Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
International Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Wednesday 13 January 2021

Afternoon (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 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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Answer ALL questions.

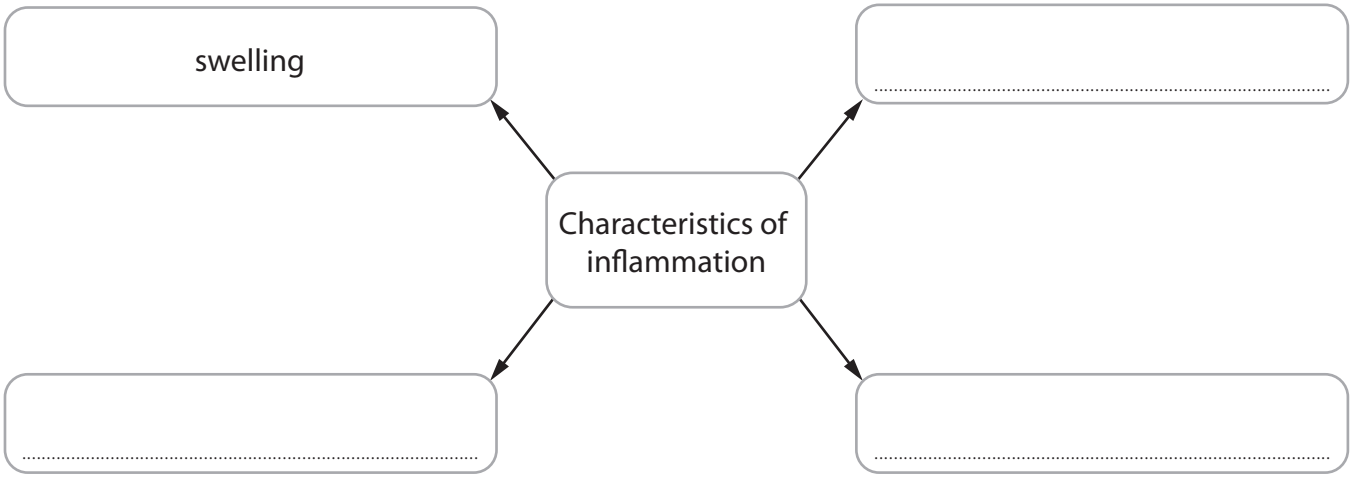
Write your answers in the spaces provided.

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 Inflammation is involved in the non-specific response of the body to infection and injury.

(a) (i) Complete the diagram to show the four characteristics of inflammation.

(2)



(ii) Inflammation occurs following a cut to the skin.

Describe the role of **two** of these characteristics of inflammation in response to a cut to the skin.

(2)

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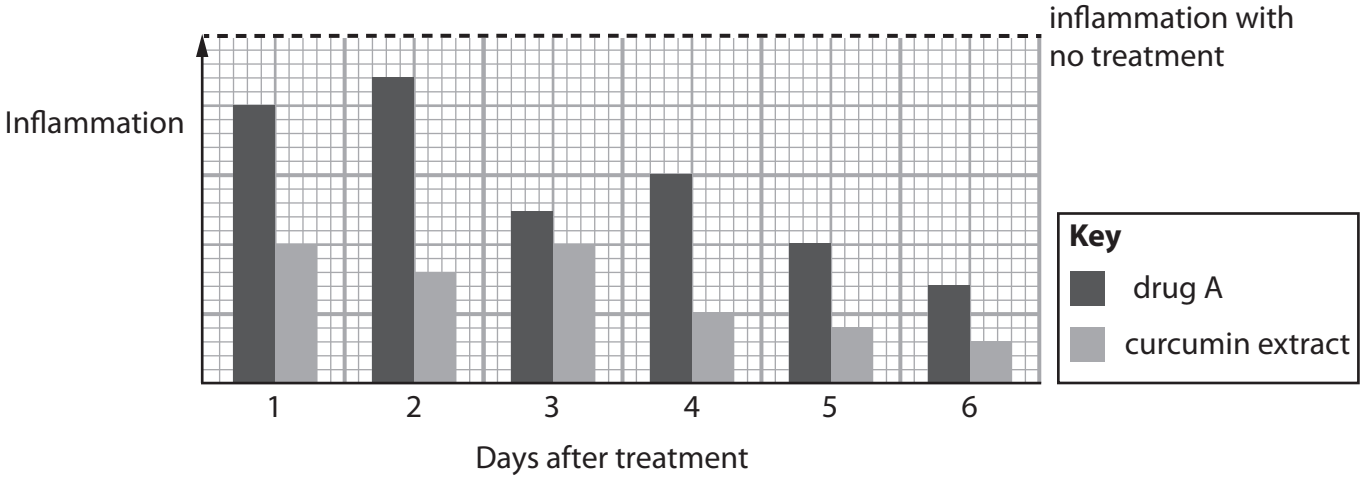
(b) Anti-inflammatory drugs reduce inflammation.

