

1 Ascorbic acid (vitamin C) is named from the Latin word for scurvy, *scorbutus*.

Scurvy is caused by vitamin C deficiency and used to be a serious concern for sailors. These sailors had no access to fresh fruit and vegetables during long sea voyages.

Sauerkraut (fermented cabbage) contains vitamin C. Ships stored sauerkraut because it does not decompose easily.

Vitamin C is water soluble and is found in cabbage cells. These cells also contain an enzyme, ascorbic acid oxidase, that can oxidise vitamin C.

The table below shows the vitamin C content of sauerkraut and cabbage, treated in different ways.

Food	Treatment	Vitamin C content / mg per 100 g
Sauerkraut	freshly made	41.4
Sauerkraut	stored for 3 months	10.2
Cabbage	raw	32.2
Cabbage	added to cold water and then boiled for 5 minutes	7.6
Cabbage	added to boiling water and boiled for 5 minutes	14.3
Cabbage	stored for 3 months	not possible to measure

(a) Using the information in the table, calculate the percentage loss of vitamin C when raw cabbage was added to cold water and then boiled for 5 minutes.

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(b) Describe an experimental technique for measuring the vitamin C content of raw cabbage.

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(c) (i) Suggest why the vitamin C content is reduced by boiling cabbage in water.

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(ii) Suggest why less vitamin C is lost when the cabbage is added to boiling water rather than cold water before being boiled for 5 minutes.

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(d) Suggest why sauerkraut was more useful than cabbage on a long sea voyage.

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(Total for Question 1 = 10 marks)

- 2 An experiment was carried out to investigate the effect of temperature on the activity of the enzyme RUBISCO. This enzyme is involved in the light-independent reaction of photosynthesis.

The RUBISCO was isolated from cotton plants and its activity measured.

The results of this experiment are shown in the table below.

Temperature / °C	Activity of RUBISCO / arbitrary units
25	2.3
30	3.2
35	4.2
40	5.0
45	4.4
50	1.7

- (a) Using the information in the table, explain the effects of temperatures above 40 °C on the activity of RUBISCO.

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(b) Name the **two** substrates that would have been used in this experiment.

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(c) Place a cross ☒ in the box to complete the following sentences.

(i) The pH was kept constant to make the experiment

(1)

A accurate

B precise

C reliable

D valid

(ii) The optimum temperature of RUBISCO can be determined by

(1)

A measuring the activity at 1°C intervals between 35°C and 40°C

B measuring the activity at 1°C intervals between 40°C and 45°C

C measuring the activity at 1°C intervals between 35°C and 45°C

D repeating the experiment at 35°C, 40°C and 45°C three more times

(Total for Question 2 = 8 marks)

3 Lysozyme is an enzyme found in tears. Lysozyme can destroy some bacteria by breaking down the polysaccharide chains that form part of their cell walls.

(a) The primary structure of lysozyme is a specific sequence of 129 amino acids.

Two of the amino acids that make up the active site are in positions 35 and 52 in the primary structure.

Suggest how these two amino acids could be brought closer together to form part of the active site of this enzyme.

