



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2018

Centre Number

--	--	--	--	--

Candidate Number

--	--	--	--	--

Biology

StemUp Model Solution

Assessment Unit AS 3

assessing

Practical Skills in AS Biology



[SBY31]

SBY31

WEDNESDAY 2 MAY, MORNING

TIME

1 hour.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Do not write outside the boxed area on each page or on blank pages.

Complete in black ink only. **Do not write with a gel pen.**

Answer **all eight** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 50.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

You are reminded of the need for good English and clear presentation in your answers.

Use accurate scientific terminology in all answers.

11074.05 R



1 Chromatography is a technique that can be used to separate different solutes.

(a) When **preparing** a chromatogram, state **two** precautions necessary to ensure a valid result.

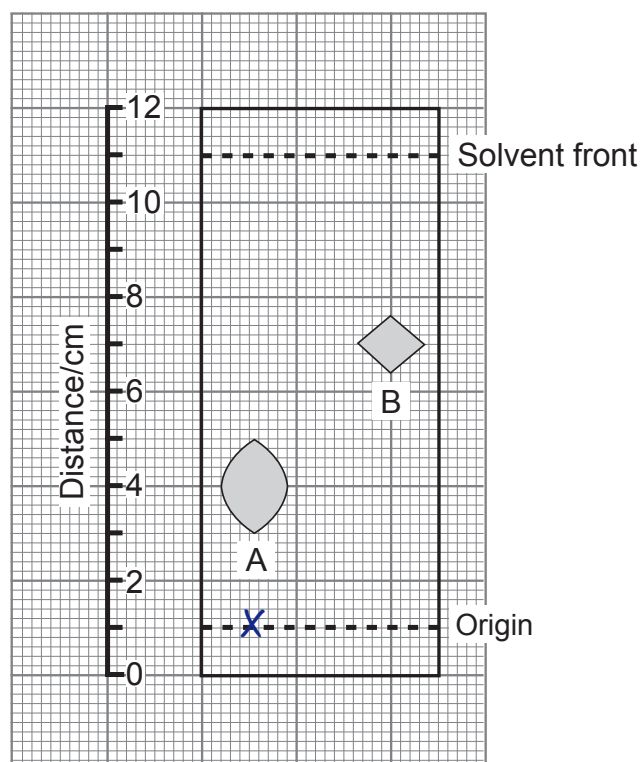
1. Draw the base line (origin) in pencil, not ink, so it does not dissolve and run in the solvent.

2. Keep the spot very small and concentrated (let it dry between applications), and keep the origin above the solvent level.

[2]



- (b) The diagram below represents a chromatogram showing two amino acids, **A** and **B**.



- (i) On the diagram, use the letter **X** to show the position where the spot for amino acid **A** would have been placed. [1]
- (ii) Calculate the R_f value for amino acid **B**. Give your answer to two decimal places.

(Show your working.)

$$\text{Distance moved by B} = 7 - 1 = 6 \text{ cm}$$

$$\text{Distance moved by solvent} = 11 - 1 = 10 \text{ cm}$$

$$R_f = 6 \div 10 = 0.60$$

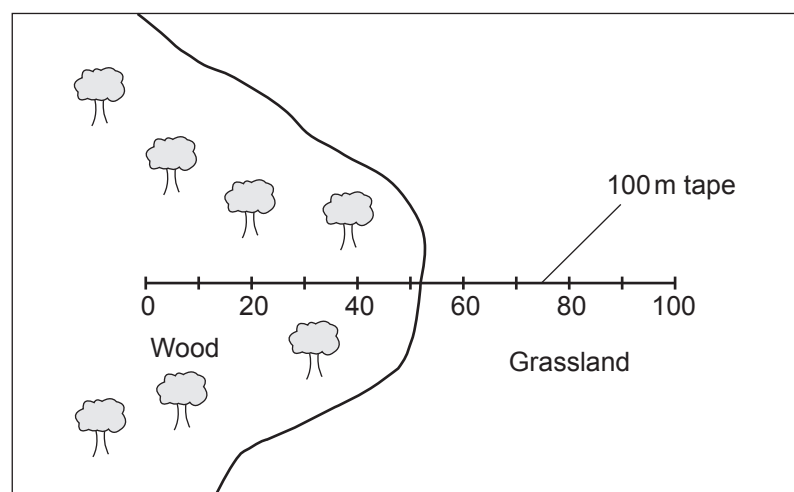
0.60

[2]



2 In ecological sampling, species abundance can be measured in a variety of ways.

In one investigation, a 100 m line tape was laid out, extending from the centre of a small wood into an area of grassland, as shown in the diagram below.