Turmeric is a spice that is added to food.

Curcumin is a chemical in turmeric that has been shown to reduce inflammation.

(i) The graph shows the effect of treating inflammation with curcumin extract and an anti-inflammatory drug, drug A.



Compare and contrast the effect of treating inflammation with curcumin extract and with drug A.

(3)

(ii) Many treatments use 1 g curcumin extract.

A sample of turmeric contains 3 % curcumin.

Which is the mass of turmeric for one treatment?

(1)

☒ **A** 0.03 g

☒ **B** 3.33 g

☒ **C** 33.3 g

☒ **D** 33.4 g

(Total for Question 1 = 8 marks)

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2 Antibiotics are medicines used to treat some medical conditions.

(a) The table shows some medical conditions and whether or not antibiotics are needed to treat the condition.

Medical condition	Are antibiotics needed to treat the condition?
Impetigo	yes
Whooping cough	yes
Middle ear infections	sometimes
Sinus infections	sometimes
Multiple sclerosis	no
Rheumatoid arthritis	no

Explain the use of antibiotics to treat these conditions.

(2)

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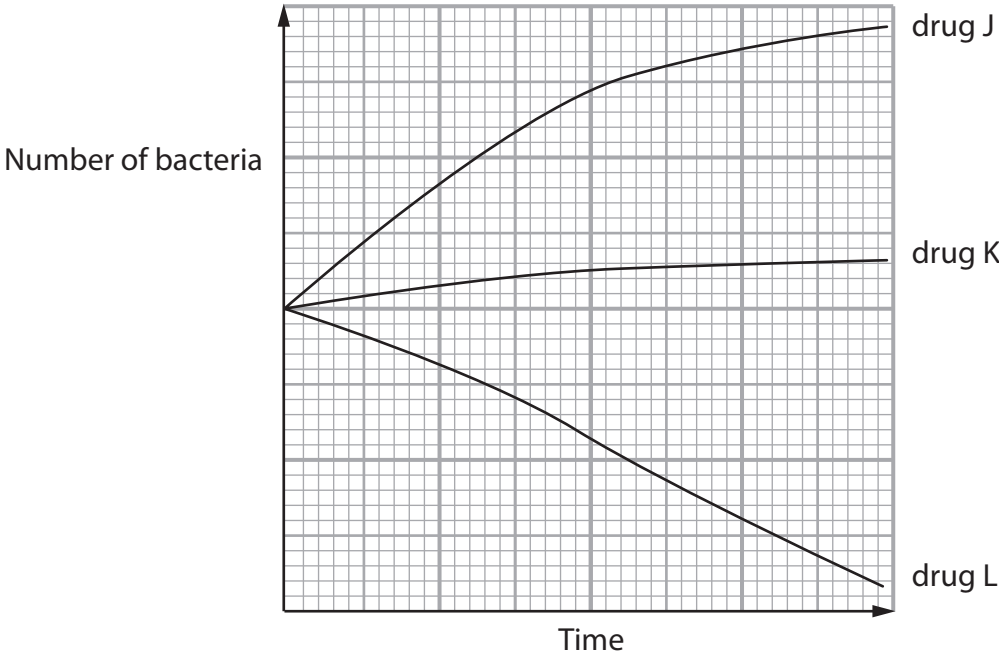
(b) The graph shows the effect of three drugs, J, K and L, on the number of bacteria in a culture.



Which row of the table describes each of these three drugs?

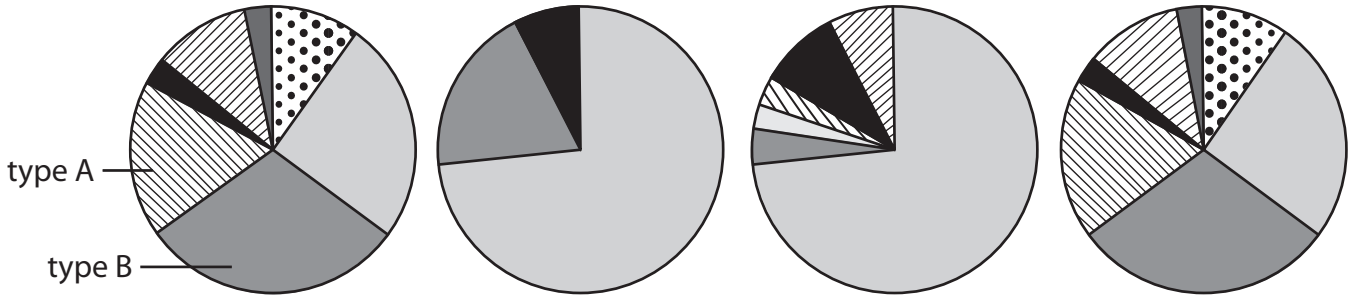
(1)

