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2637117915

BIOLOGY **9700/51**

Paper 5 Planning, Analysis and Evaluation **October/November 2017**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

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Write in dark blue or black pen.
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Do not use staples, paper clips, glue or correction fluid.
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Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

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1 The enzyme urease catalyses the breakdown of urea into carbonate ions and ammonium ions as shown in Fig. 1.1.

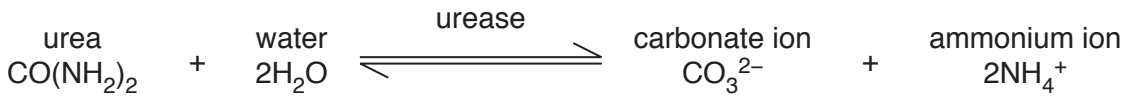


Fig. 1.1

A solution of urea does not conduct electricity, but a solution of the two ions does conduct electricity.

An increase in ions increases conductivity, so the rate of reaction is proportional to the conductivity.

A meter measures conductivity in microsiemens per centimetre ($\mu S\,cm^{-1}$). The conductivity meter also records temperature.

K_m shows the affinity of an enzyme for its substrate. The lower the K_m the greater the affinity.
A student carried out an investigation to find the K_m of the enzyme urease at different temperatures.

The student:

- made 500 cm^3 of 0.2 $mol\,dm^{-3}$ solution of urea, molar mass 60.1 $g\,mol^{-1}$
- used serial dilution to make a total of five urea solutions from 0.2 $mol\,dm^{-3}$ stock solution
- used 1 g per 10 cm^3 urease solution
- used a conductivity meter to measure the initial rate of reaction at each temperature.

Fig. 1.2 shows the experimental set-up during the course of a reaction.

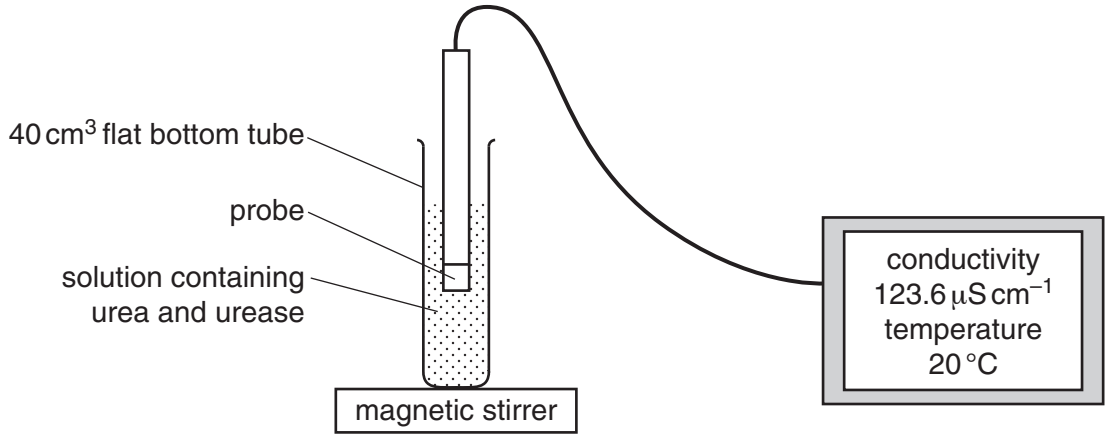


Fig. 1.2

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(a) (i) Describe how the student could make 500 cm^3 of 0.2 mol dm^{-3} solution of urea.

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..... [2]

(ii) Describe how the student made a further **four** solutions of urea by **serial dilution**.

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..... [2]

(b) (i) Identify the independent and dependent variables in this investigation.

independent .....

dependent .....
[2]

(ii) Suggest a suitable control for this investigation.

.....

..... [1]

(iii) Describe a method the student could use to find the K_m value of urease at different temperatures. The solutions were made as described in **(a)(i)** and **(a)(ii)** and the apparatus shown in Fig. 1.2 was used.

Your method should be set out in a logical way and be detailed enough to let another person follow it. You should **not** include details of how to prepare the urea or urease solutions.