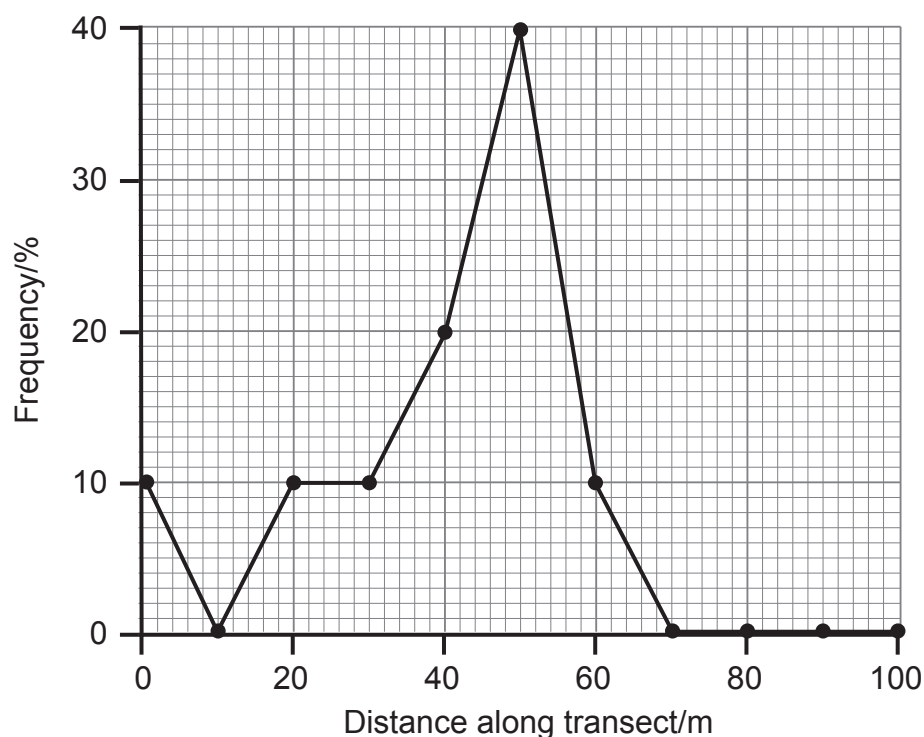


The frequency of lesser celandine (*Ranunculus ficaria*), a small ground layer plant, was sampled at 10 m intervals along the transect using a pin frame.

A pin frame can be used to measure the frequency of plant species along a transect. At each sampling point, the ten pins in the frame were lowered, and the number of pins which touched lesser celandine was recorded. This data was used to estimate percentage frequency.

The results are shown in the graph opposite.





- (a) With reference to habitat, describe the distribution shown by the lesser celandine along the transect.

In the centre of the wood (shaded woodland habitat) the frequency of lesser celandine is low (10 % at 0 m, 0 % at 10 m).

Frequency increases through the wood to reach a peak of 40 % at the edge of the wood (50 m).

It then decreases sharply outside the wood into the grassland (10 % at 60 m).

Between 70 and 100 m in the grassland none is found at all.