		drug J	drug K	drug L
☒	**A**	not an antibiotic	bactericidal antibiotic	bacteriostatic antibiotic
☒	**B**	not an antibiotic	bacteriostatic antibiotic	bactericidal antibiotic
☒	**C**	bactericidal antibiotic	not an antibiotic	bacteriostatic antibiotic
☒	**D**	bacteriostatic antibiotic	not an antibiotic	bactericidal antibiotic

(c) One problem of taking antibiotics is their effect on gut flora.

The diagrams show the effects of three antibiotics, P, Q and R, on the proportion of different types of gut flora.

Each section in each of the diagrams represents a different type of gut flora.



(i) Explain the role of gut flora in protecting the body from infection.

(2)

(ii) Explain why antibiotics can affect gut flora.

(2)

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(iii) The number of type A in gut flora in the absence of antibiotics is 6 000 000.

Estimate the number of type B in gut flora in the absence of antibiotics.

Give your answer in standard form.

(1)

Answer .....

(iv) Deduce the effects of antibiotics P, Q and R on gut flora.

(3)

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(Total for Question 2 = 11 marks)

3 In 2018, an organisation carried out a global survey into the attitudes of people towards vaccines.

Vaccines provide artificial active immunity.

(a) Describe how a vaccine results in active immunity.

(4)

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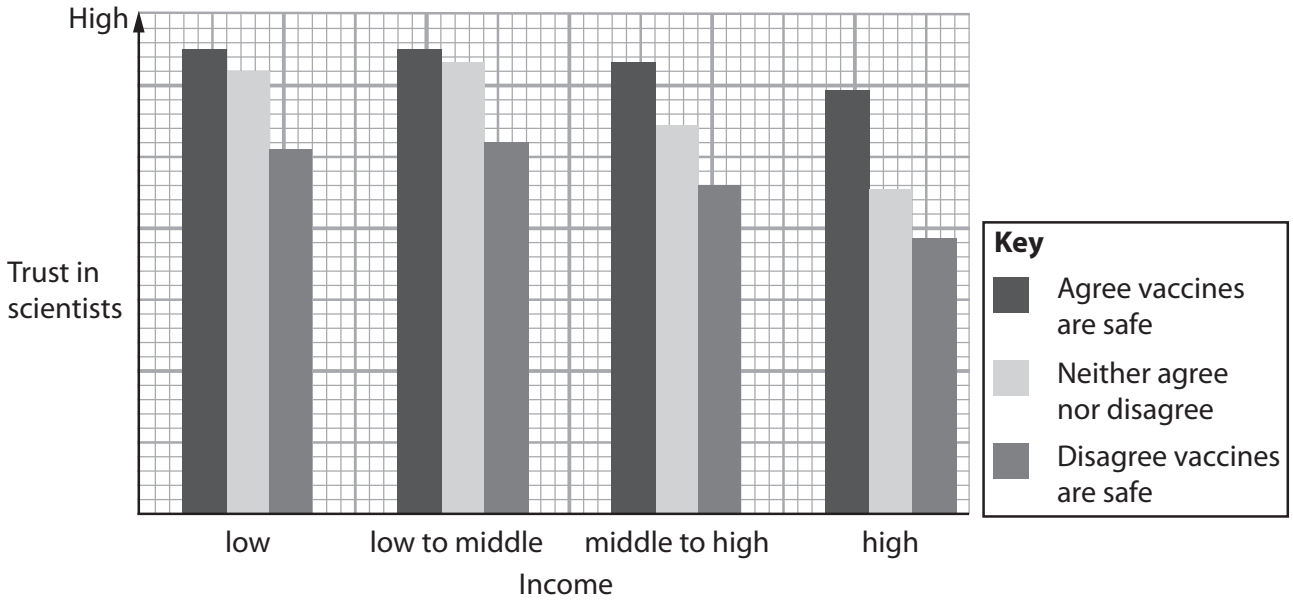
(b) This survey included three aspects:

- the trust that people have in scientists
- their thoughts on the safety of vaccines
- their income.

The graph shows some of the results of this survey.



(i) Identify **three** conclusions that can be drawn from the results of this survey.

(3)

(ii) Suggest **one** reason for the different attitudes of these people.

(1)

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(c) The more people in a population who are vaccinated against a disease, the less likely it is for non-vaccinated people to become infected.

Suggest why vaccination is more successful when a greater proportion of people are vaccinated.