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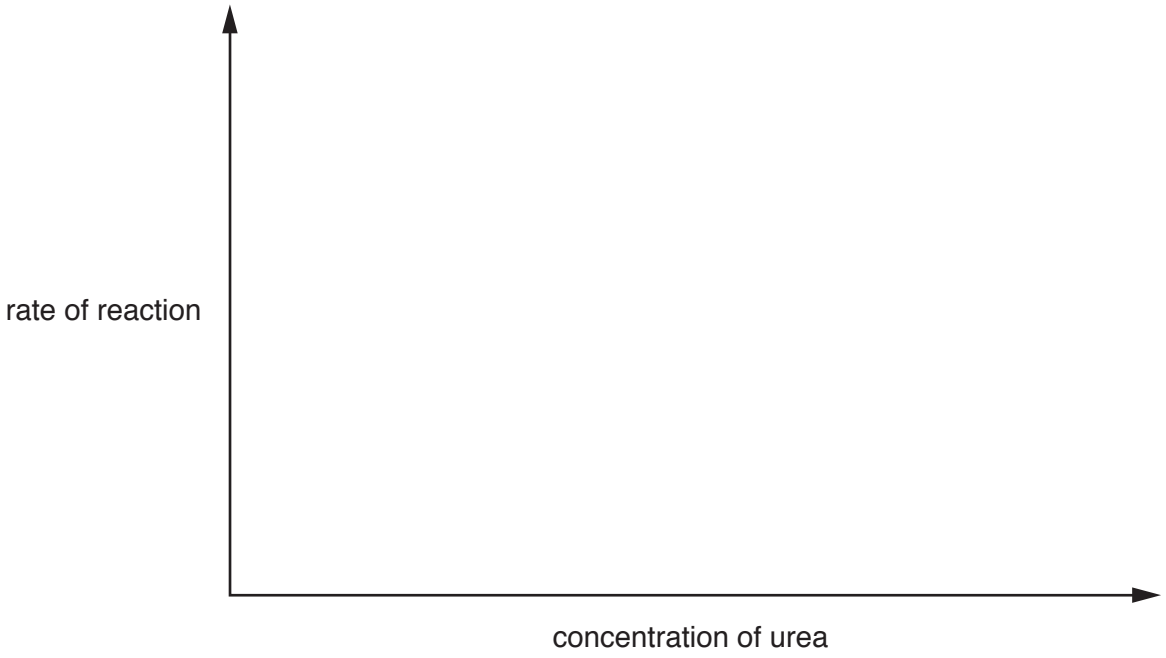
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..... [6]

(c) (i) Use the axes below to sketch a graph to show the effect of substrate concentration on the initial rate of reaction at **one** temperature.

Indicate on your graph how the student could find the K_m of urease at that temperature.



[4]

(ii) Table 1.1 shows the results that the student obtained for K_m at different temperatures.

Table 1.1

temperature	**A**	**B**	**C**	**D**	**E**
K_m/arbitrary units	1.8	1.3	0.9	0.8	1.2

State which of these temperatures, **A** to **E**, is closest to the likely optimum temperature of urease.

Explain your answer.

.....

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..... [2]

[Total: 19]

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2 Barley is often grown in soils that are high in salt (sodium chloride).

Researchers tested the salt tolerance of two varieties of barley, **X** and **Y**, by germinating grains in seven different concentrations of salt solution.

- Seven sets of barley grains of each variety were soaked in the different concentrations of salt solution for 12 hours. Each set contained 50 grains.
- Each set of grains was then split into groups of 10 grains. These were placed in Petri dishes on filter paper soaked in the same concentrations of salt solution that were used for soaking the grains.
- Lids were placed on the Petri dishes and the grains were left at 20 °C to germinate.

Fig. 2.1 shows the arrangement of the grains in the Petri dishes.

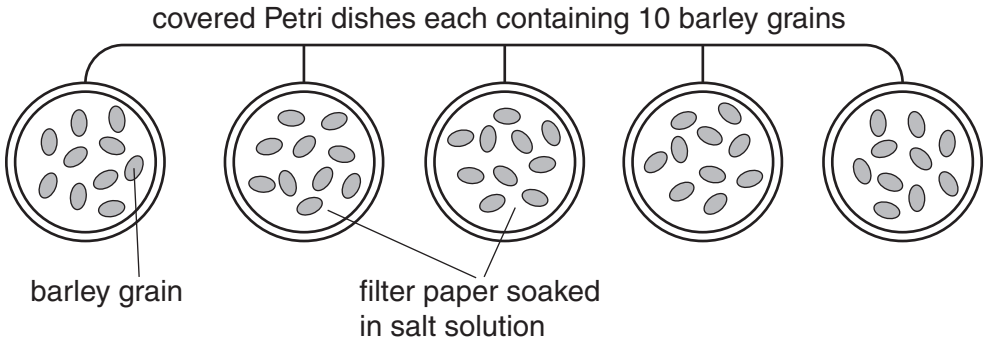


Fig. 2.1

The grains were then observed at 8 hour intervals for a total of five days. The percentage of grains in each set of 50 that had germinated each day was calculated.

