Cambridge International AS & A Level

**Cambridge International Examinations**
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

*6279741017*

**BIOLOGY** **9700/36**

Paper 3 Advanced Practical Skills 2 **October/November 2017**

**2 hours**

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

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.

| For Examiner's Use | |
|---|---|
| 1 | |
| 2 | |
| Total | |

This document consists of **14** printed pages and **2** blank pages.

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Before you proceed, read carefully through the **whole** of Question 1 and Question 2.

Plan the use of the **two hours** to make sure that you finish all the work that you would like to do.

If you have enough time, think about how you can improve the accuracy of your results, for example by obtaining and recording one or more additional measurements.

You will **gain marks** for recording your results according to the instructions.

**1** You are provided with a solution, labelled **E**, containing an enzyme which coagulates (clots) milk. Enzyme **E** hydrolyses (breaks) peptide bonds between certain amino acids in a protein found in milk and this results in the coagulation of the milk. Calcium ions are required for this coagulation.

You are required to:

- carry out a trial test to think about sources of error
- investigate the effect of substrate concentration on this enzyme-catalysed coagulation.

When a mixture of milk, calcium chloride solution and **E** is gently rotated in a test-tube the coagulation goes through the stages shown in Fig. 1.1.

Stage **3** is the end-point of the enzyme-catalysed coagulation.

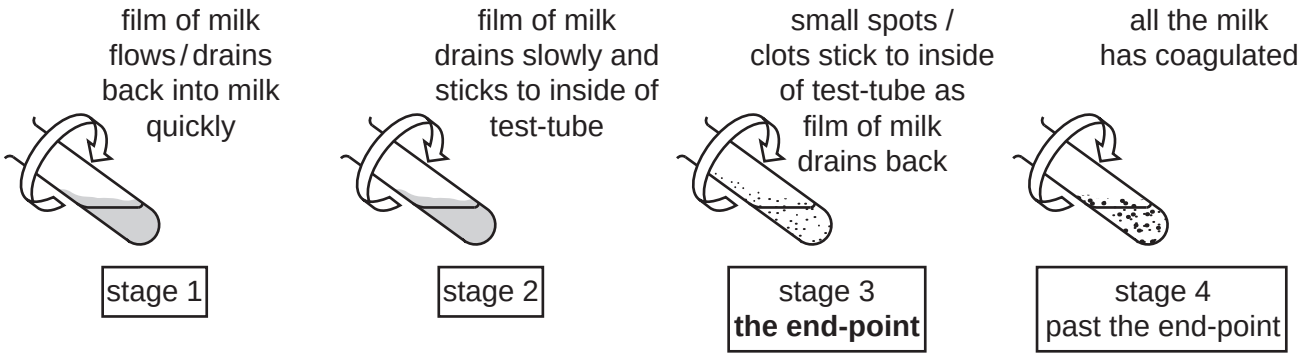



**Fig. 1.1**

You are provided with:

| labelled | contents | hazard | volume / $cm^3$ |
|---|---|---|---|
| **C** | 10% calcium chloride solution | harmful irritant | 20 |
| **W** | distilled water | none | 100 |
| **M** | milk | none | 100 |
| **E** | 1% enzyme solution | harmful irritant | 20 |

If **C** or **E** comes into contact with your skin, wash off immediately under cold water. It is recommended that you wear suitable eye protection.

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You are required to carry out a trial test (step 1 to step 16) before you start your investigation.

*Read step 1 to step 16 before proceeding*.

Proceed as follows:

1. You are provided with a beaker labelled **water-bath**. Use the hot and cold water to set up a water-bath in this beaker. The starting temperature of the water-bath should be between 35 °C and 40 °C.

   You will **not** need to maintain this temperature during steps 2 to 15.

2. Put 10 $cm^3$ of **M** into a test-tube.

3. Repeat step 2 so that you have three test-tubes containing **M**.

4. Put 1 $cm^3$ of **C** into each test-tube.

5. Gently shake each of the test-tubes to mix **M** and **C**.

6. Take the temperature of the water-bath and record this temperature in **(a)(ii)** on page 5.

7. Put the test-tubes into the water-bath and leave for at least 3 minutes.

**(a) (i)** Explain why the test-tubes are left in the water-bath for at least 3 minutes in step 7.

.....

.....[1]

8. Remove one of the test-tubes from the water-bath.

   The process of coagulation will start when **E** is added to the test-tube.