(2)

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(Total for Question 3 = 10 marks)

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4 Greenhouse gases are involved in anthropogenic climate change.

(a) (i) Which of the following are greenhouse gases?

(1)

☒ **A** carbon dioxide and oxygen

☒ **B** methane and water vapour

☒ **C** carbon dioxide, oxygen and water vapour

☒ **D** methane, carbon dioxide and oxygen

(ii) State what is meant by **anthropogenic climate change**.

(2)

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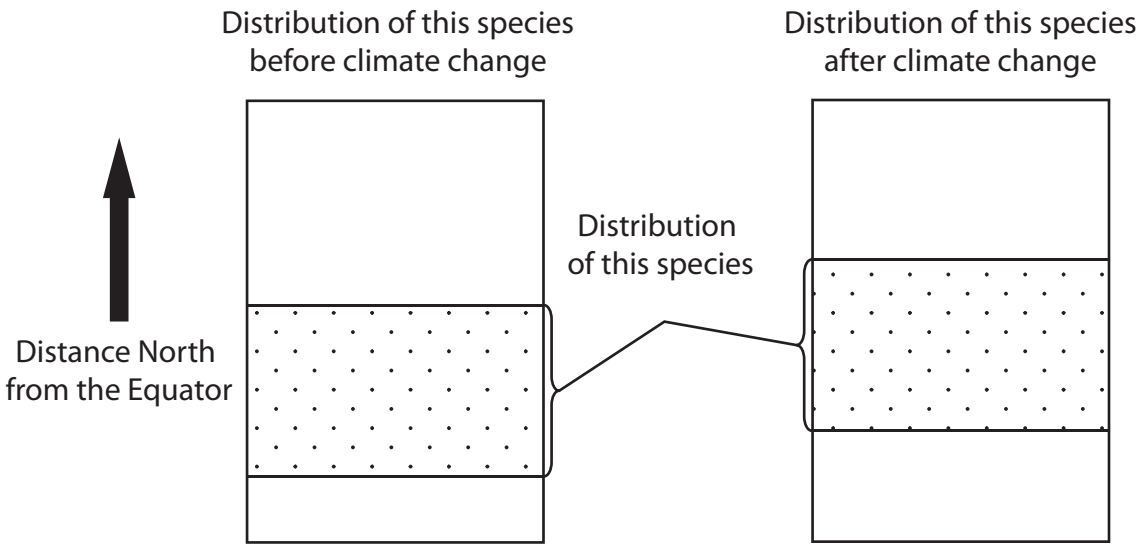
(b) The distribution of species has been affected by climate change.

The diagrams show how the distribution of one species, in a country in the Northern Hemisphere, could change as a result of climate change.



Explain the changes in the distribution of this species in this country.

(3)

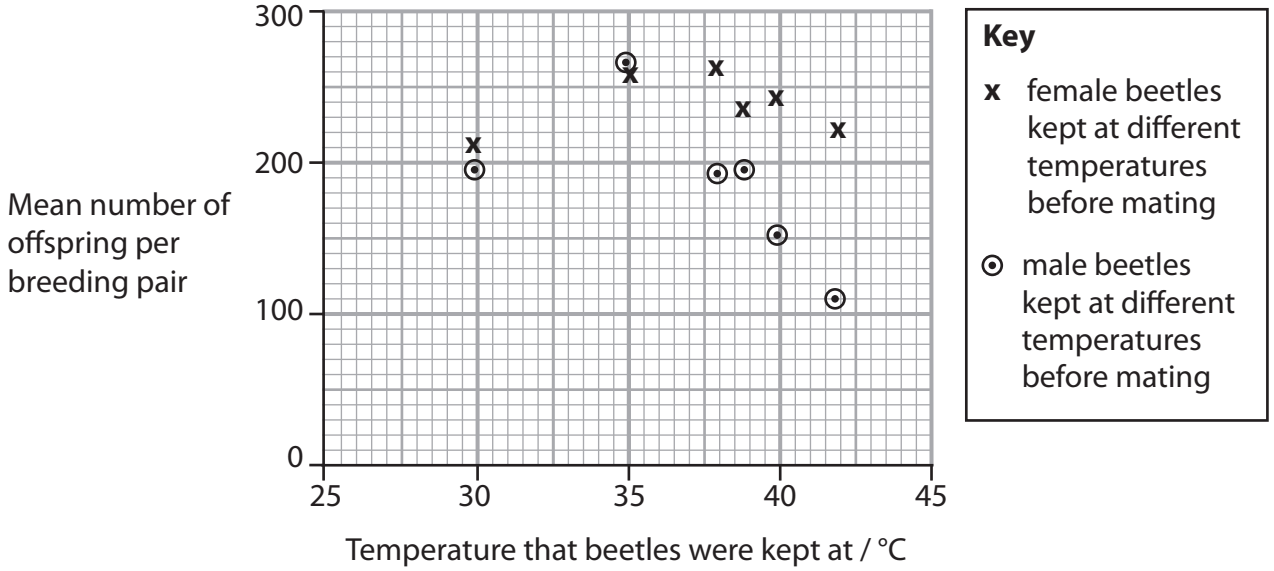
(c) The effect of temperature on reproduction in a species of beetle was studied.

