



General Certificate of Education  
Advanced Subsidiary Examination  
June 2011

**Biology**

**BIO3X/TN**

**Unit 3X AS Externally Marked Practical Assignment**

**Teachers' Notes**

**Confidential**

**To be given immediately to the teacher(s) responsible for GCE Biology**

**Open on receipt**

**Teachers' Notes****CONFIDENTIAL**

These notes must be read in conjunction with *Instructions for the Administration of the Externally Marked Practical Assignment: GCE Biology* published on the AQA website.

**The effect of substrate concentration on the rate of the reaction catalysed  
by the enzyme chymosin**

**Task 1****Materials**

In addition to access to general laboratory equipment, each candidate needs

- 50 cm<sup>3</sup> whole fresh milk
- 10 cm<sup>3</sup> of chymosin solution
- Pasteur pipette
- six test tubes
- bung for test tube
- test tube rack
- stop watch or timer
- pipettes or syringes to measure a minimum 3 cm<sup>3</sup> and a maximum 20 cm<sup>3</sup>

**Managing the investigation**

Either animal or vegetarian rennet/rennin may be used as the source of chymosin. The number of drops used will depend on the concentration of the enzyme. This should be adjusted so that curd is seen in whole milk between 30 seconds and 100 seconds after addition of the enzyme at room temperature.

This investigation was trialled using vegetarian and animal rennin from [www.cheesemaking.co.uk](http://www.cheesemaking.co.uk) and Maxiren and Fromase from NCBE.

Powdered rennin and rennet essence should not be used.

**The task must be trialled before use.**

Candidates **must not** be given information about an EMPA until one week before Task 1. One week before Task 1, teachers may give their candidates the following information.

You will investigate the effect of enzymes on the coagulation of milk.

There **must** be no further discussion and candidates **must not** be given any further resources to prepare for the assessment.

**In Task 1 teachers must not give candidates the following information**

- how to decide when curd is present in the tubes.

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## Task 2

### Materials

In addition to access to general laboratory equipment, each candidate needs

- 100 cm<sup>3</sup> whole fresh milk
- distilled water
- 10 cm<sup>3</sup> of chymosin solution
- Pasteur pipette
- five test tubes
- five bungs for test tubes
- test tube rack
- five 100 cm<sup>3</sup> beakers or plastic/paper cups
- one 250 cm<sup>3</sup> beaker to be used as a water bath
- thermometer to measure in the range 0-100°C
- source of water at 30 °C
- large container to hold waste
- stop watch or timer
- pipettes or syringes to measure a minimum 3 cm<sup>3</sup> and a maximum 20 cm<sup>3</sup>
- access to hot water (eg in a kettle)
- marker pen or chinagraph pencil

**The task must be trialled before use.**

Candidates are not required to carry out repeats in Task 2.

**In Task 2 teachers must not give candidates the following information**

- how to minimise the effect of temperature changes.

Turn over ►

Centre Number										Candidate Number									
Surname																			
Other Names																			
Candidate Signature																			

For Examiner's Use
Total Task 1



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## Biology

## BIO3X/PM1

### Unit 3X AS Externally Marked Practical Assignment Task Sheet 1

To be completed before Task Sheet 2.

For submission by 15 May 2011

**For this paper you must have:**

- a ruler with millimetre measurements
- a calculator.

## The effect of substrate concentration on the rate of the reaction catalysed by the enzyme chymosin

### Introduction

Casein is a protein found in milk. Chymosin is an enzyme which breaks some of the peptide bonds in casein. The product is an insoluble polypeptide which precipitates to form a solid white curd. When all the protein has been broken down the milk turns solid.

### Task 1

You will investigate the effect of substrate concentration on the rate of reaction catalysed by chymosin.