[3]

[Turn over]



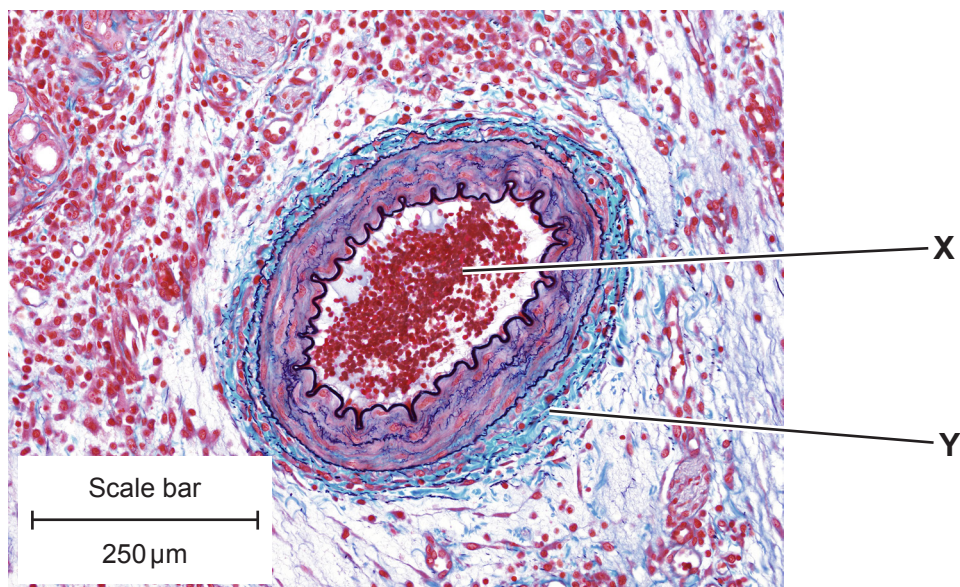
- (b) The distribution of lesser celandine is affected by light intensity and competition from other ground layer plants (e.g. grasses). Taking account of this, explain the frequency of lesser celandine at a distance of 50 m along the transect.

At the wood edge there is sufficient light (no dense tree canopy) and little or no competition from grasses, so frequency is highest.

[1]



- 3 The photomicrograph below shows a section through an artery.



© Microscape / Science Photo Library

- (a) Identify the tissues labelled X and Y.

X Blood (red blood cells)
Y Fibrous (connective) tissue [2]

- (b) Identify **one** piece of evidence from the photomicrograph which shows that the structure is an artery rather than a vein.

The wall is thick relative to the size of the lumen, and the vessel is
round in cross section.

[1]

- (c) Using the scale bar, calculate the magnification of the photomicrograph.

(Show your working.)

Length of scale bar = 30 mm; $30 \times 1000 = 30\,000\ \mu\text{m}$

Magnification = image size $\div$ actual size = $30\,000 \div 250 = 120$

$\times 120$ [3]

[Turn over]



- 4 Beetroot cells contain the pigment betalain which gives beetroot its dark red-purple colour. Damage to membranes in beetroot cells can cause some of the pigment to leak out of the cells.

A colorimeter can be used to investigate the effect of temperature on membrane permeability in beetroot.

A typical procedure is as follows:

1. Cut several small sections of beetroot
2. Rinse the sections of beetroot in running water
3. Add one section of beetroot to a boiling tube half filled with water
4. Place the boiling tube in a water bath set at 20°C
5. After 10 minutes in the water bath, remove a small amount of the water surrounding the beetroot in the boiling tube and measure percentage transmission using a colorimeter
6. Repeat at temperatures of 30, 40, 50 and 60°C.

- (a) (i) Suggest what was used to calibrate the colorimeter to 100% transmission.

Distilled water (in a cuvette)

[1]

- (ii) In this investigation, a blue-green filter is typically used in the colorimeter.

State the benefit of using a filter in investigations using a colorimeter.

The filter gives maximum differentiation (sensitivity) across the results, as only the colour of light the pigment absorbs is used.

[1]



At 20°C, 97% transmission was obtained, 95% was obtained at 30°C and 87% at 40°C. Percentage transmission at 50°C was 72% and 40% at 60°C.

- (iii) Using the information provided, complete the table below of the results. Your table does **not** require a caption.

<i>Temperature / °C</i>	<i>Transmission / %</i>
20	97
30	95
40	87
50	72
60	40

[3]

- (iv) Explain the results of this investigation.

Percentage transmission decreases as temperature increases, slowly up to 40 °C and then steeply.