Groups of male and groups of female beetles were each kept at different temperatures for five days.

The beetles were then mated with beetles, of the opposite sex, that had been kept at 30°C for five days.

The mean number of offspring per breeding pair was then determined.

The graph shows the results of this study.



(i) Identify **two** conclusions that can be drawn from this study.

(2)

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(ii) Explain the differences in the results obtained for the male and female beetles kept at different temperatures.

(3)

(Total for Question 4 = 11 marks)

5 Photosynthesis consists of the light-dependent reactions and the light-independent reactions.

(a) In the light-dependent reactions, light energy is converted into energy stored in ATP.

(i) Explain why light energy is converted into energy stored in ATP.

(2)

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(ii) An equation can summarise the production and breakdown of ATP.

Complete this equation, by writing the names of the substrates and the type of reaction on the three dotted lines provided.

(2)

..... + ... ⇌ **ATP**

.....

phosphorylation

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(iii) Explain the role of light energy in the light-dependent reactions.

(3)

(b) The light-independent reactions use products of the light-dependent reactions to produce simple sugars.

(i) Which row of the table shows the products of the light-dependent reactions that are used in the light-independent reactions?

(1)

	ATP produced by	NADP
☒ **A**	cyclic photophosphorylation	oxidised
☒ **B**	cyclic photophosphorylation	reduced
☒ **C**	non-cyclic photophosphorylation	oxidised
☒ **D**	non-cyclic photophosphorylation	reduced

(ii) Simple sugars have the formula $C_nH_{2n}O_n$.

Name the inorganic molecule from which each element in a simple sugar originated.

(2)

C .....

H .....

O .....

(iii) Simple sugars are used in the synthesis of new biological molecules.

Which row of the table shows the inorganic ions that are needed to synthesise these new biological molecules?

(3)

New biological molecule	Nitrates	Phosphates	Both nitrates and phosphates	Neither nitrates nor phosphates
protein	☒	☒	☒	☒
RNA	☒	☒	☒	☒
triglyceride	☒	☒	☒	☒

(Total for Question 5 = 13 marks)

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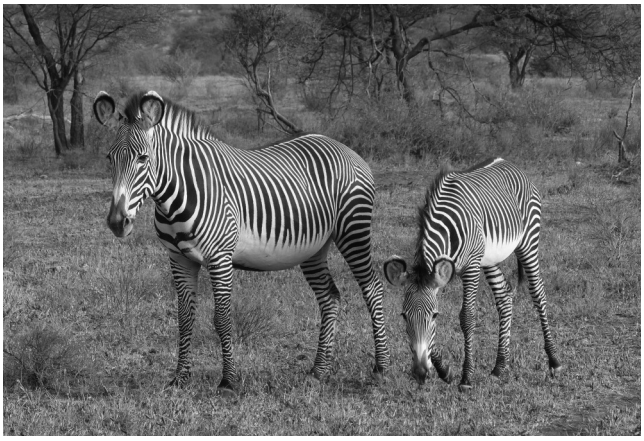
6 The photograph shows two zebras.



(Source: Caroline Wilcox)

The stripes of zebras are thought to reduce attack by biting flies.

Biting flies cause stress and disease to cattle, reducing food production and causing financial losses for farmers.

(a) Farmers use chemicals to kill the flies.

Flies often evolve resistance to a new chemical within about 10 years.

(i) Explain how flies evolve resistance to new chemicals.

(3)

(ii) Suggest why the evolution of resistance to these chemicals occurs so quickly in flies.

(1)

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*(b) An investigation was carried out to see if the presence of stripes on cattle reduced the number of biting flies on their bodies.