### Materials

You are provided with

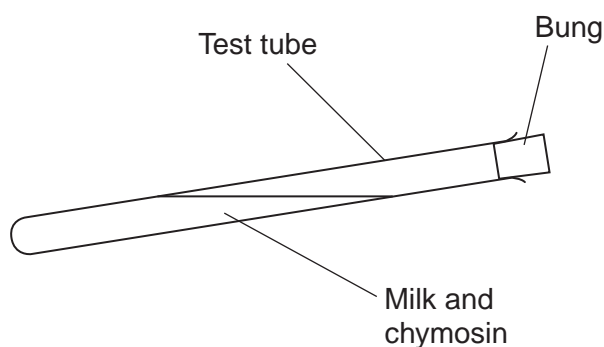
- milk
- chymosin solution
- Pasteur pipette
- test tubes
- bungs for test tubes
- test tube rack
- stop watch or timer
- pipettes or syringes

You may ask your teacher for any other apparatus you require.

### Outline Method

**Read these instructions carefully before you start your investigation.**

1. Add 5 cm<sup>3</sup> of milk to each of six test tubes.
2. Add 10 drops of chymosin solution to the milk in one tube and put a bung in the tube.
3. Hold the tube nearly horizontal as shown in the diagram. Keeping the tube nearly horizontal, gently mix the contents by rotating the tube several times.



Turn over ►

4. Rotate the tube every 10 seconds.
5. Record the time taken for the first white curd to appear on the side of the tube.
6. Repeat steps 2–5 with the other tubes of milk so that you have six sets of data.
7. Record your results in the table provided.

### You will need to decide for yourself

- when curd appears on the side of the tube.

### Recording your results

Sample number	Time taken for curd to appear / seconds
1	
2	
3	
4	
5	
6	

**Questions on Task 1**

Answer **all** questions in the spaces provided.

- 1** You were told to rotate the tube every 10 seconds (Step 4). Give **two** reasons why you were told to rotate the tube.
- 2 (a)** The time taken for the curd to appear on the side of the tube can be used as a measure of the rate of the reaction. Give **two** ways in which measuring the rate of the reaction in this way would make your results unreliable.
- 2 (b)** Suggest **two** other ways of measuring the rate of the reaction.
- 3** If you have carried out this experiment carefully, your data for the last three tubes may be more reliable than for the first three tubes. Explain why.

**END OF TASK 1**

Turn over ►

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use Total Task 2



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## Biology

## BIO3X/PM2

### Unit 3X AS Externally Marked Practical Assignment Task Sheet 2

To be completed before the EMPA Written Test.

For submission by 15 May 2011

**For this paper you must have:**

- a ruler with millimetre measurements
- a calculator.



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**Task 2****The effect of substrate concentration on the rate of the reaction catalysed by the enzyme chymosin****Introduction**

Casein is a protein found in milk. Chymosin is an enzyme which breaks some of the peptide bonds in casein. The product is an insoluble polypeptide which precipitates to form a solid white curd. When all the protein has been broken down the milk turns solid.

You will now investigate how changing the concentration of casein affects the rate of curd formation by chymosin.

**Materials**

You are provided with

- milk
- distilled water
- chymosin solution
- Pasteur pipette
- test tubes
- bungs for test tubes
- test tube rack
- 100 cm<sup>3</sup> beakers
- 250 cm<sup>3</sup> beaker to be used as water bath
- water at 30 °C to be used in the water bath
- thermometer
- stop watch or timer
- large container to hold the waste
- pipettes or syringes
- marker pen or chinagraph pencil
- access to hot water

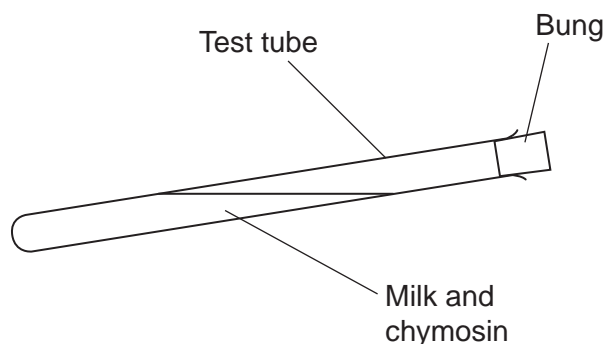
You may ask your teacher for any other apparatus you require.

**Turn over ►**

## Outline method

Read these instructions carefully before you start your investigation.