At higher temperatures the cell membranes break down and become more permeable (proteins denature, phospholipids become more fluid), so more betalain pigment diffuses out into the water, which absorbs more light.

[2]

[Turn over]



- (b) Rather than using different sections of beetroot, a student carried out this investigation using only one section of beetroot, which was immersed at each temperature in turn.

Suggest and explain how the results would be different from those shown in (a)(iii).

The % transmission would be lower at the higher temperatures (more pigment in the water).

This is because the membrane damage accumulates over time: the same section has already been heated at each lower temperature, so it has leaked more pigment by the time it is tested.

[2]





BLANK PAGE

DO NOT WRITE ON THIS PAGE

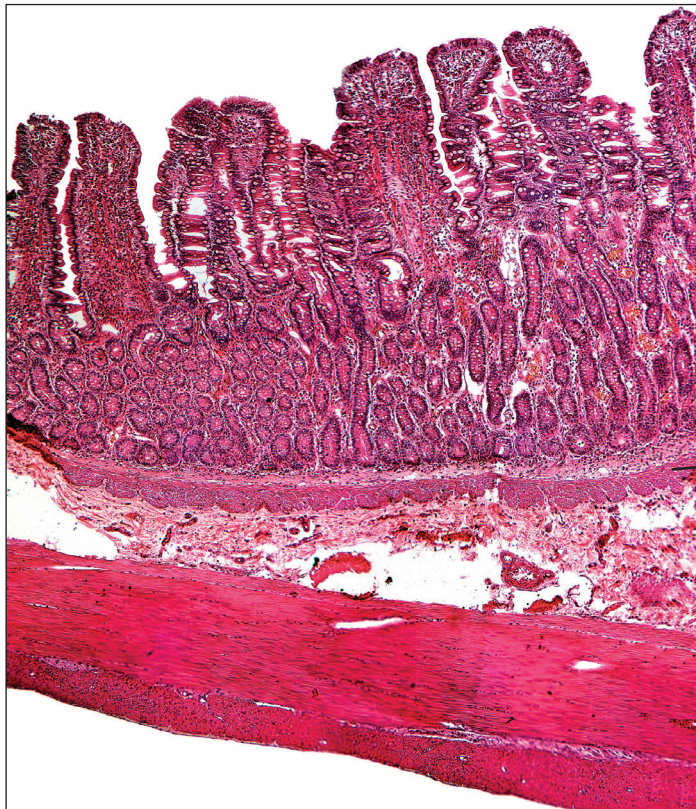
(Questions continue overleaf)

11074.05 R

[Turn over



- 5 The photomicrograph below shows a section through the ileum. The muscularis mucosa is labelled.