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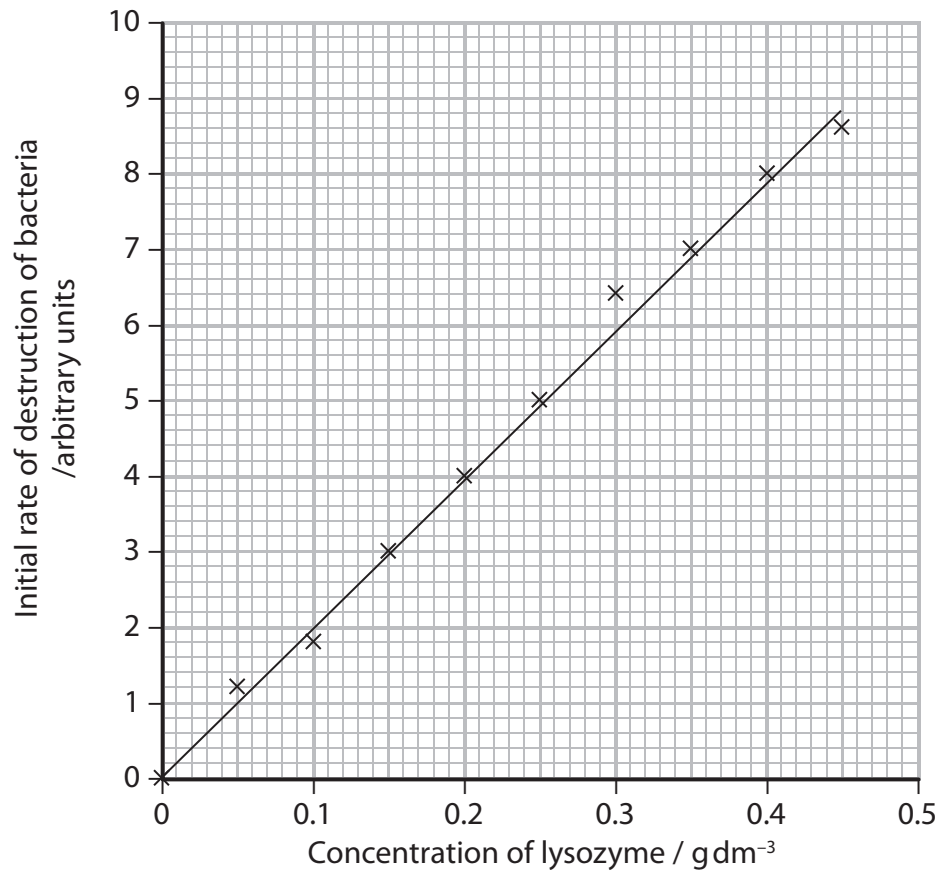
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(b) The graph below shows the effect of increasing the concentration of lysozyme on the initial rate of destruction of bacteria.



(i) Using the information in the graph, explain the effect of the concentration of lysozyme on the initial rate of destruction of bacteria.

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(ii) Suggest why some of the data points in the graph do not fit on a straight line.

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(c) Temperature affects the activity of lysozyme.

Suggest why increasing the temperature above 45 °C causes a decrease in the activity of lysozyme.

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(Total for Question 3 = 9 marks)

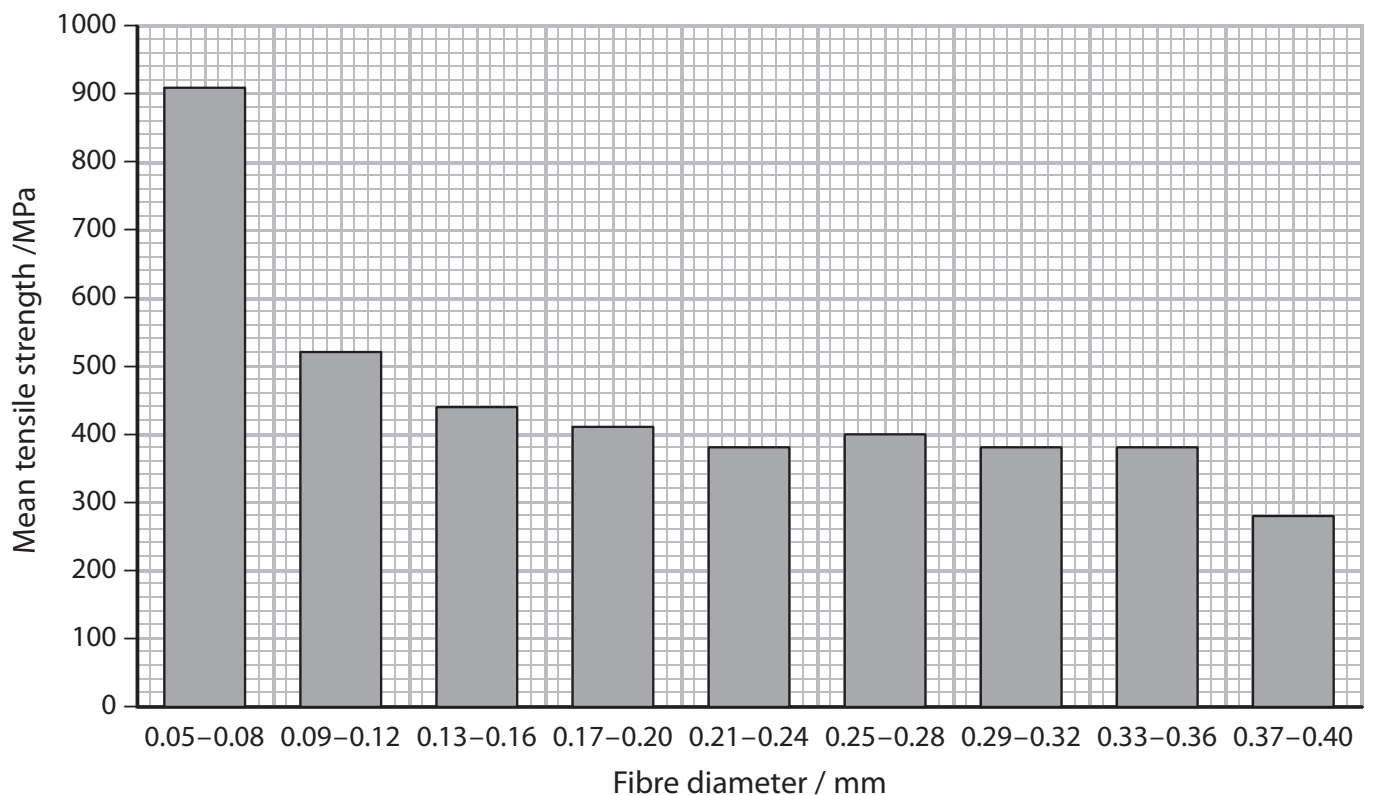
- 4 The photograph below shows a sisal plant. Fibres from its leaves are used to make rope.