1. Use distilled water and milk to make up  $20\text{ cm}^3$  of five different concentrations of milk in the  $100\text{ cm}^3$  beakers provided. The concentrations should be 40%, 55%, 70%, 85% and 100% (undiluted) milk.  
Complete the table in Question 4 to show the volumes of milk and water you used to make up each concentration.
2. Use the  $250\text{ cm}^3$  beaker to set up a water bath at  $30\text{ }^\circ\text{C}$ .
3. Add  $5\text{ cm}^3$  of each of the five concentrations of milk to separate labelled test tubes.
4. Place all the tubes in the water bath. Leave for at least 5 minutes.
5. Add 10 drops of chymosin solution to the 100% concentration of milk and put a bung in the tube.
6. Hold the tube nearly horizontal as shown in the diagram. Keeping the tube nearly horizontal, gently mix the contents by rotating the tube several times.



7. Rotate the tube every 10 seconds.
8. Record the time taken for the first white curd to appear on the side of the tube in a table in Question 5.
9. Repeat steps 5 to 8 with the other four concentrations of milk.

You should decide for yourself

- how to minimise the effect of temperature changes.

- 4** Volumes of milk and water you used to make up 20 cm<sup>3</sup> of milk at each concentration

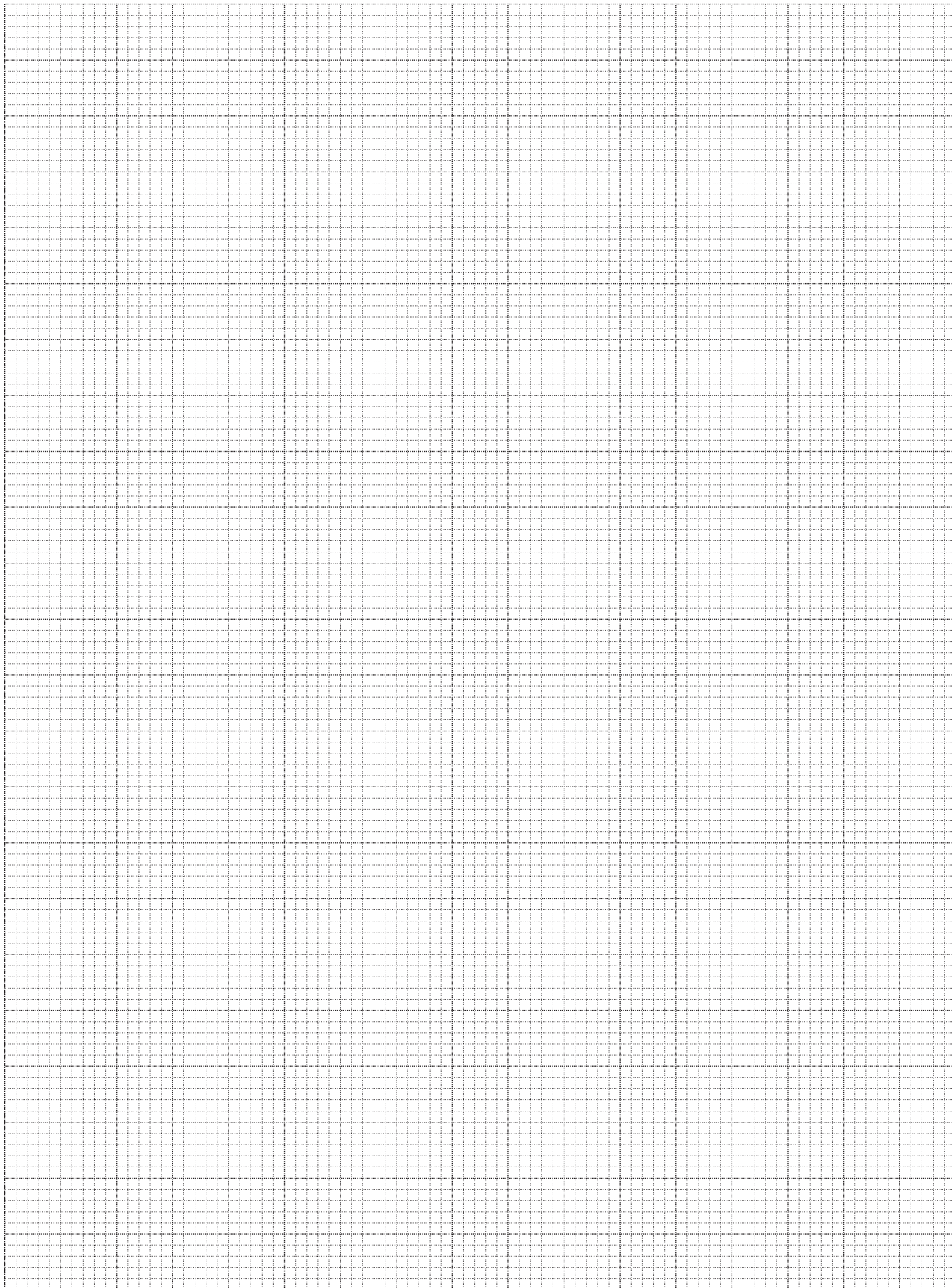
	Concentration of milk / %				
	40	55	70	85	100
Volume of milk / cm <sup>3</sup>					20
Volume of water / cm <sup>3</sup>					0

