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**BIOLOGY** **9700/31**

Paper 3 Advanced Practical Skills 1 **May/June 2019**

**2 hours**

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

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

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**1** Catalase breaks down hydrogen peroxide as shown in Fig. 1.1.




**Fig. 1.1**

The decrease in the concentration of hydrogen peroxide can be measured to investigate the progress of this enzyme-catalysed reaction.

Catalase can be found in plant extract.

Potassium manganate(VII) solution can be used to estimate the concentration of hydrogen peroxide.

The greater the concentration of hydrogen peroxide, the higher the volume of potassium manganate(VII) solution needed to reach the end-point.

The end-point is reached when the first colour change appears and stays for at least 5 seconds.

Potassium manganate(VII) solution will be added one drop at a time using a syringe.

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Carry out step 1 to step 3 to practise releasing drops from a syringe.

1. Fill a syringe with 1 $cm^3$ of distilled water, **W**.

2. Hold the syringe over an empty beaker as shown in Fig. 1.2. Push the plunger slowly to release one drop.

3. Repeat this until you can release one drop at a time.

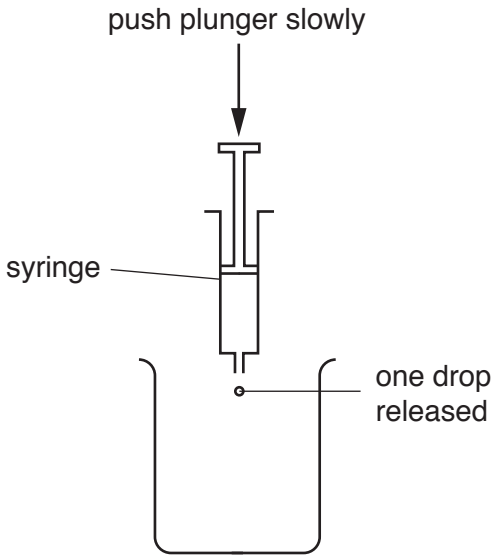



**Fig. 1.2**

You will need to investigate the effect of changing pH on the activity of the enzyme catalase by:

- changing the pH using different pH buffers
- measuring the volume of **P** needed to reach the end-point for each pH.

The lower the concentration of hydrogen peroxide remaining after 5 minutes, the lower the volume of **P** needed to reach the end-point.

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**[Turn over**

You are provided with the materials shown in Table 1.1.

**Table 1.1**

| labelled | contents | hazard | volume/cm$^3$ |
|---|---|---|---|
| **A** | dilute sulfuric acid | irritant | 25 |
| **H** | 1% hydrogen peroxide solution | irritant | 25 |
| **P** | 1% potassium manganate(VII) solution | oxidising harmful | 50 |
| **E** | plant extract solution | harmful irritant | 25 |
| **B3** | buffer pH3 | none | 10 |
| **B4** | buffer pH4 | none | 10 |
| **B5** | buffer pH5 | none | 10 |
| **B6** | buffer pH6 | none | 10 |
| **B7** | buffer pH7 | none | 10 |

If any solution comes into contact with your skin, wash off immediately under cold water.

It is recommended that you wear suitable eye protection.

**(a) (i)** Think about the hazards of using the materials in Table 1.1.

State whether you think the risk of using the materials is **low**, **medium** or **high**.
Give a reason for your answer.

*risk*.....

*reason* .....

..... [1]

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Carry out step 4 to step 18 to investigate the effect of pH on the activity of catalase in the plant extract **E**.

4. Label 5 beakers **pH3**, **pH4**, **pH5**, **pH6** and **pH7**.

5. Put 1 $cm^3$ of each buffer into the appropriately labelled beaker.

6. Put 1 $cm^3$ of **E** into each beaker. Stir gently to mix.

7. Leave the beakers for at least 1 minute. Stir gently to mix.

*The reaction will start as soon as **H** is added to the mixture of **E** and buffer in step 8.*

8. Put 1 $cm^3$ of **H** into each beaker. Stir gently to mix.

9. Leave for 5 minutes.

*While you are waiting, use your time to continue with Question 1.*

10. After 5 minutes, put 1 $cm^3$ of **A** into each beaker. Stir gently to mix.

You will now test each solution to find the volume of **P** needed to reach the end-point.

11. Put the beaker labelled **pH3** onto a white tile.

12. Fill the syringe labelled **P** with 2.0 $cm^3$ of **P**.

13. Wipe off any **P** from the outside of the syringe with a paper towel.

14. Put one drop of **P**, as shown in Fig. 1.2, into the beaker labelled **pH3**.

15. Stir gently to mix.

16. Repeat step 14 and step 15 until the end-point is reached.

    *You may need to refill the syringe with **P**.*

17. Record in **(a)(ii)** the volume of **P** added.

18. Repeat step 11 to step 17 with each of the beakers labelled **pH4**, **pH5**, **pH6** and **pH7**.

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**[Turn over**

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

[6]

**(iii)** State the independent variable in this investigation.

..... [1]

**(iv)** Use your results in **(a)(ii)** to suggest an optimum pH for catalase in this plant extract.

Give a reason for your answer.

*optimum pH*.....

*reason* .....

..... [1]

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**(v)** Identify **one** source of error in this investigation.

Explain why this is a source of error.

*source of error*.....

*explanation*.....

.....

..... [1]

**(vi)** Suggest how you would make improvements to this investigation in order to obtain a more accurate estimate of the optimum pH for catalase in this plant.

.....

.....

.....

.....

.....

.....

.....

..... [3]

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**[Turn over**

**(b)** A student carried out another investigation into the effect of temperature on the release of oxygen from hydrogen peroxide, using a plant extract containing the enzyme catalase.

Test-tubes containing plant extract and hydrogen peroxide were placed in thermostatically controlled water-baths, at five different temperatures for 180 seconds.

The volume of oxygen produced was measured. All other variables were standardised.

The results are shown in Table 1.2.

**Table 1.2**

| temperature/ °C | volume of oxygen produced in 180 seconds/cm$^3$ |
|---|---|
| 17.5 | 3.7 |
| 25.0 | 6.4 |
| 38.5 | 9.8 |
| 47.5 | 4.3 |
| 60.0 | 0.3 |

**(i)** Plot a graph of the data in Table 1.2 on the grid in Fig. 1.3.

*Use a sharp pencil for drawing graphs*.