The first appearance of the radicle (root) was used to indicate that the grains had germinated.

If no radicle appeared after five days, germination was considered to have failed.

The researchers repeated the whole investigation several times and calculated mean results.

(a) (i) Describe **one** variable that has been standardised in this investigation.

.....

..... [1]

(ii) Suggest **one** other variable that should be standardised.

.....

..... [1]

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[Turn over

Table 2.1 shows the results of this investigation.

Table 2.1

concentration of salt solution /mmol dm^{-3}	mean (cumulative) percentage of grains that had germinated each day			
	1		5	
	X	**Y**	**X**	**Y**
0	93.8	92.0	98.0	97.0
10	93.0	90.2	97.4	96.4
20	92.2	87.0	96.6	93.6
30	96.4	90.0	96.4	93.0
40	92.0	90.4	95.4	92.4
50	91.3	91.0	95.0	91.6
60	91.2	90.0	95.0	91.0

(b) (i) Identify **two** results which may be anomalous.
Show your answer by circling the two values. [2]

(ii) State a statistical test that could be used to find out if the correlation between the percentage germination and the salt concentration is significant.
Give a reason for your answer.

test .....

reason .....

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[2]

(c) Use the data from Table 2.1 to state **three** conclusions that are valid for **both** varieties, **X** and **Y**.

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(d) The researchers concluded that variety **X** would be better suited than variety **Y** to grow in salty soil.
Other researchers did not think there was sufficient evidence to make definite conclusions.

(i) State the evidence in Table 2.1 that supports the conclusion that variety **X** is better suited than variety **Y** to grow in salty soil.

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..... [1]

(ii) The researchers decided to carry out further investigations to find out which is the most suitable variety, **X** or **Y**, to grow in salty soils.

Suggest **one** other investigation they could carry out.

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..... [1]

[Total: 11]

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BIOLOGY **9700/52**

Paper 5 Planning, Analysis and Evaluation **October/November 2017**

1 hour 15 minutes

Candidates answer on the Question Paper.

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1 The enzyme lactase hydrolyses the disaccharide lactose to glucose and galactose. This enzyme is produced in the small intestine of mammals and by some fungi and bacteria.

Fig. 1.1 shows this reaction.

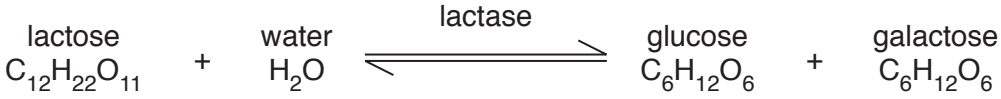


Fig. 1.1

The Michaelis-Menten constant, K_m, shows the affinity of an enzyme for its substrate. The lower the K_m the greater the affinity.

A student carried out an investigation to find the K_m of the enzyme lactase at different pH values commonly found in organisms.

The student:

- made 1 dm^3 of 0.15 mol dm^{-3} solution of lactose, molar mass 342.3 g mol^{-1}
- used proportional dilution to make a total of five lactose solutions from 0.15 mol dm^{-3} stock solution, each of 500 cm^3
- used 1 g per 100 cm^3 lactase solution
- used a glucose biosensor to measure the initial rate of reaction at each pH. A glucose biosensor measures glucose in mmol dm^{-3}.

Fig. 1.2 shows the experimental set-up.

