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9790/03

May/June 2015

2 hours 30 minutes

Additional Materials: As listed in the Confidential Instructions.

READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

Write your answers in the spaces provided on the Question Paper.

Write your answers in the spaces provided on the Question Paper.

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

The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
Total	

The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

This document consists of **18** printed pages and **2** blank pages.

Section A

Answer **all** the questions.

You are recommended to spend no longer than **90 minutes** on question 1.

- 1 You should read through the whole of this question carefully and then plan your use of the time to make sure that you finish all the work that you would like to do.

You are required to investigate the effect of enzyme concentration on the rate of hydrolysis of protein.

In this investigation you will use milk powder as a source of protein. Casein is the main protein in milk.

You are provided with:

- a 1% solution of bacterial protease
- a 10 g dm^{-3} milk solution prepared from skimmed milk powder
- a 1 g dm^{-3} milk solution prepared from skimmed milk powder
- distilled water.

The milk powder contains 36 g of protein per 100 g of powder.

Tap water at 30°C and at 40°C is available for you to use.

You are also provided with a variety of other apparatus and materials that you may use as you wish. You may request more supplies of any of the apparatus and materials from the Supervisor during the course of your investigation.

You should carry out this investigation in two parts.

Part 1 is a trial in which you will use the bacterial protease solution provided to help you to judge a suitable end-point.

In Part 2 you will plan and carry out your investigation using the 10 g dm^{-3} milk solution.

Part 1

- 1 Half fill a beaker or other suitable container with water to act as a water-bath. Adjust its temperature to 30°C ($\pm 2^\circ\text{C}$). Maintain the temperature of the water-bath at this temperature throughout your trial.
- 2 Label three test-tubes **A**, **B** and **C**.
- 3 Use a 10 cm^3 syringe to place 5 cm^3 of the 1 g dm^{-3} milk solution into test-tube **A**. This is to be used to help identify the end-point of the reaction.
- 4 Stir the 10 g dm^{-3} milk solution. Use a 10 cm^3 syringe to place 5 cm^3 of the 10 g dm^{-3} milk solution into each of the test-tubes labelled **B** and **C**.
- 5 Place test-tubes **A**, **B** and **C** in the water-bath and leave until the contents of the test-tubes reach the temperature of the water-bath.

- 6 Once equilibrated to the temperature of the water-bath, use a 1 cm^3 syringe to add 0.5 cm^3 of the 1% bacterial protease solution to test-tube **B**. Mix the contents of the tube.

At the same time, start a stopwatch or stop clock and return test-tube **B** to the water-bath.

- 7 Record the length of time for the cloudiness of the milk in test-tube **B** to match the appearance of the 1 g dm^{-3} milk solution in test-tube **A**. This is the end-point.

.....

- 8 Repeat steps 6 and 7 with test-tube **C** to improve your confidence in judging the end-point. Record the length of time to reach the end-point.

.....

- 9 When you have completed step 8, look carefully at the contents of test-tube **B** and compare with the contents of test-tube **A** again.

- (a) Describe the appearance of the contents of test-tube **B**.

.....[1]

Part 2

Use the apparatus and materials provided to make suitable concentrations of the bacterial protease so that you can investigate the effect of enzyme concentration on the **rate of hydrolysis of milk protein**. Plan how you will carry out this investigation.

Use the space provided on page 4 for a dilution table and any calculations and notes that you wish to make on your proposed method.

In planning your investigation you may decide to use a different:

- temperature
- volume of protease solution
- volume of milk solution as the substrate
- concentration of milk solution as the substrate
- concentration of milk solution to use for judging the end-point.

Carry out your proposed method to investigate the effect of enzyme concentration on the **rate of hydrolysis of milk protein**.