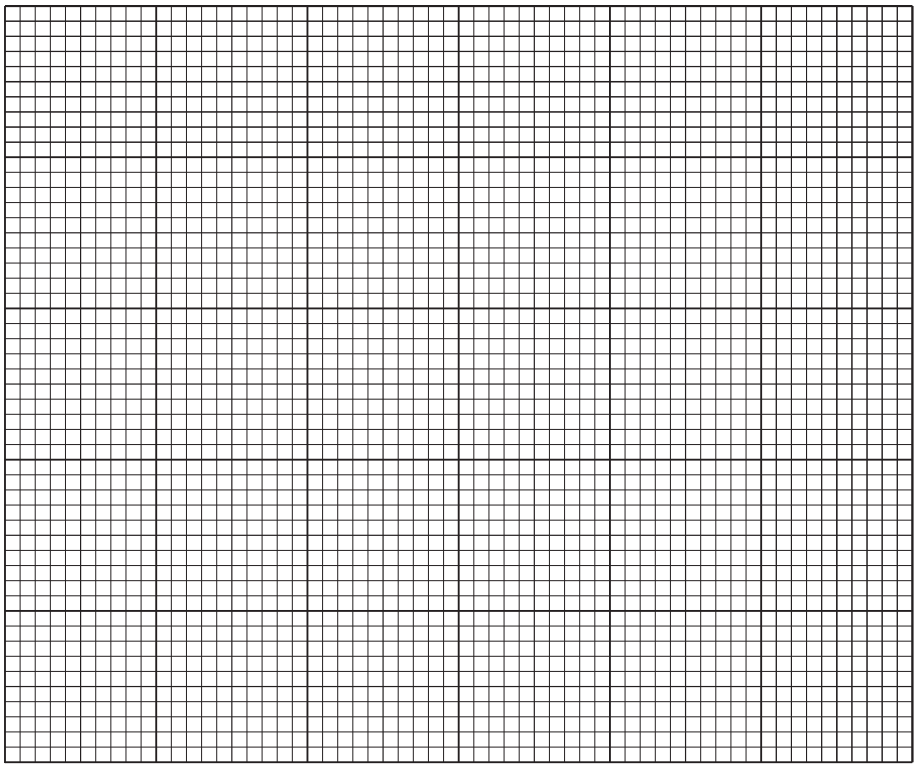


**Fig. 1.3**

[4]

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**(ii)** Use your graph in Fig. 1.3 to determine the volume of oxygen produced when the temperature is 29.5 °C.

Show on your graph how you determined your answer.

volume of oxygen = ..... [1]

**(iii)** Suggest an explanation for the results between 20.0 °C and 60.0 °C.

.....

.....

.....

.....

.....

.....

.....

..... [3]

**(iv)** Suggest an appropriate control the student could have used for this investigation.

.....

..... [1]

[Total: 22]

**2** **J1** 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 drawings*.

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

**(a)** **(i)** Draw a large plan diagram of the whole root.

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

[5]

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**(ii)** Observe the cells in the cortex of the root on **J1**.

Select **four** adjacent, touching cells which show observable features of the cortex tissue.

Each cell must touch at least two other cells.

Make a large drawing of this group of **four** touching cells.

Use **one** ruled label line and label to identify the cell wall of **one** cell.

[5]

**(b)** Fig. 2.1 is a photomicrograph of a stained transverse section through a root of a different type of plant.

You are not expected to be familiar with this specimen.

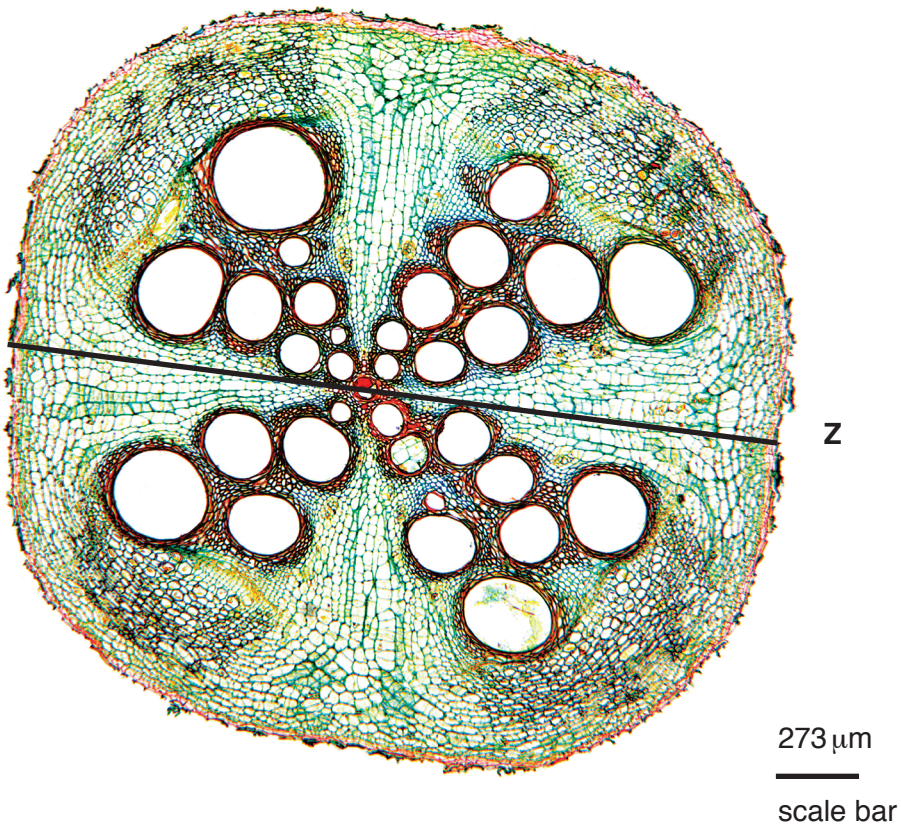



**Fig. 2.1**

**(i)** Annotate Fig. 2.1 to describe **three** observable differences between the root in Fig. 2.1 and the root on **J1**.

- Draw label lines to **three** features of the root in Fig. 2.1 that are different from the root on **J1**.
- Label one line **Q**, label one line **R** and label one line **S**.
- Next to each letter, describe how each feature of the root in Fig. 2.1 differs from the root on **J1**.

[3]

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**(ii)** Use the scale bar and the line **Z** on Fig. 2.1 to calculate the actual width of the root.

Show all the steps in your working and use appropriate units.

actual width of the root = ..... [5]

[Total: 18]

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**BIOLOGY** **9700/32**

Paper 3 Advanced Practical Skills 2 **May/June 2019**

**2 hours**

Candidates answer on the Question Paper.

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**1** Fusicoccin is a chemical that increases the sucrose concentration in phloem at the source.

In this investigation you will be provided with a sample, **U**, which has been taken from the phloem of a plant.