9. Put 1 $cm^3$ of **E** into the test-tube, so that it runs down the side of the test-tube and forms a layer on the surface of the mixture, as shown in Fig. 1.2.

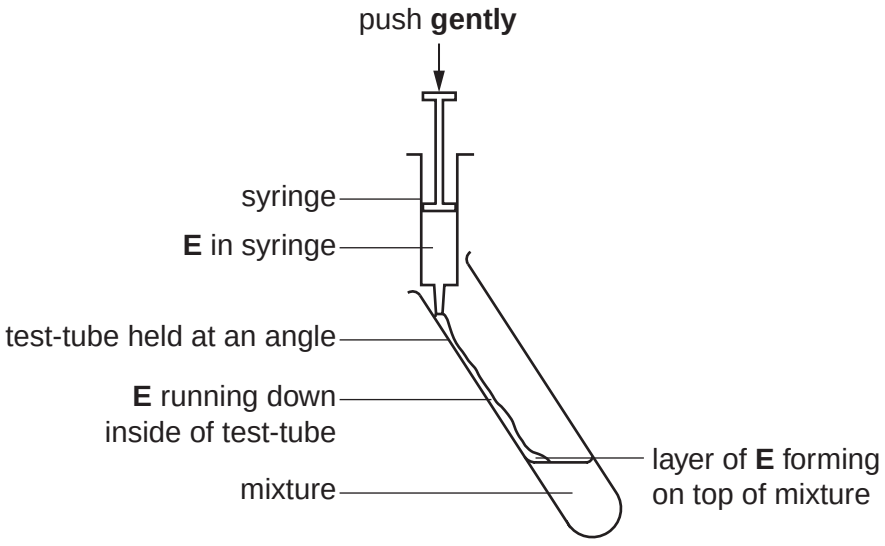



**Fig. 1.2**

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10. Gently shake the test-tube to mix the solutions and start timing.

11. Hold the test-tube over a piece of black card on the table as shown in Fig. 1.3.

12. Gently rotate the test-tube to form a film of milk on the inside of the test-tube.

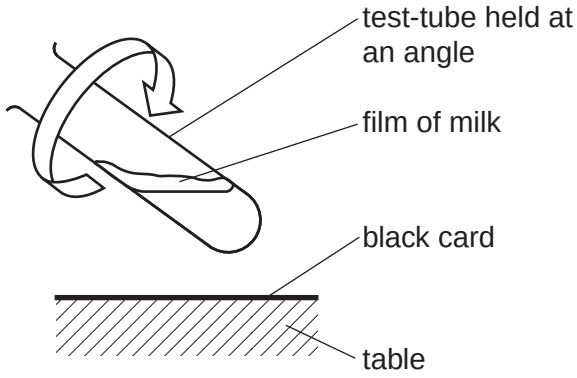



**Fig. 1.3**

13. Observe the film until the end-point is reached (stage 3 in Fig. 1.1). Ignore any small bubbles on the inside of the test-tube. Stop timing.

14. Record in **(a)(iii)** the time taken to reach the end-point.

    If the end-point has not been reached in 4 minutes, stop the experiment and record 'more than 240'.

15. Repeat step 8 to step 14 with each of the other two test-tubes in the water-bath.

16. Take the temperature of the water-bath when the final test-tube has been removed and record this in **(a)(ii)**.

**(ii)** Temperature may be a source of error in this investigation.

State the temperatures of the water-bath.

temperature of water-bath taken in step 6 ..... °C

temperature of water-bath taken in step 16 ..... °C

Explain whether the temperature of the water-bath is a significant source of error in this investigation.

.....

.....

.....[1]

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**(iii)** Record your results in an appropriate table.

[2]

**(iv)** A significant source of error for this investigation is deciding when the end-point is reached.
Suggest **one** advantage of carrying out this trial test **before** investigating the effect of substrate concentration on this enzyme-catalysed reaction.

.....

.....

.....[1]

You are required to investigate the effect of substrate concentration on this enzyme-catalysed coagulation.

**(v)** Identify the dependent variable in this investigation.

.....[1]

**(vi)** You are required to prepare different concentrations of milk, using **M**.

**M** is undiluted milk and is to be referred to as 100% milk.

You are required to make a serial dilution of **M**, which reduces the concentration of **M by half** between each successive dilution. You will need to prepare 3 further concentrations of milk.

You will need to prepare 20 $cm^3$ of each concentration.