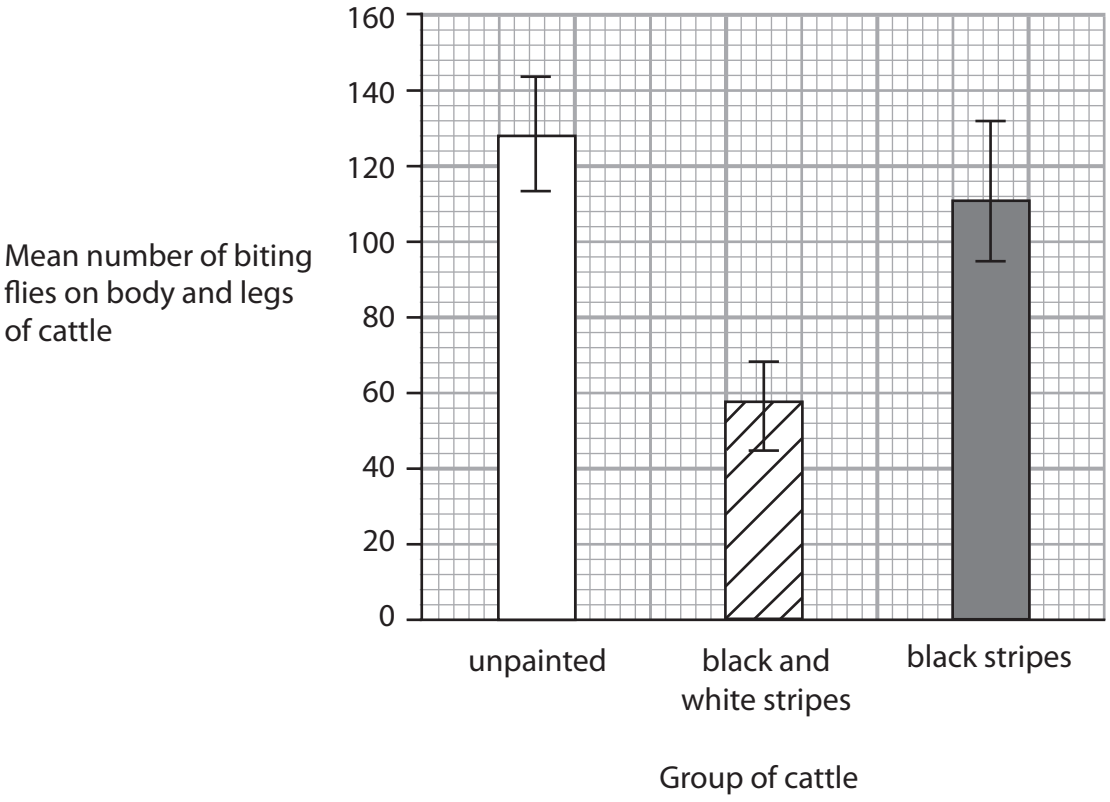
Three groups of black cattle were compared:

- unpainted cattle
- cattle painted with black and white stripes
- cattle painted with black stripes only.

Cattle repel flies by flicking their tails, stamping their feet and skin twitching.

The frequencies of these fly-repelling behaviours were recorded.

The graph and tables show some of the results of this investigation.



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Group of cattle	Number of flies on the body	Number of flies on the legs
unpainted	662	1309
black and white stripes	231	710
black stripes	677	1030

Table 1

Group of cattle	Mean frequencies of fly-repelling behaviours / number per hour		
	Flicking their tails	Stamping their feet	Skin twitching
unpainted	54	16	5
black and white stripes	42	10	8
black stripes	55	16	5

Table 2

Determine the effectiveness of painting stripes on cattle in reducing the number of biting flies on them.

Use the information in the graph and both tables to support your answer.

(6)

(Total for Question 6 = 10 marks)

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7 Gel electrophoresis is used to separate DNA fragments of different lengths.

The rate at which the DNA fragments move through the gel depends on several factors including:

- molecular size of the DNA fragment
- shape of the DNA fragment
- concentration of the gel.

(a) (i) Which enzyme is used to cut the DNA into fragments?

(1)

☒ **A** DNA polymerase

☒ **B** integrase

☒ **C** restriction enzyme

☒ **D** reverse transcriptase

(ii) Explain why the use of an enzyme to cut the DNA results in fragments, of different lengths, that can be separated by gel electrophoresis.

(3)

(b) Fragments of double-stranded DNA move through the gel at a relative rate (M_r) that is inversely proportional to the log of their molecular weight (MW).

(i) Complete the table using the equation:

$$M_r = \frac{1}{\log_{10} MW}$$

(2)