You will need to:

- prepare proportional dilutions of a 10% sucrose solution
- carry out the test for non-reducing sugars on each concentration of sucrose solution
- carry out the test for non-reducing sugars on the unknown concentration of sucrose, **U**
- estimate the concentration of sucrose in **U**.

You are provided with the materials shown in Table 1.1.

**Table 1.1**

| labelled | contents | hazard | volume/cm$^3$ |
|---|---|---|---|
| **S** | 10% sucrose solution | none | 50 |
| **Benedict's** | Benedict's solution | harmful | 30 |
| **W** | distilled water | none | 50 |
| **H** | dilute hydrochloric acid | irritant | 20 |
| **A** | 10 g sodium hydrogencarbonate powder | none | – |
| **U** | solution of unknown sucrose concentration | none | 10 |

If any of the materials come into contact with your skin, wash off immediately under cold water.

It is recommended that you wear suitable eye protection.

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**(a)** You will need to:

- make a proportional dilution of 10% sucrose solution, **S**, which reduces the concentration by 2% between each successive dilution
- prepare 5 $cm^3$ of each concentration of sucrose solution.

**(i)** Complete Table 1.2 to show how you will prepare these concentrations.

**Table 1.2**

| percentage concentration of sucrose solution | volume of **S** / $cm^3$ | volume of **W** / $cm^3$ |
|---|---|---|
| 10.0 | 5.0 | 0.0 |

[2]

Carry out the test for non-reducing sugars on the concentrations of sucrose using step 1 to step 17.

1. Set up a water-bath and heat to boiling, ready for step 7 and step 14.
2. Prepare the concentrations of sucrose solution as shown in Table 1.2, using the beakers provided.
3. Label test-tubes with the concentrations of sucrose prepared in step 2.
4. Put 2 $cm^3$ of each concentration of sucrose into the appropriately labelled test-tubes.
5. Label another test-tube **U** and put 2 $cm^3$ of **U** into this test-tube.
6. Put 2 $cm^3$ of **H** into all the test-tubes. Shake gently to mix.
7. Put all the test-tubes into the boiling water-bath (set up in step 1).
   Leave the test-tubes for 2 minutes.
8. After 2 minutes, remove all the test-tubes from the water-bath and put them into the beaker of water labelled **For cooling**.

*You will need the boiling water-bath again for step 14.*

9. Leave the test-tubes in the beaker for 3 minutes.
10. After 3 minutes, put a small amount of **A** into each test-tube. The mixture will fizz and rise up the test-tube.

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11. Continue to put a small amount of **A** into each test-tube until there is no more fizzing and there is a small amount of **A** in the bottom of the test-tube.

12. Put 4 $cm^3$ of Benedict's solution into the test-tube containing the highest concentration of sucrose solution.

13. Shake the test-tube gently to mix.

14. Put this test-tube in the boiling water-bath. Start timing.

15. Measure the time taken for the first appearance of a colour change in the test-tube.
If there is no colour change after 120 seconds, **stop timing** and record as 'more than 120'.

16. Record the result from step 15 in **(a)(ii)**.

17. Remove the test-tube from the water-bath. Put the test-tube in the test-tube rack.

18. Repeat step 12 to step 17 with the remaining concentrations of sucrose solution.

**(ii)** Record your results in an appropriate table for the known concentrations of sucrose solution.

[5]

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19. Repeat step 12 to step 15 with **U** and record the result from step 15 in **(a)(iii)**.

**(iii)** State the result for **U**.

..... [1]

A plant that has been treated with fusicoccin has a phloem sucrose concentration of between 5.5% and 7.5%.

**(iv)** State whether **U** is taken from the phloem of a plant treated with fusicoccin.
Give a reason for your answer.

*answer*.....

*reason* .....

..... [1]

**(v)** Suggest how you could change the independent variable to have more confidence in your answer to **(iv)**.

.....

.....

.....

..... [2]

An investigation was carried out to show the effect of fusicoccin on two plants, **F** and **G**.

- Plant **F** was treated with 10 $cm^3$ of fusicoccin solution.
- Plant **G** was treated with 10 $cm^3$ of water instead of fusicoccin solution.
- Plant **F** and plant **G** were grown in moist soil and in identical conditions.

**(vi)** State why plant **G** was treated with 10 $cm^3$ of water.

.....

.....

..... [1]

**(b)** A scientist investigated the effect of treating a plant with fusicoccin.
Samples were taken from the phloem every 35 minutes for a total of 175 minutes.

The concentration of sucrose in each sample was measured. These raw results were then used to calculate the rate of mass flow.

The results are shown in Table 1.3.

**Table 1.3**

| time/min | rate of mass flow /$cm^3 min^{-1}$ |
|---|---|
| 35 | 6.00 |
| 70 | 10.25 |
| 105 | 15.00 |
| 140 | 19.50 |
| 175 | 23.75 |

**(i)** Plot a graph of the data in Table 1.3 on the grid in Fig. 1.1.

*Use a sharp pencil for drawing graphs*.

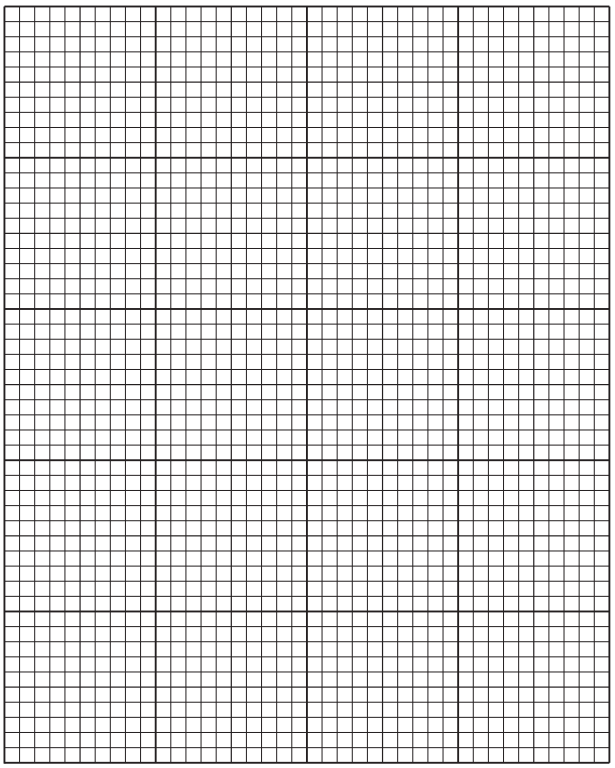


**Fig. 1.1**

[4]

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**(ii)** Use your graph to find the time when the rate of mass flow was $20\,cm^3\,min^{-1}$.
Show on the graph how you determined your answer.

time = ..... [2]

**(iii)** Before treating the plant with fusicoccin, the scientist had obtained a rate of mass flow of $1.5\,cm^3 min^{-1}$.