Complete Fig. 1.4 to show how you will dilute **M** by:

- stating, under each beaker, the volume and concentration of the milk available for use in the investigation
- using one arrow, with a label above the beaker, to show the volume and concentration of milk added to prepare the concentration
- using another arrow, with a label above the beaker, to show the volume of distilled water, **W**, added to prepare the concentration.

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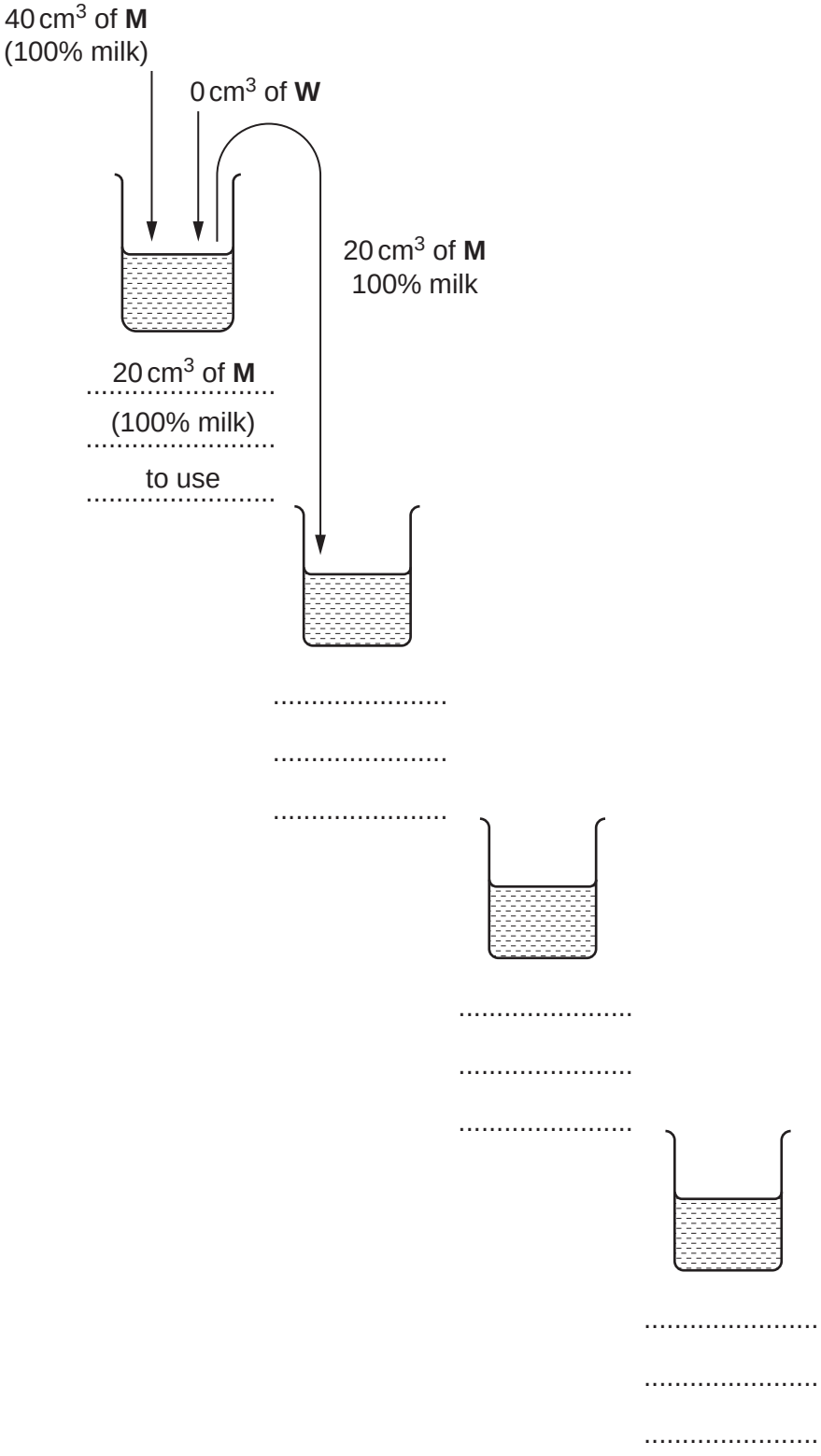



**Fig. 1.4** [3]

17. Prepare the concentrations of milk as decided in **(a)(vi)** and in Fig. 1.4.

18. Adjust the temperature of the water-bath so that it is between 35 °C and 40 °C.
    You will **not** need to maintain this temperature during step 19 to step 24.