**Presenting data**

- 5** Record your data in a table in the space below. Hand in this sheet at the end of each practical session.
- You will be awarded up to 2 marks for the quality of your practical work.
- 6** Use the space below to process your data.

Turn over ►

Use the graph paper provided to plot a graph of your processed data.



**END OF TASK 2**

Centre Number						Candidate Number					
Surname						Other Names					
<b>Notice to Candidate.</b> The work you submit for assessment must be your own. If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified.											
<b>Candidate Declaration.</b> I have read and understood the Notice to Candidate and can confirm that I have produced the attached work without assistance other than that which is acceptable under the scheme of assessment.											
Candidate Signature						Date					

For Examiner's Use Total EMPA mark	
Examiner's Initials	
Section	Mark
Task 1	
Task 2	
Section A	
Section B	
TOTAL EMPA MARK	



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## Biology

## BIO3X

### Unit 3X AS Externally Marked Practical Assignment

For submission by 15 May 2011

<p><b>For this paper you must have:</b></p> <ul style="list-style-type: none"> <li>• Task Sheet 2, your results and your calculations</li> <li>• a ruler with millimetre measurements</li> <li>• a calculator.</li> </ul>	<p><b>Time allowed</b></p> <ul style="list-style-type: none"> <li>• 1 hour 15 minutes</li> </ul>
<p><b>Instructions:</b></p> <ul style="list-style-type: none"> <li>• Use black ink or black ball-point pen.</li> <li>• Fill in the boxes at the top of this page.</li> <li>• Answer <b>all</b> questions.</li> <li>• You must answer the questions in the space provided. Do not write outside the box around each page or on blank pages.</li> <li>• Do all rough work in this book. Cross through any work you do not want to be marked.</li> </ul>	<p><b>Information</b></p> <ul style="list-style-type: none"> <li>• The marks for questions are shown in brackets.</li> <li>• The maximum mark for this paper is 31.</li> <li>• You will be marked on your ability to: <ul style="list-style-type: none"> <li>– organise information clearly</li> <li>– use scientific terminology accurately.</li> </ul> </li> </ul>
<p><b>Details of additional assistance (if any).</b> Did the candidate receive any help or information in the production of this work? If you answer yes give the details below or on a separate page.</p> <p>Yes <input type="checkbox"/> No <input type="checkbox"/></p>	

### Teacher Declaration:

I confirm that the candidate has met the requirements of the practical skills verification (PSV) in accordance with the instructions and criteria in section 3.8 of the specification.