Muscularis
mucosa

© Dr Keith Wheeler / Science Photo library

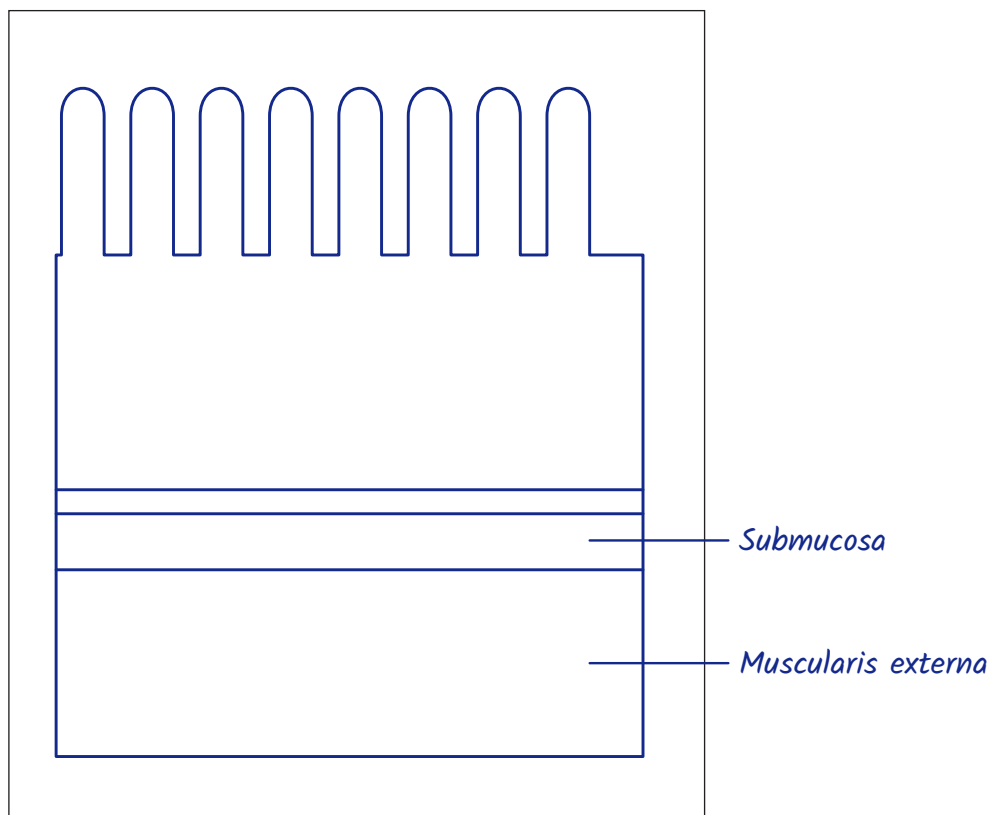


Draw a block diagram of this section in the box below. Your diagram should only show the following layers:

- muscularis externa
- mucosa
- muscularis mucosa
- submucosa.

(Note: the serosa is not clearly visible in this section and should **not** be included.)

Label the submucosa and the muscularis externa.



[5]

[Turn over



BLANK PAGE
DO NOT WRITE ON THIS PAGE

11074.05 R



- 6 Describe how you would carry out an investigation in order to measure the average water potential of cells in potato tissue using the weighing method.

Use a cork borer to cut identical potato cylinders, trim to the same length,

blot dry and weigh each one on a balance.

Make up a range of sucrose solutions (e.g. 0 to 1.0 mol dm⁻³) of known

solute potential and place a cylinder in each (with repeats), in labelled tubes.

Leave for a set time, between 1 and 48 hours (e.g. 24 hours), at the same

temperature.

Remove the potato, surface dry with paper towel and reweigh.

Calculate the percentage change in mass for each cylinder: (final – initial) ÷

initial × 100.

Plot percentage change in mass against the solute potential of the sucrose

solution and draw a line of best fit.

Where the line of best fit crosses the x-axis (0 % change), the solute

potential of the immersing solution is equal to the water potential of the

potato tissue.

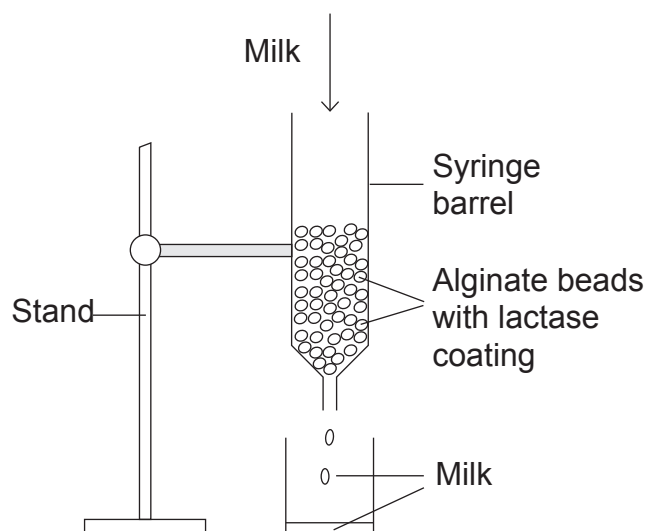
[5]

[Turn over]