19. Put 10 $cm^3$ of the lowest concentration of milk into a test-tube.

20. Repeat step 19 with each of the other concentrations of milk that you have prepared and with 100% milk.

21. Put 1 $cm^3$ of **C** into each test-tube.

22. Gently shake each of the test-tubes to mix the milk and **C**.

23. Put the test-tubes in the water-bath and leave for at least 3 minutes.

*While you are waiting read step 8 to step 13*.

24. After 3 minutes remove one of the test-tubes from the water-bath. Add 1 $cm^3$ of **E** as in step 9, then repeat step 10 to step 13 and record in **(a)(vii)** the time taken to reach the end-point.

25. Repeat step 24 with each of the other test-tubes.

**(vii)** Record your results in an appropriate table.

[4]

**(viii)** Describe a control that could be carried out as part of your investigation.

.....

.....

.....[1]

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**(ix)** This procedure investigated the effect of substrate concentration on the activity of enzyme **E**, using the time taken to reach the end-point.

To modify this procedure for investigating another variable, the substrate concentration would need to be standardised.

Describe how the substrate concentration could be standardised.

.....

.....

Think about how you could modify this procedure to investigate the effect of temperature on the time taken to reach the end-point.

Describe the modifications needed to investigate the effect of **temperature**.

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[3]

**Question 1 continues on page 10**

**(b)** A scientist investigated the percentage mass of protein in milk produced by different animals.

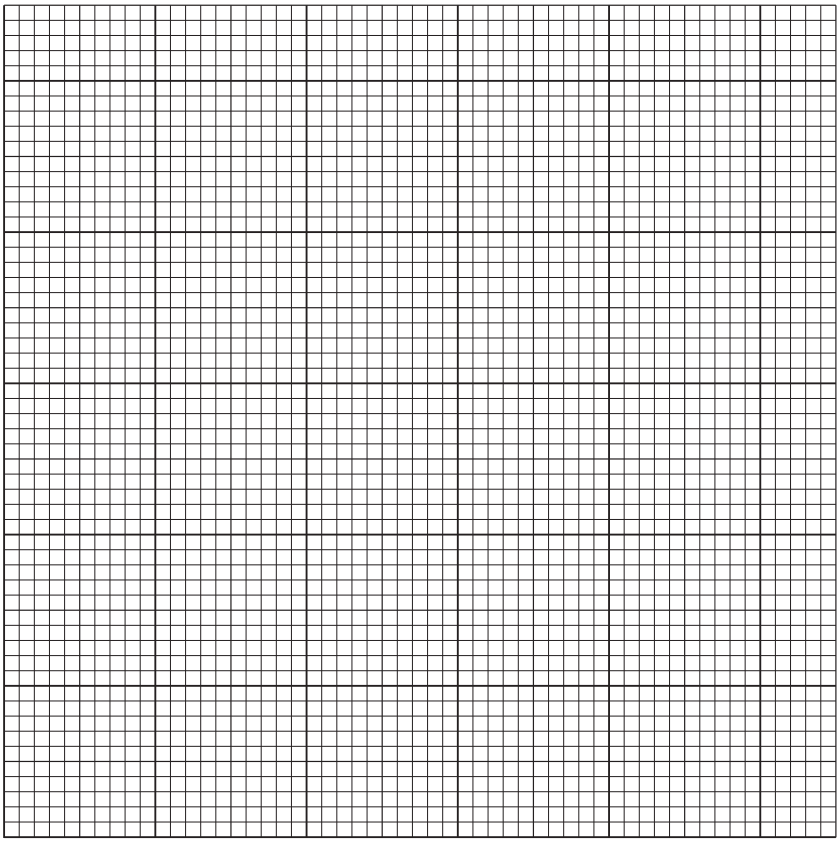
The results are shown in Table 1.1.

**Table 1.1**

| source of milk | percentage mass of protein in milk |
|---|---|
| cow (co) | 3.5 |
| elephant (el) | 4.0 |
| sheep (sh) | 5.4 |
| seal (se) | 10.2 |
| mouse (mo) | 9.0 |

*Use a sharp pencil for drawing charts*.

**(i)** Draw a chart of the data shown in Table 1.1.



[4]

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**(ii)** A scientist investigated enzyme-catalysed coagulation of milk using enzyme **E**. This enzyme hydrolyses (breaks) peptide bonds between certain amino acids in a protein found in milk and this results in the coagulation of the milk.