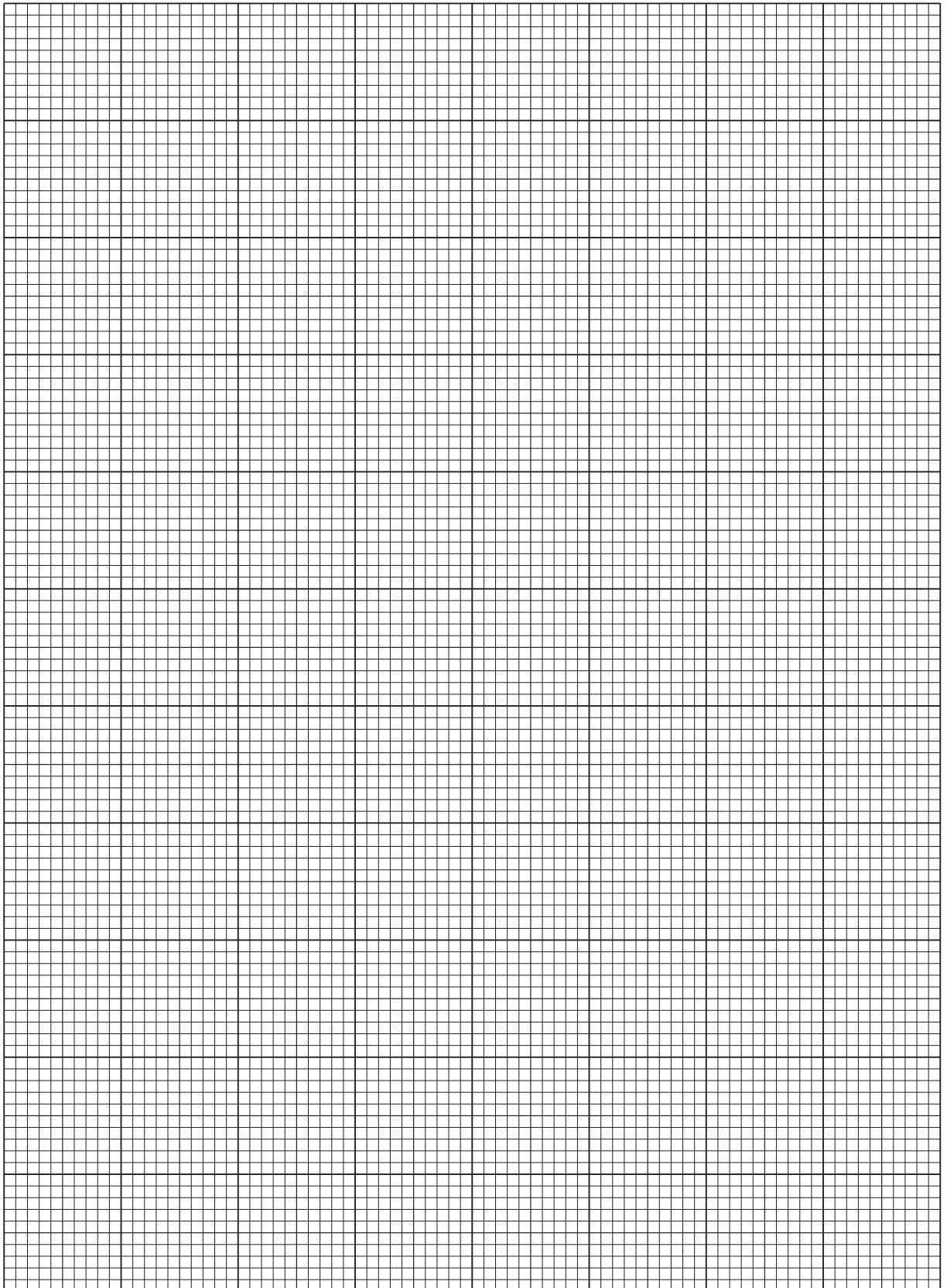
Space for dilution table, calculations and notes.

(b) Describe the method you used to find the effect of the concentration of protease on the rate of hydrolysis of the milk protein.

[8]

- (c) Use the space below to present all your results and any calculations that you have carried out.

- (d) Draw a graph of your results to show the effect of enzyme concentration on the **rate of hydrolysis of milk protein**.



[5]

- (e)** The bacterial protease you have used catalyses the hydrolysis of casein molecules to peptides.

Suggest why this enzyme is not capable of catalysing the complete breakdown of casein.

[3]

- (f)** Describe **and** explain the pattern of results shown in your graph.

[8]

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- (g)** Discuss the validity and suitability of the method of judging the end-point used in this investigation.

[3]

- (h) Judging the end-point is one possible limitation of this investigation.

Identify other limitations that may have affected the quality of the results.

Explain how you would improve the method to overcome these limitations.

[illegible]

Section B

Answer **all** the questions.

You are recommended to spend no longer than **60 minutes** on questions 2 and 3.

You are advised to read through the whole of questions 2 and 3 carefully and then plan your use of the time to make sure that you finish all the work that you would like to do.

- 2** Exocrine tissue in the pancreas secretes a variety of enzymes, including proteases. This tissue is composed of acinar cells, which secrete into branches of the pancreatic duct.

Fig. 2.1 shows a section through a small branch of the pancreatic duct surrounded by acinar cells.



Fig. 2.1

Fig. 2.2 is a diagram made from transmission electronmicrographs of acinar cells from the pancreas.