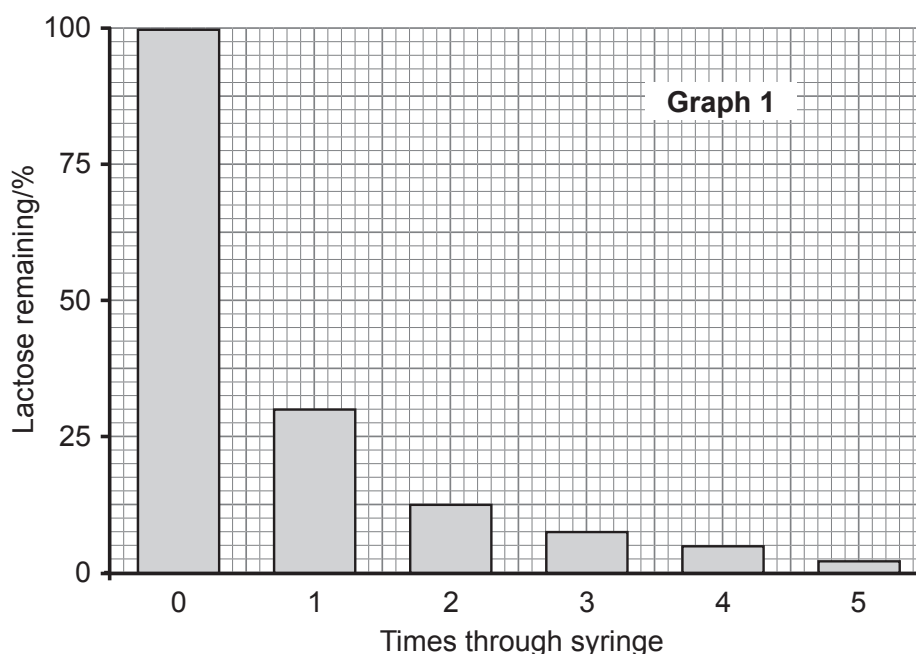


- 7 Milk contains the sugar lactose, a disaccharide which can be broken down to its constituent monosaccharides (glucose and galactose) by the enzyme lactase.

Alginate beads were coated with lactase and placed into the barrel of a large syringe. 50 cm³ of milk was then poured through the syringe containing the beads, as shown in the diagram below.



The percentage of lactose remaining after all the milk had passed through once was analysed. This milk was then passed through the syringe a second time and the percentage of lactose in the milk again analysed. This process was repeated a further three times. The results are shown in **Graph 1**.



(a) Describe and explain the results shown.

The amount of lactose remaining decreases each time the milk is poured through, from 100 % to 30 % after one pass and about 3 % after five.

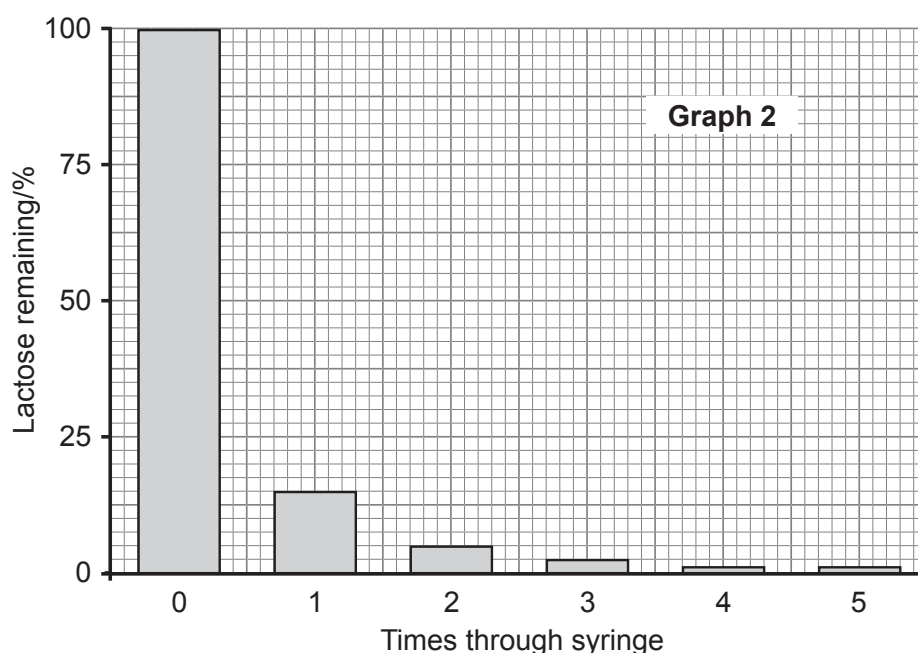
The decrease is greatest the first time the milk is poured through the syringe and gets smaller each time.