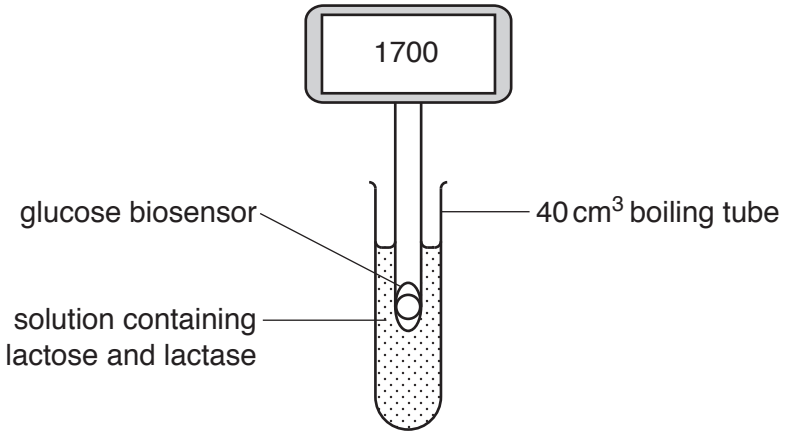


Fig. 1.2

(a) (i) Describe how the student could make 1 dm^3 of 0.15 mol dm^{-3} solution of lactose.

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(ii) Describe how the student made a further four solutions of lactose by proportional dilution.

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..... [2]

(b) (i) Identify the independent and dependent variables in this investigation.

independent .....

dependent .....
[2]

(ii) Suggest a suitable control for this investigation.

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..... [1]

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[Turn over

(iii) Describe a method that the student could use to find the K_m of lactase at different pH values. The solutions were made as described in **(a) (i)** and **(a) (ii)** and the apparatus shown in Fig. 1.2 was used.

Your method should be set out in a logical way and be detailed enough to let another person follow it.

You should **not** include details of how to make the lactose or lactase solutions.

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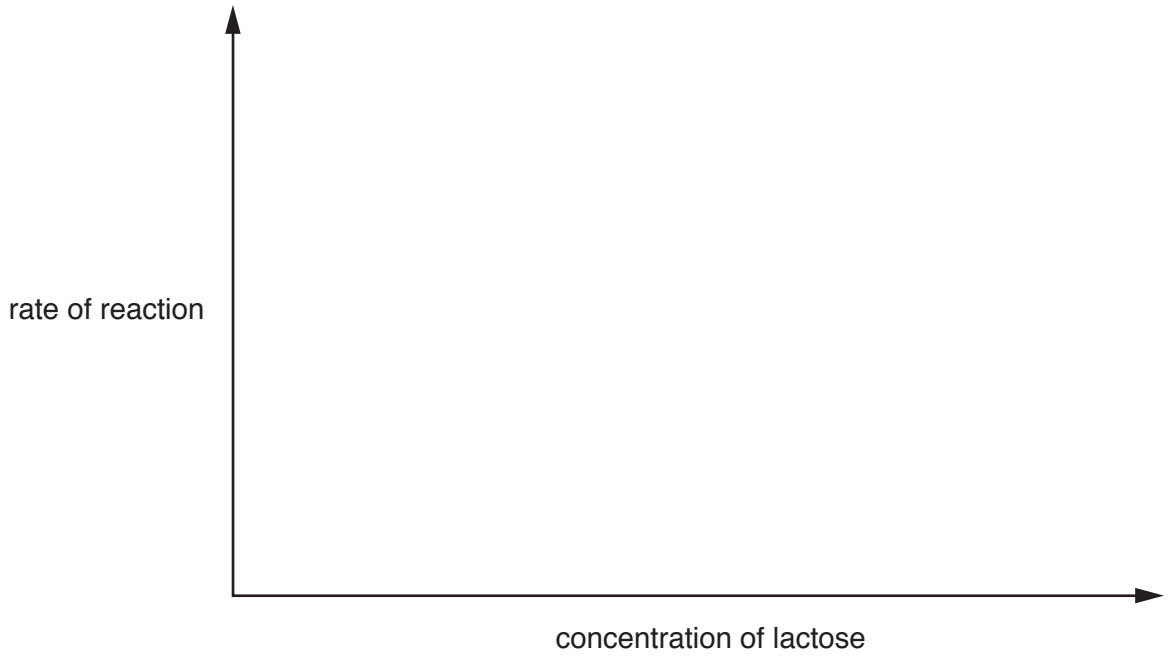
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..... [6]

(c) (i) Complete Fig. 1.3 by sketching a graph to show the effect of substrate concentration at one pH on the initial rate of reaction.

Indicate on your graph how the student could find the K_m value of lactase at that pH.



[4]

Fig. 1.3

(ii) Table 1.1 shows the results that the student obtained for K_m at different pH values.