Describe the effect of fusicoccin on the rate of mass flow shown in Fig. 1.1.

..... [1]

**(iv)** Suggest how fusicoccin increases the loading of sucrose into phloem sieve tubes.

.....

.....

.....

.....

..... [2]

[Total: 21]

**2** **M1** is a slide of a stained transverse section through a plant organ.

You are not expected to be familiar with this specimen.

**(a)** Select a field of view so that you can observe:

- the epidermis
- at least three vascular bundles.

*Use a sharp pencil for drawings.*

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

**(i)** Draw a large plan diagram from the selected field of view which has:

- part of the epidermis
- only **three** vascular bundles
- any other observable tissues.

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

[5]

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**(ii)** Observe the epidermis of the organ on **M1**.

Select two epidermal cells **and** two adjacent, touching cells on the layer below the epidermis.

Each cell must touch at least two other cells.

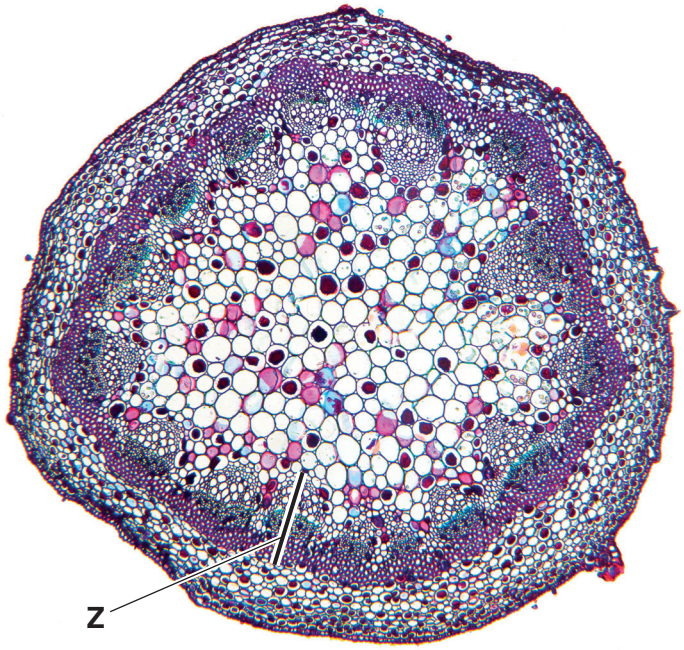
Make a large drawing of this group of **four** cells.

Use **one** ruled label line and label to identify the cell wall of **one** cell.

[5]

**(b)** Fig. 2.1 is a photomicrograph of a stained transverse section through an organ from a different species.

You are not expected to be familiar with this specimen.




magnification ×20

**Fig. 2.1**

**(i)** Identify the organ shown in Fig. 2.1.
Describe **one** observable feature that supports your identification.

*name of organ* .....

*feature* .....

..... [1]

**(ii)** Use the magnification and the line **Z** on Fig. 2.1 to calculate the actual length of the vascular bundle.

Show all the steps in your working and use appropriate units.

actual length of the vascular bundle = .....[5]

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**(iii)** State the apparatus that you would use with a microscope to measure the actual length of a vascular bundle in the organ on **M1**.

..... [1]

**(c)** Identify the observable differences between the organ on **M1** and the organ shown in Fig. 2.1.

Record the observable differences in Table 2.1.

**Table 2.1**

| feature | M1 | Fig. 2.1 |
|---|---|---|
| | | |

[2]

[Total: 19]

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**BIOLOGY** **9700/33**

Paper 3 Advanced Practical Skills 1 **May/June 2019**

**2 hours**

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**1** Milk protein concentrates (MPCs) are used for manufacturing food products such as cheese and ice cream.

Different types of milk contain different concentrations of protein. It is important for the food industry to know the concentration of protein in the milk used in the production of MPCs.

The concentration of protein in milk can be measured using potassium hydroxide solution and copper sulfate solution.

You will need to:

- prepare a serial dilution of the proteins in the milk, **M**
- carry out the test for protein on each concentration of milk.

You are provided with the materials shown in Table 1.1.

**Table 1.1**

| labelled | contents | hazard | volume / $cm^3$ |
|---|---|---|---|
| **M** | 100% milk | none | 25 |
| **W** | distilled water | none | 100 |
| **P** | 5% potassium hydroxide solution | harmful irritant | 25 |
| **C** | 0.15% copper sulfate solution | none | 25 |

If any solution 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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**[Turn over**

You will need to make a **serial** dilution of 100% milk, **M**.
The concentration of the milk should decrease by a **factor of ten** between each successive dilution.

Fig. 1.1 shows the first two beakers you will use to make your serial dilution.

**(a)(i)** Complete Fig. 1.1 by drawing as many extra beakers as you need for your serial dilution.

For each beaker:

- state, under the beaker, the volume and concentration of **M** available for use in the investigation
- use one arrow with a label, above the beaker, to show the volume and concentration of **M** added to prepare the concentration
- use another arrow with a label, above the beaker, to show the volume of **W** added to prepare the concentration.

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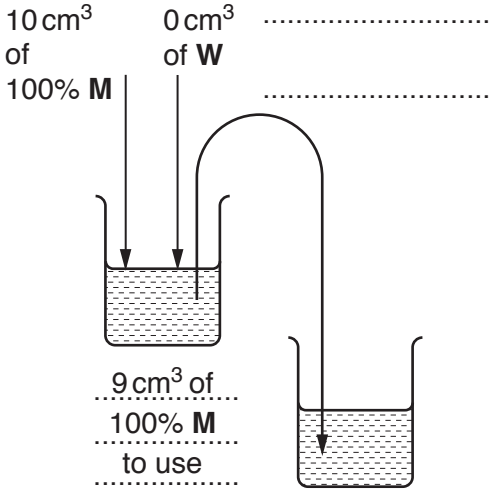



**Fig. 1.1**

[3]

Carry out the test for protein on different concentrations of milk using step 1 to step 9.

The syringe labelled **M** must be used **only** for the 100% **M**.