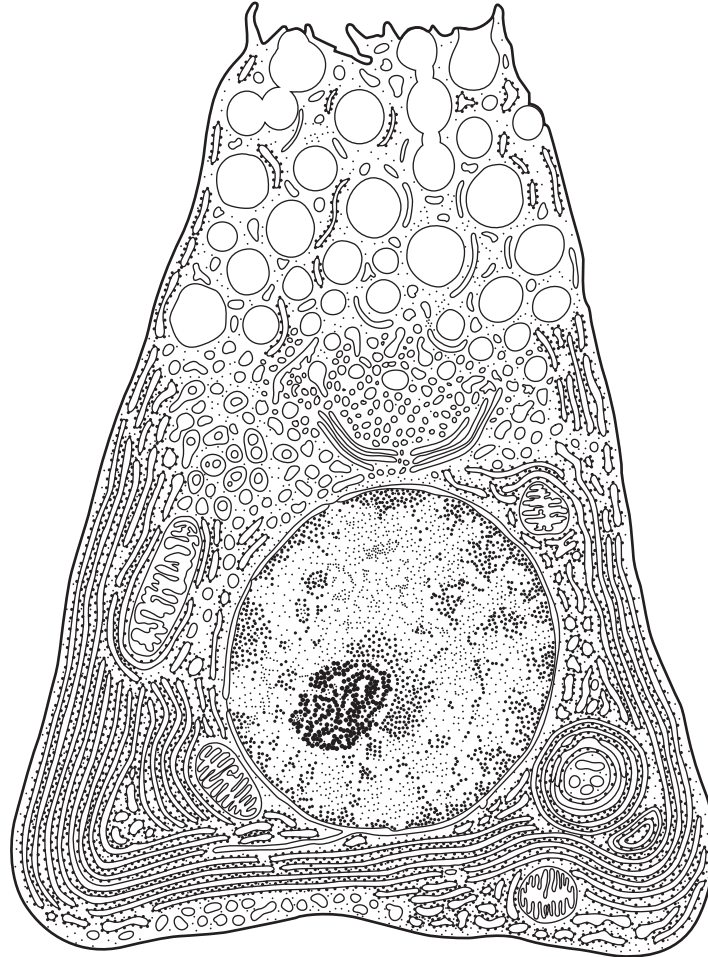


Fig. 2.2

- (b)** Explain how this cell is adapted for the secretion of proteins. You may label and annotate Fig. 2.2 to help your answer if you wish.

.....[6]

- (c) Describe **two** limitations of studying cell structure from transmission electronmicrographs alone.

.....[2]

- (d)** Trypsinogen is one of the proteins secreted by acinar cells. When trypsinogen reaches the lumen of the duodenum it is activated by the enzyme enterokinase to form trypsin. Trypsin is a protease.

Suggest why it is necessary for exocrine cells in the pancreas to secrete an inactive protease.

.....[2]

[Total: 15]

- 3 All drawings made in this question should include an indication of the size of the original specimen by stating the actual size or magnification, or providing a scale bar.**

You are provided with some fruits of shepherd's purse, *Capsella bursa-pastoris*, labelled **K2**. Shepherd's purse is a flowering plant that is a common weed.

- (a)** Use a hand lens and the low power of your microscope to observe the fruits of *C. bursa-pastoris*.

Use the space below to make a **labelled** and **annotated** drawing of one fruit.

(b) Slide **K3** is a section of a fruit of *C. bursa-pastoris*.

Fig. 3.1 shows the position of the seeds within the fruit as they appear in slide **K3**.

Use the low power of your microscope to find a complete section of a seed, as shown in Fig. 3.1.



Fig. 3.1

Make a labelled drawing of a section of a seed to show the structure of an embryo.

- (c) The Petri dish labelled **K4** contains some soaked fruits of maize, *Zea mays*.

Use the apparatus provided to cut one fruit in half longitudinally and another in half transversely, as shown in Fig. 3.2.

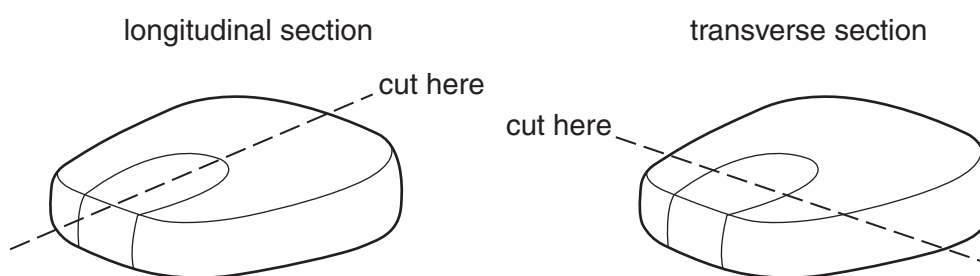


Fig. 3.2

Stain the sections of the fruits with the iodine solution provided.

Use the space below to make **labelled** and **annotated** drawings to show the external appearance and internal structure of the maize fruits.

- (d) Use the table below to record the similarities and differences between the fruits of the two species. You may add extra rows if you wish.

feature	shepherd's purse <i>Capsella bursa-pastoris</i>	maize <i>Zea mays</i>

[4]

[Total: 20]

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