Table 1.1

pH	**A**	**B**	**C**	**D**	**E**
K_m / arbitrary units	0.216	0.112	0.166	0.178	0.324

State which of these pH values, **A** to **E**, is closest to the likely optimum pH of lactase.

Explain your answer.

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..... [2]

[Total: 19]

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[Turn over

2 In some countries crops are irrigated using water containing salt (sodium chloride).
This makes the soil saline (salty) which means it contains sufficient neutral soluble salts to reduce the growth and yield of most crop plants.

The responses of crop plants to salinity vary between two extremes:

- sensitive – plants show the greatest reduction in growth and yield
- tolerant – plants show the least reduction in growth and yield.

Agricultural research organisations have investigated the effect of irrigation with salt solutions on the yields of a variety of crop plants. The data collected allowed researchers to determine, for each crop, the concentration of salt solution at which yield is reduced by 50%. From the data recommendations could be made about which crops were most suitable to grow in saline soils.

Table 2.1 shows the crops tested.

Table 2.1

grasses (monocotyledons)	**broad leaf crops (dicotyledons)**
human consumption	
Triticum aestivum bread wheat	*Solanum tuberosum* Irish potato
Hordeum vulgare barley	*Brassica oleracea* cabbage
	Spinacia oleracea spinach
animal grazing	
Festuca arundinacea tall fescue	*Medicago sativa* alfalfa
Agropyron cristatum crested wheatgrass	

- Seeds were germinated in salt-free conditions.
- Young plants were planted into fields that were divided into standard test plots of the same area for each crop.
- Each field was irrigated regularly with a different concentration of salt solution.
- Control plots were irrigated with salt-free water.
- Each crop was grown to maturity and harvested.
- The dry mass of the edible parts of the plants was measured to find the yield for each concentration of salt solution.

(a) (i) Identify **one** variable that could be standardised once the young plants are in the test plots in the fields.

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..... [1]

(ii) Suggest **one** other variable that **cannot** be standardised once the young plants are in the test plots in the fields.

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..... [1]

(b) Suggest why the researchers used dry mass to estimate the yield of the different crops.

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(c) The data collected by the researchers allowed them to determine, for each crop, the concentration of salt solution at which yield is reduced by 50%.

Explain how the researchers determined the concentration of salt at which yield is reduced by 50%.

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[Turn over

Fig. 2.1 shows the results of this investigation.