1. Prepare the concentrations of milk as decided in **(a)(i)** and as shown in **Fig. 1.1**.

   *Use a glass rod to mix the milk solution and water.*

2. Label the test-tubes with the concentrations of milk as prepared in step 1.

3. Put 1 $cm^3$ of each concentration into the appropriately labelled test-tube.

4. Label another test-tube **0.0%** and put 1 $cm^3$ of **W** into this test-tube.

5. Put 1 $cm^3$ of **P** into each test-tube. Shake gently to mix.

6. Put 1 $cm^3$ of **C** into each test-tube. Shake gently to mix.

7. Leave the test-tubes for at least 2 minutes. Shake gently to mix.

   Fig. 1.2 shows the key you need to use to record your results.

   A blue colour indicates that the concentration of protein is too low to be detected.

   **Key**

| **colour** | **symbol** |
|---|---|
| *pink/purple* | ++++++ |
| *dark purple* | +++++ |
| *purple* | ++++ |
| *pale purple* | +++ |
| *blue* | ++ |
| *pale blue* | + |

   **Fig. 1.2**

8. After step 7 observe the test-tubes.

   *It may help to observe the colour with a piece of white card behind the test-tube.*

   You may observe the same colour for more than one test-tube.

9. Record your results in **(a)(ii)** using the symbols shown in the key in Fig. 1.2.

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**(ii)** Record your results in an appropriate table for the known concentrations of milk.

[4]

You are provided with a different type of milk, **X**. The concentration of protein in **X** is unknown.

You now need to:

- carry out the test for protein on **X** using step 10 to step 12
- use your results in **(a)(ii)** to estimate the concentration of protein in **X**.

10. Label a test-tube with the letter **X**.
11. Put 1 $cm^3$ of **X** into the test-tube labelled **X**.
12. Repeat step 5 to step 7, with **X**.

**(iii)** After step 12, record your result for **X** using one of the symbols shown in the key in Fig. 1.2.

*result for **X*** ..... [1]

**(iv)** The 100% **M** contains 12 g of protein in 100 $cm^3$.

Using your results in **(a)(ii)** and **(a)(iii)**, estimate the concentration of protein in **X**.

*Space for working*

concentration of protein in **X** = ..... g per 100 $cm^3$

[1]

**(v)** Identify **one** significant source of error in the investigation described in step 1 to step 12.

Explain why this is a source of error.

*source of error* .....

*explanation* .....

.....

[1]

**(vi)** Suggest **three** improvements to this investigation (step 1 to step 12) so that a more accurate estimate of the concentration of protein in **X** can be obtained.

.....

.....

.....

.....

.....

.....

..... [3]

**(b)** A student carried out some research into the percentage mass of protein in the milk from different mammals.

The results are shown in Table 1.2.

**Table 1.2**

| type of mammal | percentage mass of protein |
|---|---|
| buffalo (B) | 4.05 |
| camel (C) | 2.35 |
| horse (H) | 0.80 |
| goat (G) | 3.60 |
| sheep (S) | 3.25 |

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Plot a bar chart of the data in Table 1.2 on the grid in Fig. 1.3.

*Use a sharp pencil for drawing graphs*.

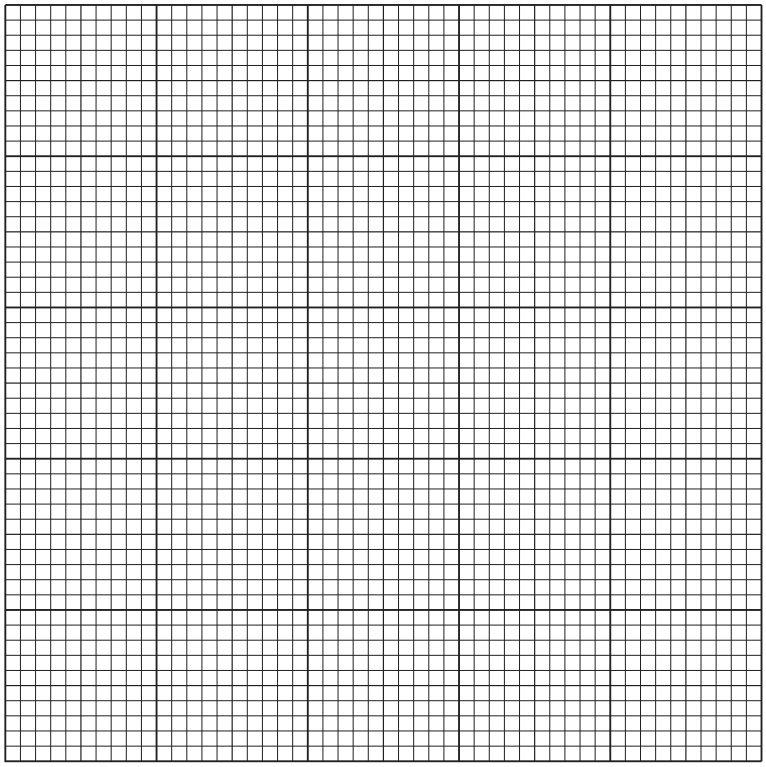


**Fig. 1.3**

[4]

**(c)** Pepsin is an enzyme that breaks down proteins.

A student investigated the effect of changing pH on the activity of pepsin.

After mixing the milk, buffer and pepsin, the activity of pepsin was measured by recording the mass of protein **remaining**, in arbitrary units.

All other variables were standardised.

The student plotted a graph of the results, shown in Fig. 1.4.