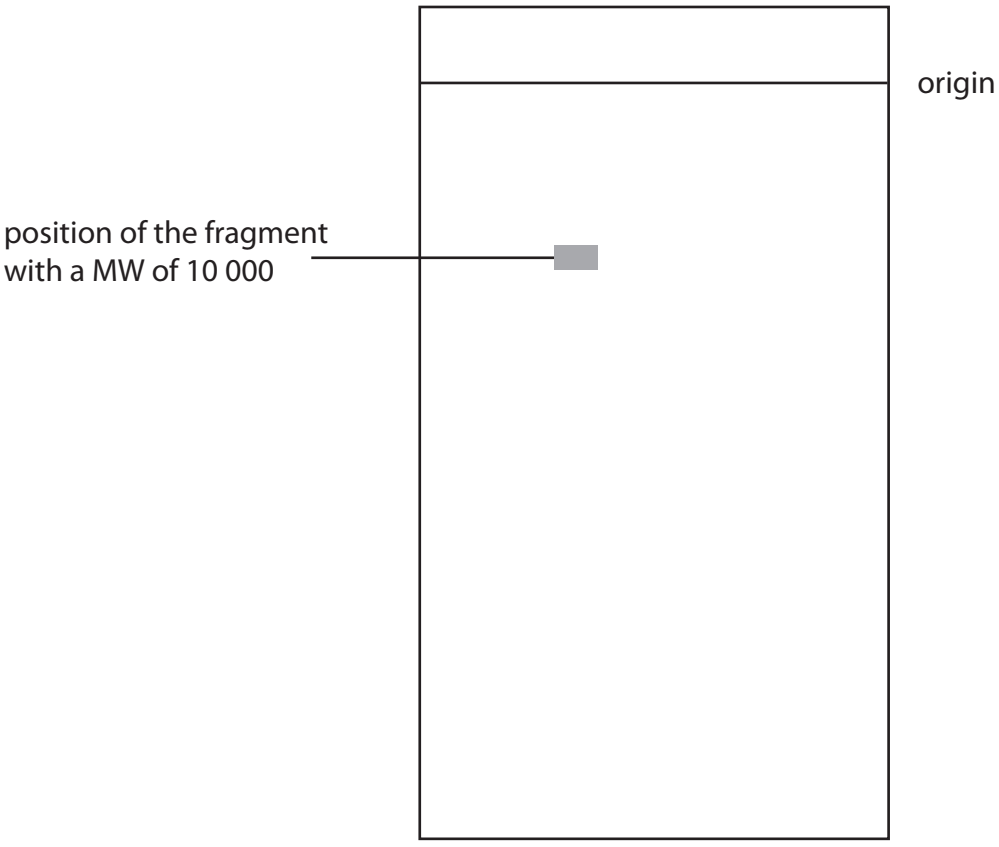
Molecular weight of DNA fragment (MW)	Relative rate of movement (M_r)
100 000	
10 000	0.25
	0.34

(ii) The diagram shows the position of a DNA fragment with a MW of 10 000, after gel electrophoresis.

Complete the diagram to show the position of a DNA fragment with a MW of 100 000.

Use the information in the question.

(1)



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(c) The fragments move more slowly through a higher concentration of gel.

Suggest why the fragments move more slowly through a higher concentration of gel.

(1)

(d) Circular DNA moves at a faster rate through the gel than linear DNA.

(i) Give **two** examples of circular DNA found in cells.

(2)

(ii) Give **two** differences between the structure of circular DNA and that of linear DNA, other than their shapes.

(2)

(Total for Question 7 = 12 marks)

8 Quince are fruit that grow on trees.

When a quince falls from the tree, two processes take place: browning and decomposition.

(a) Browning takes place when the fruit is cut and exposed to the air. The browning is catalysed by the enzyme polyphenol oxidase (PPO).

The photographs show browning in a quince cut in half.