Magnification $\times 0.02$

Tensile strength is the force required to break a fibre when it is placed under stress. The units used to measure this force are megapascals (MPa).

The graph below shows the mean tensile strength of sisal fibres of different diameters.



(a) (i) Using information in the graph, describe the relationship between the diameter and the mean tensile strength of the fibres.

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(ii) Suggest which variables should be controlled when investigating the tensile strength of fibres of different diameters.

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(b) Suggest **two** advantages of making rope from a sustainable resource, such as sisal, instead of oil-based plastics.

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(c) The fibres used from sisal are mainly sclerenchyma tissue. The photograph below shows a group of sclerenchyma fibres labelled S.



Magnification $\times 100$

Using information in the photograph and your own knowledge, suggest how the structure of sclerenchyma fibres makes them useful for making rope.

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(Total for Question 4 = 10 marks)

5 Lipoprotein lipase is a biological catalyst and is involved in the hydrolysis of triglycerides.

(a) For each of the statements below, put a cross in the box that corresponds to the correct statement.

(i) A catalyst

(1)

A decreases the rate of reaction by increasing the activation energy

B decreases the rate of reaction by reducing the activation energy

C increases the rate of reaction by increasing the activation energy

D increases the rate of reaction by reducing the activation energy

(ii) Hydrolysis results in bonds between glycerol and a fatty acid

(1)

A being broken and water being formed

B being broken and water being used

C being formed and water being formed

D being formed and water being used

(iii) A triglyceride is made from

(1)

A one glycerol and one fatty acid

B one glycerol and three fatty acids

C three glycerols and one fatty acid

D three glycerols and three fatty acids

(iv) A type of bond found in a triglyceride is

(1)

A an ester bond

B a glycosidic bond

C a hydrogen bond

D a phosphodiester bond

(b) Some people have a mutation in the gene coding for lipoprotein lipase.

The table below shows the mean concentration of some types of lipid in the blood of people without the mutation and in the blood of people with the mutation.

Type of lipid	Mean concentration of lipid in blood / mg dm ⁻³	
	People without the mutation	People with the mutation
Triglyceride	102	93
LDL cholesterol	121	111
HDL cholesterol	48	49
Total cholesterol	186	179

It has been suggested that people with this mutation may be more at risk of developing cardiovascular disease (CVD).

(i) Give **two** reasons why the information in the table does **not** support this suggestion.

(2)

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(ii) Name the type of drug that could be given to people with this mutation, to reduce the risk of developing CVD.

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(iii) State **one** health risk associated with using this type of drug.

(1)

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(Total for Question 5 = 8 marks)