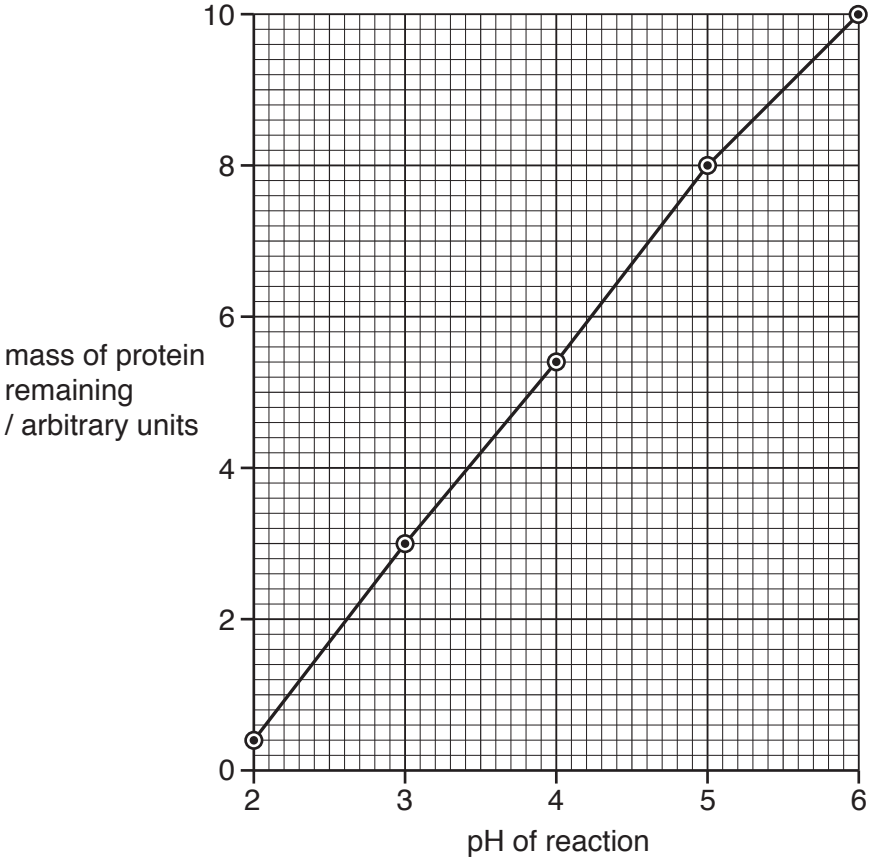



**Fig. 1.4**

**(i)** Describe the trend shown in Fig. 1.4.

.....

..... [1]

**(ii)** Suggest an explanation for the results between pH2 and pH6.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 21]

**2** **K1** is a slide of a stained transverse section through a plant stem.

You are not expected to be familiar with this specimen.

*Use a sharp pencil for drawings.*

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

**(a)** **(i)** Draw a large plan diagram of the transverse section through the plant stem on **K1**.

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

[5]

**(ii)** Observe the central region of the plant stem on **K1**.

Select **four** adjacent, touching cells. Each cell must touch at least two other cells.

Make a large drawing of this group of **four** cells.

Use **one** ruled label line and label to identify the cell wall of **one** cell.

[5]

**(b)** Fig. 2.1 is a photomicrograph of a stained transverse section through a root of a different type of plant.

You are not expected to be familiar with this specimen.

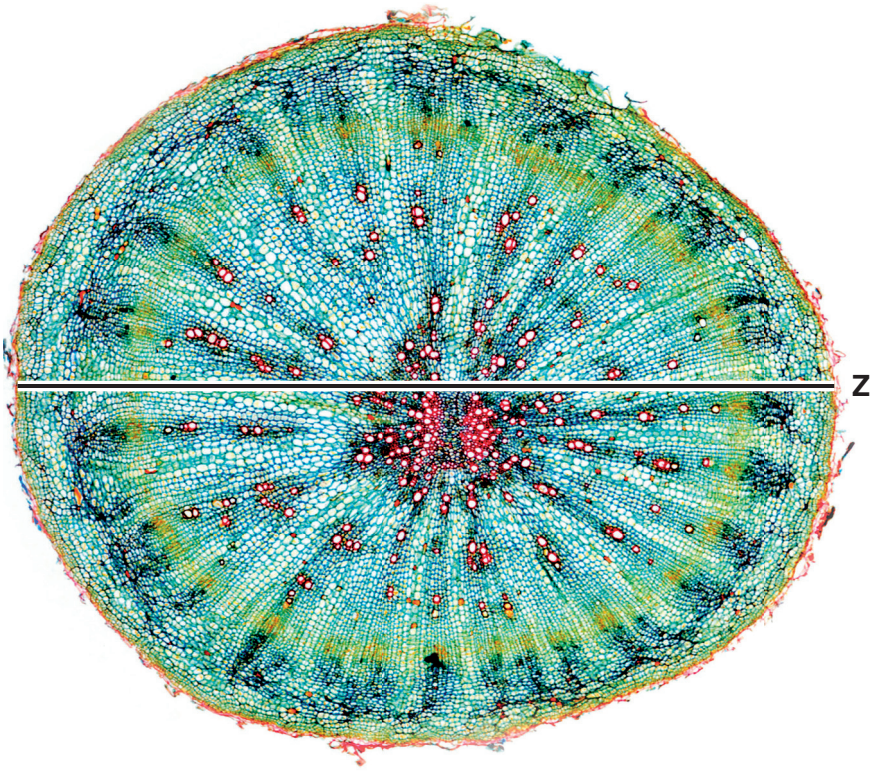



**Fig. 2.1**

**(i)** Use the scale bar and the line **Z** on Fig 2.1 to calculate the actual width of the root.

Show all the steps in your working and use appropriate units.

actual width of the root = ..... [5]

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**(ii)** Prepare an appropriate table for you to record observable differences between the stem on **K1** and the root in Fig. 2.1.

Record the observable differences in your table.

[4]

[Total: 19]

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*6121770184*

**BIOLOGY** **9700/34**

Paper 3 Advanced Practical Skills 2 **May/June 2019**

**2 hours**

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

**READ THESE INSTRUCTIONS FIRST**

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Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paperclips, 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.

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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** the whole of Question 1 and Question 2.

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

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

**1** Onion cells in sodium chloride solutions may show plasmolysis, where the cell surface membrane pulls away from the cell wall.

Fig. 1.1 shows onion cells in different states of plasmolysis.

- Cell **A** is showing no plasmolysis.
- Cells **B**, **C** and **D** are all showing plasmolysis.

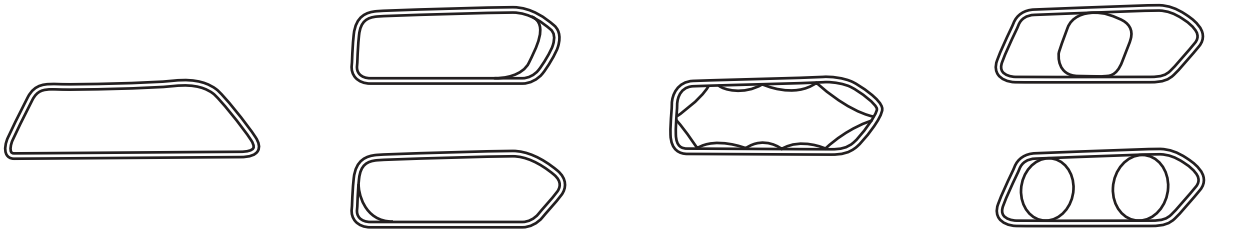



**Fig. 1.1**

Different concentrations of sodium chloride solutions have different water potentials.

When onion cells are put into a sodium chloride solution with a lower water potential than the cells, water leaves the vacuoles and the cells show plasmolysis.

You are provided with the materials shown in Table 1.1.