<b>Practical Skills Verification</b>	Yes <input type="checkbox"/>
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Signature of teacher ..... Date

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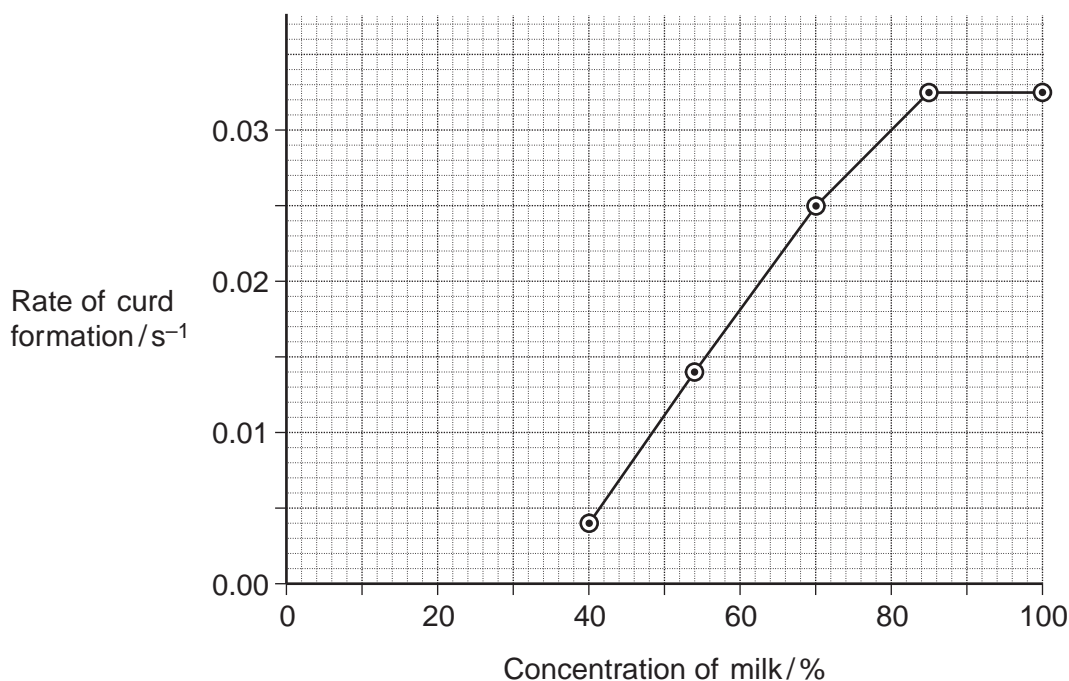
### Section A

These questions relate to your investigation into the effect of substrate concentration on the rate of the reaction catalysed by the enzyme chymosin.

Use your Task Sheet 2 and your results to answer the questions.

Answer **all** questions in the spaces provided.

- 7 (a) You were told to place the tubes containing the milk in a water bath for at least 5 minutes before adding the chymosin. Explain why you were told to leave them for at least 5 minutes.
- 7 (b) Describe what you did during the investigation to minimise the effect of temperature changes.
- 8 Another variable that affects the rate of curd formation is pH. How could you have controlled pH in your investigation?
- 9 A student carried out a similar investigation. The graph shows her results.