The scientist recorded the time taken to reach the end-point with each of the types of milk shown in Table 1.1. The shortest time to reach the end-point was recorded when seal milk was investigated.

Use your knowledge of enzymes and the data in Table 1.1 to suggest an explanation for this result.

.....

.....

.....

.....

.....[2]

[Total: 23]

**2** **(a)** **M1** is a slide of a stained transverse section through a plant root.

You are not expected to be familiar with this specimen.

*Use a sharp pencil for drawing*.

**(i)** Draw a large plan diagram of a quarter of the root on **M1**, shown by the shaded area in Fig. 2.1.

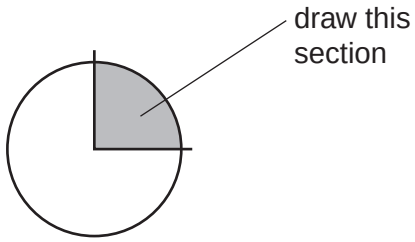



**Fig. 2.1**

Use **one** ruled label line and label to identify the endodermis.

*You are expected to draw the correct shape and proportions of the different tissues*.

[5]

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**(ii)** Observe the central tissue in the root on **M1**.

Select **one** large xylem vessel and **three** adjacent (touching) smaller xylem vessels from the tissue at the centre of the root. The large xylem vessel must touch each of the three smaller xylem vessels.

Make a large drawing of this group of **four** xylem vessels.

[4]

**(iii)** Annotate your drawing in **(a)(ii)** to describe **one** observable feature of the xylem vessels that adapts them for their function by:

- drawing a label line to the feature
- describing next to the line how the feature adapts the xylem vessel for its function.

[1]

**(b)** Fig. 2.2 is a photomicrograph of a stained transverse section of a different root.

You are not expected to be familiar with this specimen.

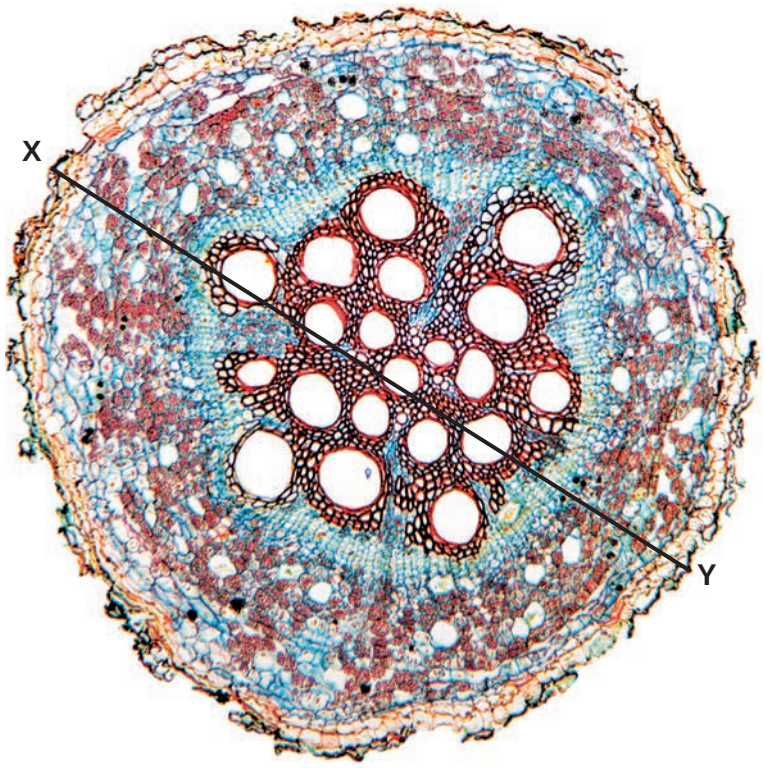



**Fig. 2.2**

In Fig. 2.2 the line **X**–**Y** is drawn across the diameter of the root.

Use the line **X**–**Y** and the scale bar to calculate the actual diameter of the root.

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

actual diameter = .....[4]

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**(c)** Observe the root on **M1** and the root in Fig. 2.2 and identify the differences between them.

Record the observable differences in Table 2.1.

**Table 2.1**

| feature | M1 | Fig. 2.2 |
|---|---|---|
| | | |

[3]

[Total: 17]

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