**Table 1.1**

| labelled | contents | hazard | volume /$cm^3$ |
|---|---|---|---|
| **S1** | 0.50 $mol\,dm^{-3}$ sodium chloride solution + onion tissue | none | 50 |
| **S2** | sodium chloride solution + onion tissue | none | 50 |
| **S3** | sodium chloride solution + onion tissue | none | 50 |
| **S4** | sodium chloride solution + onion tissue | none | 50 |

If any solution comes into contact with your skin, wash off immediately under cold water.

It is recommended that you wear suitable eye protection.

**S1** is 0.50 $mol\,dm^{-3}$ sodium chloride solution.

**S2**, **S3** and **S4** are 1.00 $mol\,dm^{-3}$, 0.25 $mol\,dm^{-3}$ and 0.00 $mol\,dm^{-3}$, but **not** necessarily in that order.

You will need to:

- observe a sample of onion cells from **S1**, **S2**, **S3** and **S4**
- decide how many cells you will observe to record the states of plasmolysis
- record the number of cells that show the different states of plasmolysis, **A**, **B**, **C** and **D**, as shown in Fig. 1.1
- use your results to identify the concentration of the sodium chloride solutions, **S2**, **S3** and **S4**.

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Carry out step 1 to step 7 to prepare a slide of onion tissue.

1. Label one dry and clean microscope slide, **S1**. Put the slide on a paper towel.

2. Put a few drops of sodium chloride solution, **S1**, onto the microscope slide.

3. Remove a piece of the onion tissue from **S1**. Peel off the inner epidermis as shown in Fig. 1.2. *The inner epidermis may start to separate or have become separated from the rest of the onion tissue, so the epidermis may be floating in the sodium chloride solution.*

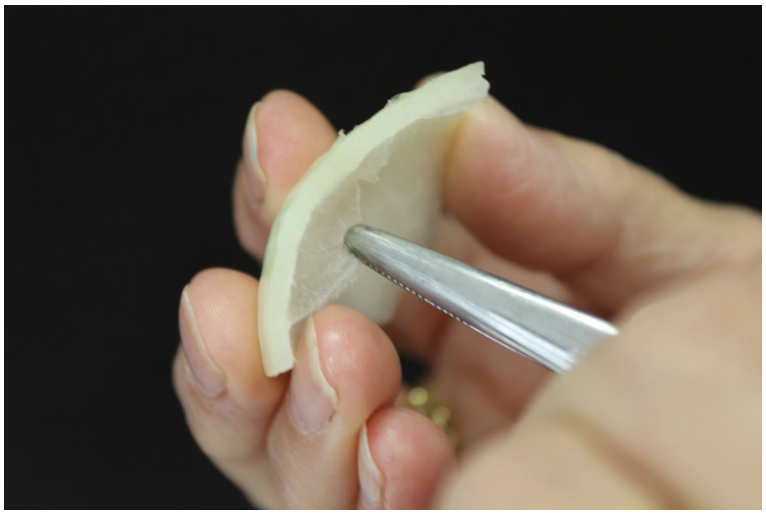


**Fig. 1.2**

4. Cut one piece of the epidermis so that it will fit under a coverslip. Put the remaining epidermis into **S1**.

5. Put the piece of epidermis on the labelled microscope slide as shown in Fig. 1.3. If the piece of epidermis is folded, you may need to add more drops of **S1** so that it floats and can be unfolded.

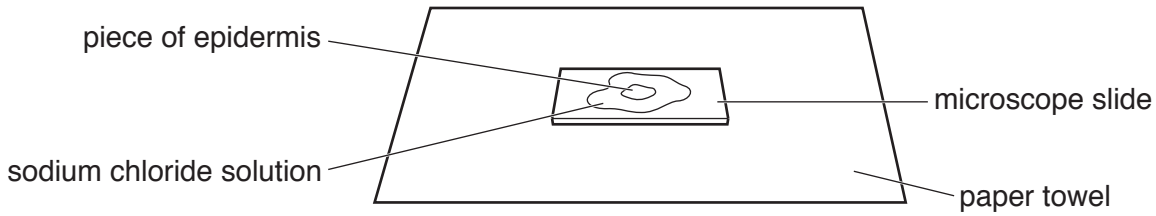



**Fig. 1.3**

6. Put a coverslip over the piece of epidermis on the microscope slide. Use a paper towel to remove any excess solution that is outside the coverslip.

7. Observe the cells of the epidermis using the microscope. You may need to reduce the amount of light entering the microscope to observe the cells clearly.

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**[Turn over**

**(a)** You need to decide which objective lens you will use **and** decide the number of cells you will need to observe to give you confidence in your results.

**(i)** State the objective lens you will use and the number of cells you will observe. Explain how this will give you confidence in your results.

*objective lens* .....

*number of cells* .....

*explanation* .....

.....

.....

[2]

8. Using the objective lens and the number of cells you decided in **(a)(i)**, count the number of cells for **S1** that are in **each** state of plasmolysis, **A**, **B**, **C** and **D** (as shown in Fig. 1.1). Record your results in **(a)(ii)**.

9. Repeat step 1 to step 8 for each of **S2**, **S3** and **S4**. Record your results in **(a)(ii)**.

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

[5]

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**(iii)** Solution **S1** is 0.50 mol $dm^{-3}$.
**S2**, **S3** and **S4** are 1.00 mol $dm^{-3}$, 0.25 mol $dm^{-3}$ and 0.00 mol $dm^{-3}$, but **not** necessarily in that order.

Using your results in **(a)(ii)**, identify the concentration of sodium chloride solution in **S2**, **S3** and **S4**.

**S2** .....

**S3** .....

**S4** .....
[1]

*Use a sharp pencil for drawings.*

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

**(b)** Observe the onion cells on the microscope slide you labelled **S4**.

Select **four** adjacent, touching cells, with at least two cells showing plasmolysis.

Make a large drawing of these **four** cells.

Use **one** ruled label line and label to identify the cell surface membrane of **one** cell.

[4]

**(c)** A student investigated the effect of different concentrations of sucrose solutions on pieces of potato tissue.

- Each piece of potato tissue was cut to exactly 50 mm in length and had a cross-sectional area of exactly 10 mm × 10 mm.
- Each piece of potato tissue was put into a different concentration of sucrose solution.
- After 1 hour the length of each piece of potato was measured.

The results of the student's investigation are shown in Table 1.2.

**Table 1.2**

| sucrose concentration / mol dm$^{-3}$ | change in length / mm |
|---|---|
| 0.0 | +2.5 |
| 0.2 | +1.5 |
| 0.4 | 0.0 |
| 0.6 | –0.5 |
| 1.0 | –1.5 |

**(i)** Describe the pattern of water movement shown in Table 1.2.

.....