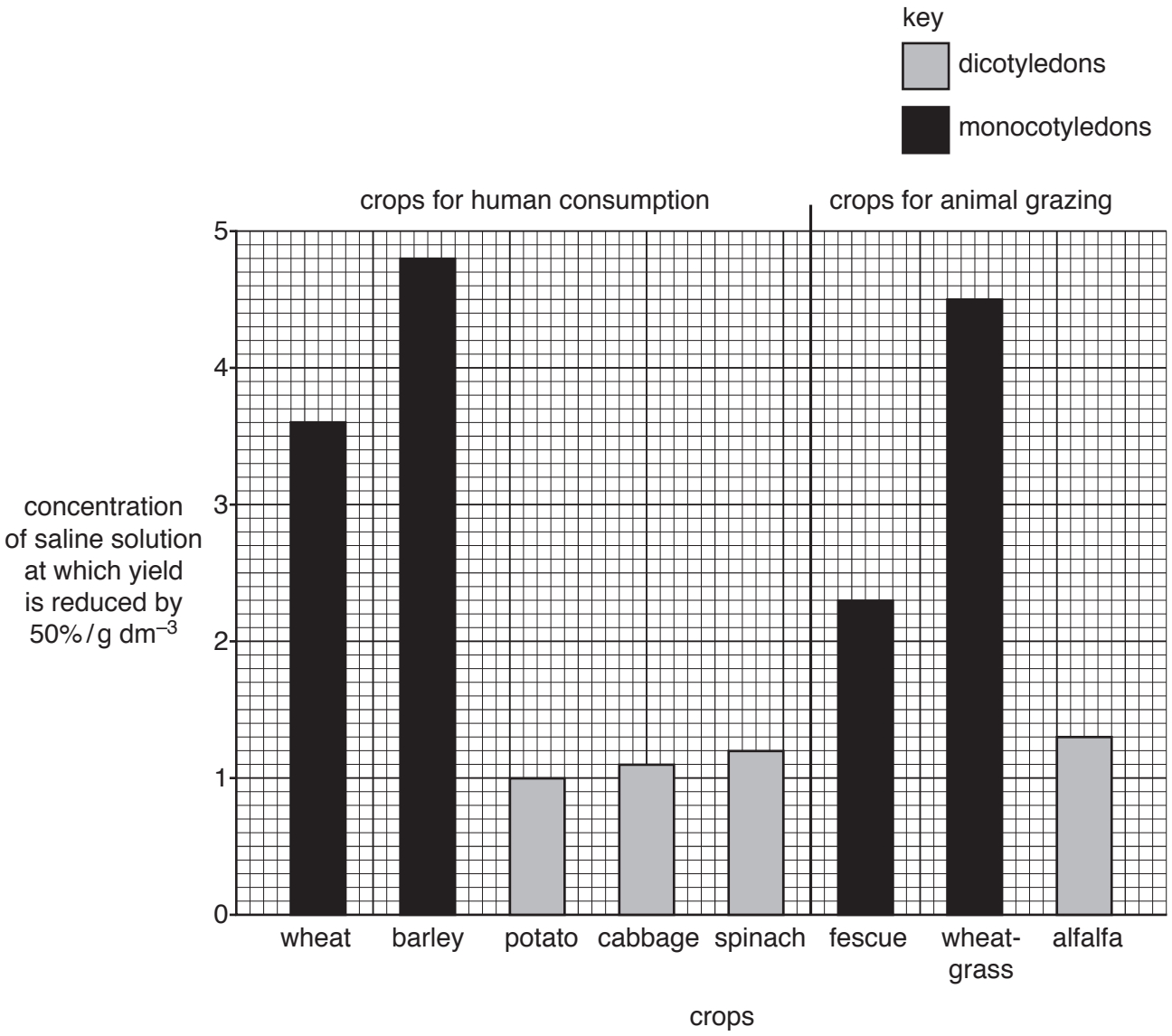


Fig. 2.1

(d) State **three** conclusions that can be made about the effect on the yield of these crops when irrigated with salt solutions.

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..... [3]

(e) Based on these results the agricultural organisations published recommendations to help farmers choose which crops to grow in saline soils.

However, farmers in different parts of the world who followed these recommendations did not obtain the yields expected.

Suggest two reasons for this.

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[Total: 11]

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9196945631

BIOLOGY **9700/53**

Paper 5 Planning, Analysis and Evaluation **October/November 2017**

1 hour 15 minutes

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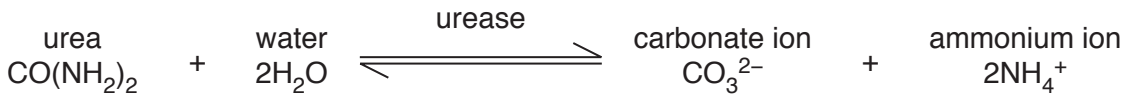


Fig. 1.1

A solution of urea does not conduct electricity, but a solution of the two ions does conduct electricity.

An increase in ions increases conductivity, so the rate of reaction is proportional to the conductivity.

A meter measures conductivity in microsiemens per centimetre ($\mu S\,cm^{-1}$). The conductivity meter also records temperature.

K_m shows the affinity of an enzyme for its substrate. The lower the K_m the greater the affinity.
A student carried out an investigation to find the K_m of the enzyme urease at different temperatures.

The student:

- made 500 cm^3 of 0.2 $mol\,dm^{-3}$ solution of urea, molar mass 60.1 $g\,mol^{-1}$
- used serial dilution to make a total of five urea solutions from 0.2 $mol\,dm^{-3}$ stock solution
- used 1 g per 10 cm^3 urease solution
- used a conductivity meter to measure the initial rate of reaction at each temperature.

Fig. 1.2 shows the experimental set-up during the course of a reaction.