Lactase immobilised on the beads breaks down (hydrolyses) the lactose into glucose and galactose.

The first time, more substrate molecules are available, so more enzyme-substrate complexes form; later there is less lactose left to collide with active sites.

[4]

The investigation was repeated using smaller alginate beads coated with lactase. The results for this are shown in **Graph 2**.



- (b) Describe and suggest an explanation for the difference between the results in **Graph 2** and **Graph 1**.

With smaller beads more lactose is broken down each time the milk is poured through (15 % remains after one pass compared with 30 %).

Smaller beads give a larger surface area, so more enzymes are exposed, and the milk flows more slowly so has more contact time.

So more active sites are available and more enzyme-substrate complexes can form.

[3]

- (c) State **two** variables that should have been controlled in this investigation.

1. *Same volume, type and age of milk*

2. *Milk at the same temperature*

[2]

- (d) Describe how you could show that the milk collected at the end of the investigation contained glucose.

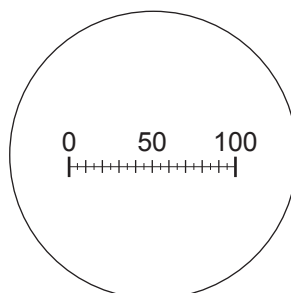
Dip a Clinistix (glucose-specific test strip) into the milk: it turns from pink to purple if glucose is present.

[1]

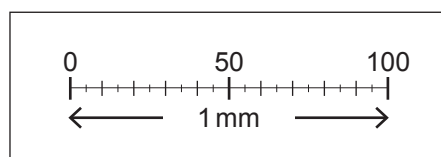


- 8 When viewing plant cells with a light microscope, their length can be calculated using an eyepiece graticule and a stage micrometer.

A typical eyepiece graticule and a stage micrometer are represented in the diagrams below.



Eyepiece
graticule
(on microscope
eyepiece lens)



Stage
micrometer
(on glass
slide)

- (a) Using information in the diagram, describe the steps you would take to calibrate an eyepiece graticule.

At low power, line up the zero of the eyepiece graticule with the zero of the stage micrometer.

Find a position further along where marked division lines on both scales overlap exactly.

Calculate this distance on the stage micrometer (1 mm divided into 100 divisions, so each is 10 μm).

Divide the distance on the stage micrometer by the number of eyepiece divisions to give the length of each eyepiece division (in μm).

[4]

[Turn over]



- (b) A student measured the length of 10 epidermal plant cells on a microscope slide using an eyepiece graticule. The mean cell length was calculated as $125\text{ }\mu\text{m}$.

The student then went for lunch for 1 hour and, when he returned, he measured the length of a further 10 cells on his slide. The mean length for these 10 cells was calculated as $105\text{ }\mu\text{m}$.

Apart from random variation in cell length, suggest an explanation for the different means obtained.

The cells have lost turgor and shrunk (become flaccid or plasmolysed).

This is due to water loss by evaporation from the slide (the mount dried out) during the hour.

[2]

THIS IS THE END OF THE QUESTION PAPER





BLANK PAGE

DO NOT WRITE ON THIS PAGE

11074.05 R



BLANK PAGE
DO NOT WRITE ON THIS PAGE

11074.05 R





BLANK PAGE

DO NOT WRITE ON THIS PAGE

11074.05 R



DO NOT WRITE ON THIS PAGE

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	

Total Marks	
-------------	--

Examiner Number

Permission to reproduce all copyright material has been applied for.
In some cases, efforts to contact copyright holders may have been unsuccessful and CCEA
will be happy to rectify any omissions of acknowledgement in future if notified.