Freshly-cut quince showing some browning



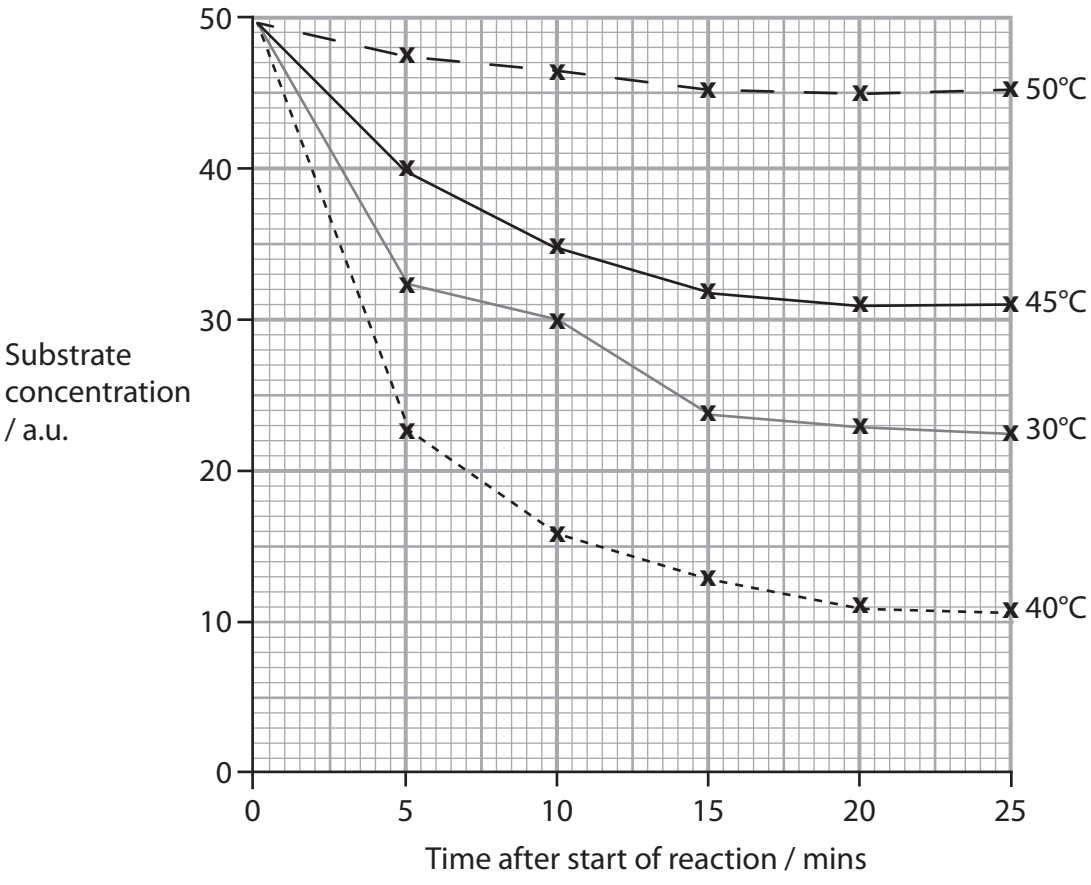
Cut quince exposed to the air showing extensive browning



(Source: John Adds)

Activity of the enzyme PPO at different temperatures was investigated.

The graph shows the results of this investigation.



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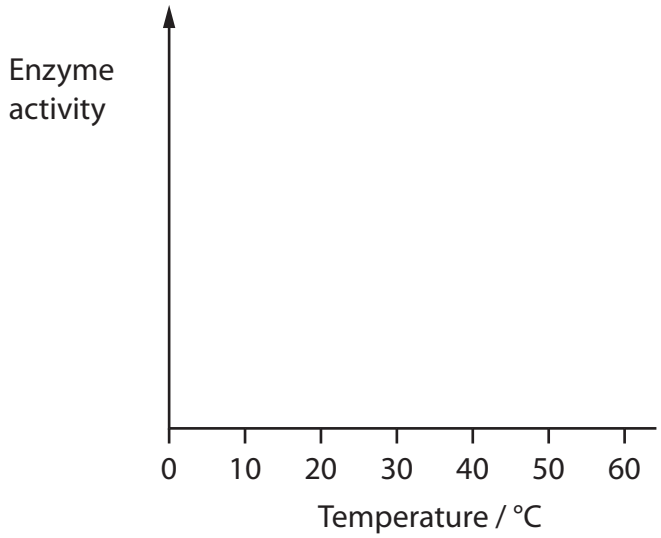
(i) Sketch the graph for enzyme activity plotted against temperature for this enzyme.

Use the data from this investigation.

(2)



(ii) Calculate the Q_{10} for this enzyme, using the data from this investigation, shown in the first graph.

Use the formula

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

where R_t is the initial rate of reaction at t °C

and R_{t+10} is the initial rate of reaction at t + 10 °C.

(4)

Answer .....

(b) A quince fruit is made up of cells and contains a lot of juice.

The table shows the composition of carbohydrates in the juice of one species of quince.

Type of carbohydrate	Name of carbohydrate	Concentration of carbohydrate / mg per 100 cm^3 juice
monosaccharide	fructose	817.2
	glucose	308.3
	inositol	8.3
	rhamnose	12.4
	sorbitol	121.1
	xylose	94.0
disaccharide	sucrose	57.0
trisaccharide	raffinose	8.3
tetrasaccharide	stachyose	9.5

(i) Complete the table to show the ratio of the concentrations of the four types of carbohydrate.

(2)

Type of carbohydrate	Ratio
monosaccharide	
disaccharide	
trisaccharide	
tetrasaccharide	

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(ii) Which row of the table shows the carbohydrates with the median concentration and modal concentration in quince juice?

(1)

	Median	Mode
☒ **A**	raffinose	fructose
☒ **B**	raffinose	sucrose
☒ **C**	sucrose	fructose
☒ **D**	sucrose	raffinose

***(iii)** Explain the role of decomposition in returning the carbon present in the carbohydrates in the quince fruit back into the atmosphere.

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

(6)

(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 90 MARKS

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