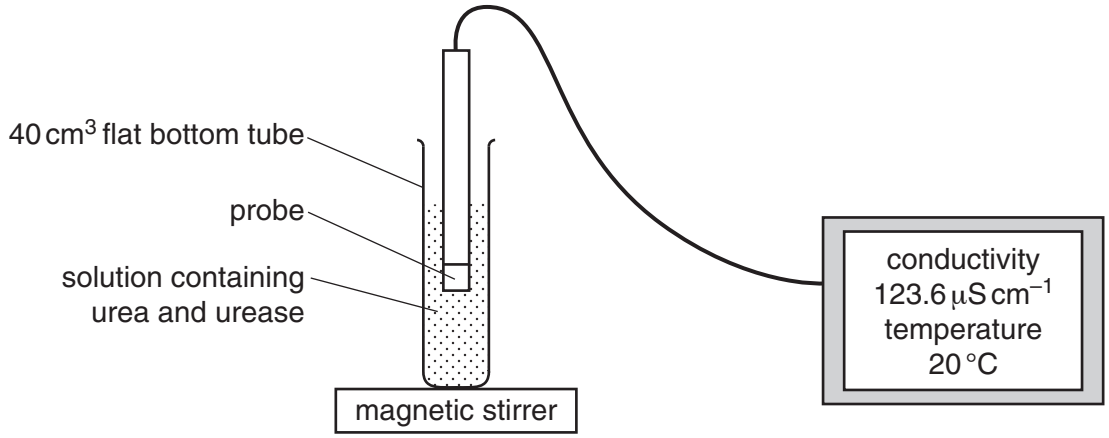


Fig. 1.2

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(a) (i) Describe how the student could make 500 cm^3 of 0.2 mol dm^{-3} solution of urea.

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..... [2]

(ii) Describe how the student made a further **four** solutions of urea by **serial dilution**.

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..... [2]

(b) (i) Identify the independent and dependent variables in this investigation.

independent .....

dependent .....
[2]

(ii) Suggest a suitable control for this investigation.

.....

..... [1]

(iii) Describe a method the student could use to find the K_m value of urease at different temperatures. The solutions were made as described in **(a)(i)** and **(a)(ii)** and the apparatus shown in Fig. 1.2 was used.

Your method should be set out in a logical way and be detailed enough to let another person follow it. You should **not** include details of how to prepare the urea or urease solutions.

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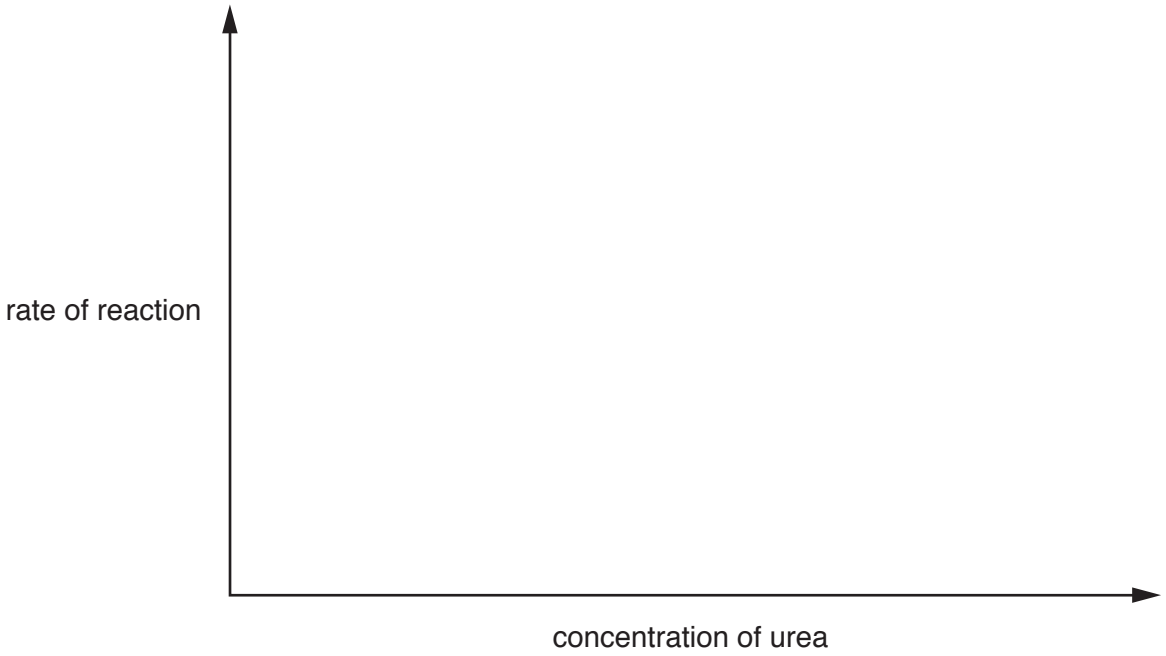
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..... [6]

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(c) (i) Use the axes below to sketch a graph to show the effect of substrate concentration on the initial rate of reaction at **one** temperature.