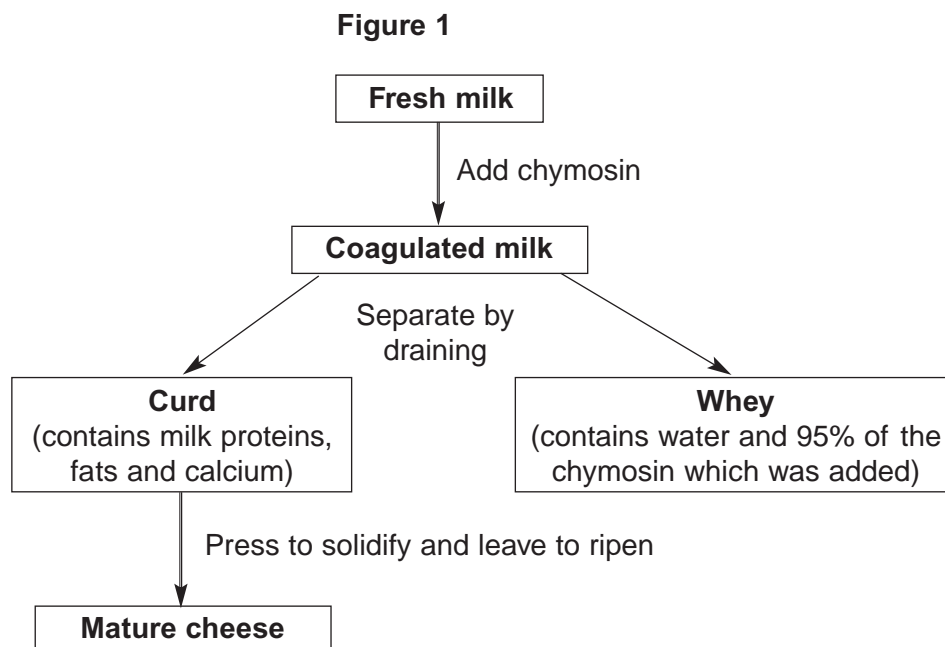


- 9(a) (i) Describe the results of this student's investigation.
- 9 (a) (ii) Explain the shape of the curve on the graph.
- 9 (b) The student did **not** continue the curve until it met the x-axis. Was she correct to do so? Explain your answer.

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**Resource Sheet****Resource A**

