. The cows in group A were fed a traditional diet and those in group B were fed the same diet with a mixture of chopped hay and straw added.

The table below shows the results of this investigation.

<b>Group</b>	<b>Diet</b>	<b>Mean milk yield per cow / dm<sup>3</sup> day<sup>-1</sup></b>	<b>Methane emission for each dm<sup>3</sup> milk produced / dm<sup>3</sup></b>
A	Traditional with no added material	24.0	30.0
B	Traditional with added chopped hay and straw	27.6	24.0

- (i) Using the information in the table, calculate the rate of methane production per cow on each of the two diets.

(2)

Group A = .....

Group B = .....