Indicate on your graph how the student could find the K_m of urease at that temperature.



[4]

(ii) Table 1.1 shows the results that the student obtained for K_m at different temperatures.

Table 1.1

temperature	**A**	**B**	**C**	**D**	**E**
K_m/arbitrary units	1.8	1.3	0.9	0.8	1.2

State which of these temperatures, **A** to **E**, is closest to the likely optimum temperature of urease.

Explain your answer.

.....

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..... [2]

[Total: 19]

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2 Barley is often grown in soils that are high in salt (sodium chloride).

Researchers tested the salt tolerance of two varieties of barley, **X** and **Y**, by germinating grains in seven different concentrations of salt solution.

- Seven sets of barley grains of each variety were soaked in the different concentrations of salt solution for 12 hours. Each set contained 50 grains.
- Each set of grains was then split into groups of 10 grains. These were placed in Petri dishes on filter paper soaked in the same concentrations of salt solution that were used for soaking the grains.
- Lids were placed on the Petri dishes and the grains were left at 20 °C to germinate.

Fig. 2.1 shows the arrangement of the grains in the Petri dishes.

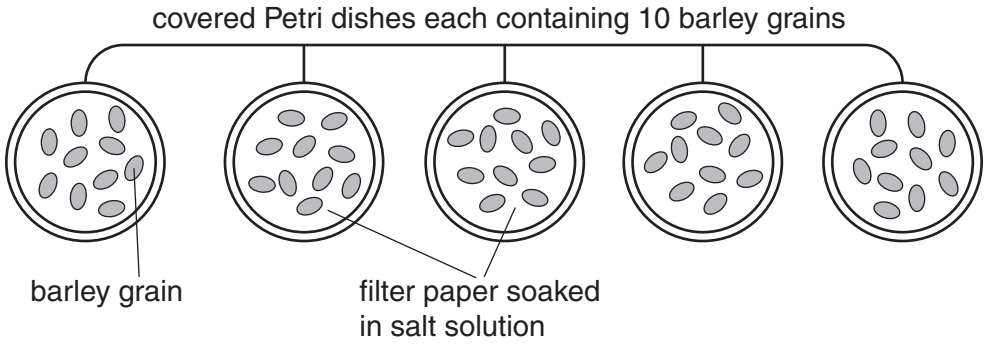


Fig. 2.1

The grains were then observed at 8 hour intervals for a total of five days. The percentage of grains in each set of 50 that had germinated each day was calculated.

The first appearance of the radicle (root) was used to indicate that the grains had germinated.

If no radicle appeared after five days, germination was considered to have failed.

The researchers repeated the whole investigation several times and calculated mean results.

(a) (i) Describe **one** variable that has been standardised in this investigation.

.....

..... [1]

(ii) Suggest **one** other variable that should be standardised.

.....

..... [1]

Table 2.1 shows the results of this investigation.

Table 2.1

concentration of salt solution /mmol dm^{-3}	mean (cumulative) percentage of grains that had germinated each day			
	1		5	
	X	**Y**	**X**	**Y**
0	93.8	92.0	98.0	97.0
10	93.0	90.2	97.4	96.4
20	92.2	87.0	96.6	93.6
30	96.4	90.0	96.4	93.0
40	92.0	90.4	95.4	92.4
50	91.3	91.0	95.0	91.6
60	91.2	90.0	95.0	91.0

(b) (i) Identify **two** results which may be anomalous.
Show your answer by circling the two values. [2]

(ii) State a statistical test that could be used to find out if the correlation between the percentage germination and the salt concentration is significant.
Give a reason for your answer.

test .....

reason .....

.....
[2]

(c) Use the data from Table 2.1 to state **three** conclusions that are valid for **both** varieties, **X** and **Y**.

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..... [3]

(d) The researchers concluded that variety **X** would be better suited than variety **Y** to grow in salty soil.
Other researchers did not think there was sufficient evidence to make definite conclusions.

(i) State the evidence in Table 2.1 that supports the conclusion that variety **X** is better suited than variety **Y** to grow in salty soil.

.....

..... [1]

(ii) The researchers decided to carry out further investigations to find out which is the most suitable variety, **X** or **Y**, to grow in salty soils.

Suggest **one** other investigation they could carry out.

.....

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[Total: 11]

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