**Figure 1** summarises the way in which cheese is made.

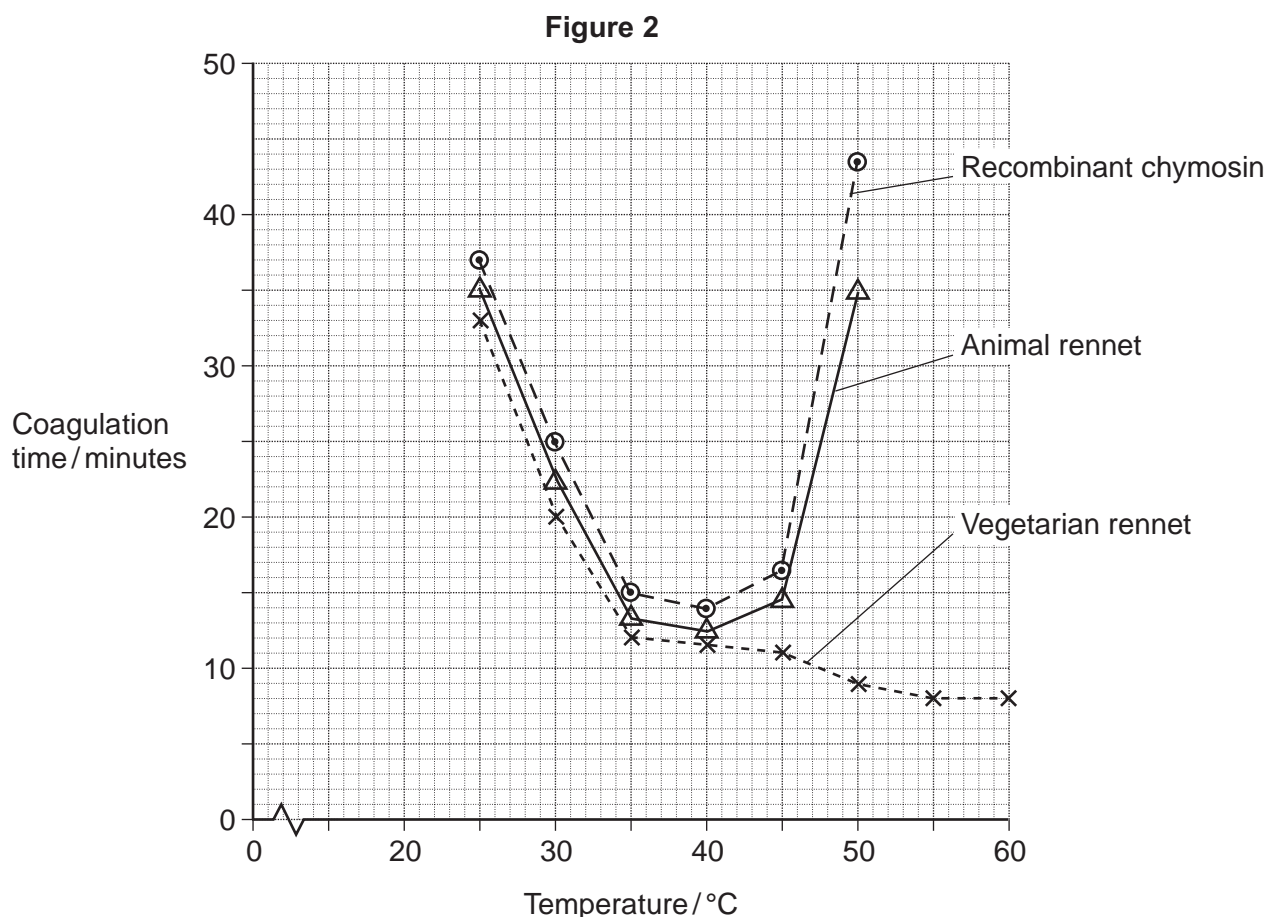
**Resource B**

Different extracts may be added to milk to make cheese. All of these extracts contain chymosin.

- Animal rennet comes from calves and lambs. Rennet from these young animals contains between 80 and 95% chymosin. It also contains between 5 and 20% of another protein-digesting enzyme called pepsin.
- Vegetarian rennet comes from fungi. It contains 100% chymosin.
- Recombinant chymosin comes from bacteria which have had an animal gene for chymosin inserted in them. It contains 100% chymosin.

Scientists investigated the effect of temperature on the time these different extracts took to coagulate milk. Their results are shown in **Figure 2**.

Turn over ►



### Resource C

Some people are lactose intolerant. The lactose in milk and milk products, such as cheese, causes digestive discomfort in these people.

Scientists gave 159 adult volunteers, who had diagnosed themselves as lactose intolerant, a questionnaire to complete. The volunteers were asked,

- do you eat the food?
- if you eat the food, do you feel discomfort after eating it?

The results are shown in **Figure 3**.

**Figure 3**

Food	Typical lactose content / g per serving	Percentage of people who			
		A do not eat the food	B feel discomfort after eating the food	C (= A + B) do not eat the food or feel discomfort after eating the food	D feel no discomfort after eating the food
Hard cheese	1.2	11.1	39.9	51.0	49.0
Pizza	3.0	10.4	57.8	68.2	31.8
Soft cheese	3.6	25.1	53.0	78.1	21.9
Ice cream	6.0	14.6	68.2	82.8	17.2
Milk	9.9	27.0	67.1	94.1	5.9



**Section B**

You should use the information on the **Resource Sheet** and your own knowledge to answer these questions.

Answer **all** questions in the spaces provided.

Use **Resource A** to answer Questions **10** and **11**.

- 10** A student carried out a biuret test on a sample of whey. The sample turned purple. Use the flowchart to explain why.
- 11** The percentage of protein in mature cheese is greater than the percentage of protein in coagulated milk. Use the flow chart to explain why.

Use **Resource B** to answer Questions **12** to **15**.

- 12** Suggest **two** disadvantages of using animal rennet rather than recombinant chymosin as a source of chymosin for making cheese.
- 13** The shape of the curve for recombinant chymosin is similar to the shape of the curve for animal rennet. Suggest why.
- 14 (a)** Describe how the coagulation time for vegetarian rennet is different from that for animal rennet.
- 14 (b)** Calculate the percentage reduction in coagulation time between 45 °C and 60 °C for vegetarian rennet. Show your working.
- 15** Explain the shape of the curve for animal rennet above 45 °C.

Turn over ►

Use **Resource C** to answer Questions **16** to **18**.

- 16** People who are lactose intolerant suffer discomfort after eating foods containing lactose. Give **two** symptoms of this discomfort.
- 17** The scientists investigated the relationship between the lactose content of the food and the amount of digestive discomfort.
- 17 (a)** The figures in columns **A** and **B** were used to produce those in column **C**. The scientists used column **C** rather than column **B** in their analysis. Suggest why.
- 17 (b)** Describe the relationship between the lactose content of the food and the data in column **C**.
- 17 (c)** The scientists could **not** conclude that the discomfort was caused by the increase in lactose content of the food. Explain why.
- 18** Suggest **two** reasons why the data in this table may be unreliable.

**END OF QUESTIONS**

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ANSWER IN THE SPACES PROVIDED**

**There are no questions printed on this page**

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