.....

.....

.....

..... [2]

**(ii)** Using your knowledge of water potential, explain the result at 0.2 mol dm$^{-3}$.

.....

.....

..... [2]

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**(iii)** The student decided to compare the effect of different concentrations of sucrose solution using a different type of potato.

Complete Table 1.3 to suggest how **three** variables would need to be standardised.

**Table 1.3**

| variable | how variable may be standardised |
|---|---|
| | |
| | |
| | |

[3]

[Total: 19]

**2** **(a)** A student investigated the effect of different factors on transpiration.
In the investigation, three identical plants were put in flasks containing 70 $cm^3$ of water as shown in Fig. 2.1.

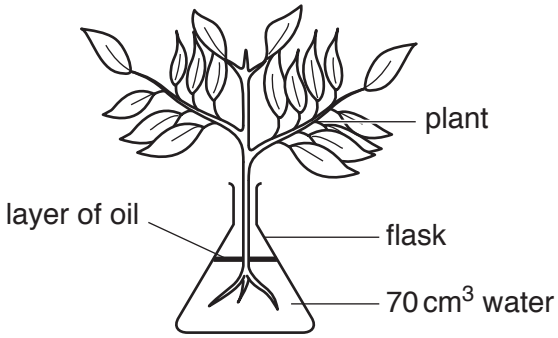



**Fig. 2.1**

The plants were each kept in different conditions:
- 20 °C + still air + high humidity
- 20 °C + windy + low humidity
- 30 °C + still air + low humidity.

All other variables were kept constant.

After 4 hours the water remaining in each flask was put into beakers labelled **P1**, **P2** and **P3**.

**(i)** Suggest a suitable control for this investigation.

.....

.....

..... [1]

**(ii)** Describe how the student could have decreased the humidity.

.....

.....

..... [1]

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You have been given the beakers, labelled **P1**, **P2** and **P3**, containing the water that was collected from each flask after the 4 hours.

You will need to determine the volume of water **lost** by transpiration from each plant.

**(iii)** Using the apparatus provided, measure the volume of water in **P1**, **P2** and **P3**.

Calculate the volume of water lost through transpiration by **each** plant.

Record your results in an appropriate table.

[2]

**(iv)** State which plant was grown in high humidity.
Give a reason for your answer.

*plant* .....

*reason* .....

.....

.....

[1]

**(b)** Plants lose water through stomata by transpiration.

A scientist investigated the effect of carbon dioxide concentration in the air on the number of stomata present per $mm^2$ of leaf area, in five plants. The carbon dioxide concentration was measured in parts per million (ppm).

**Table 2.1**

| carbon dioxide concentration /ppm | number of stomata/$mm^2$ | | | | | |
|---|---|---|---|---|---|---|
| | plant 1 | plant 2 | plant 3 | plant 4 | plant 5 | mean |
| **288** | 294 | 307 | 286 | 301 | 292 | 296 |
| **306** | 271 | 285 | 266 | 278 | 270 | 274 |
| **328** | 254 | 241 | 265 | 263 | 242 | 253 |
| **357** | 242 | 237 | 297 | 235 | 246 | |
| **383** | 234 | 227 | 231 | 234 | 219 | 229 |

**(i)** Complete Table 2.1 by calculating the mean number of stomata/$mm^2$ at a carbon dioxide concentration of 357 ppm.

Show all the steps in your working and use appropriate units.

[2]

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**(ii)** Plot a graph of the mean results shown in Table 2.1 on the grid in Fig. 2.2.
The first values for the *x*-axis and the *y*-axis are shown on the grid in Fig. 2.2.

*Use a sharp pencil for drawing graphs.*

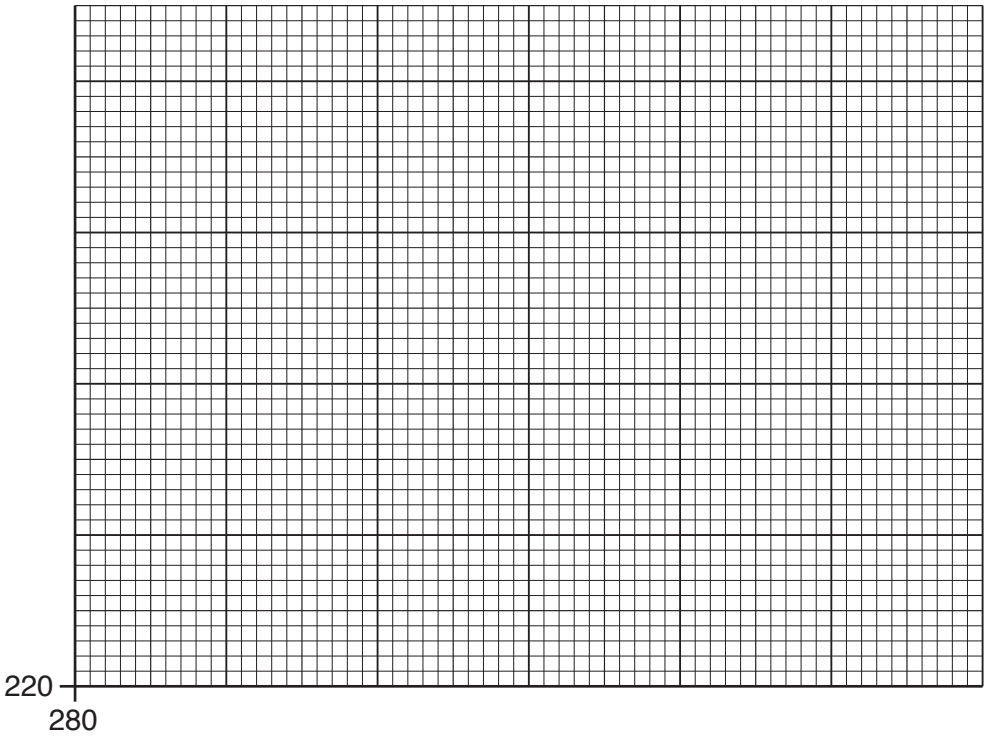



**Fig. 2.2**

[4]

**(iii)** Describe the trend shown by your graph in Fig. 2.2.

.....

.....

..... [1]

**(iv)** A plant has 302 stomata / $mm^2$.
Use your graph in Fig. 2.2 to determine the carbon dioxide concentration in the air where this plant is growing.

carbon dioxide concentration = ..... ppm
[1]

**(c)** Fig. 2.3 is a photomicrograph of a stained transverse section through a leaf.

You are not expected to be familiar with this specimen.

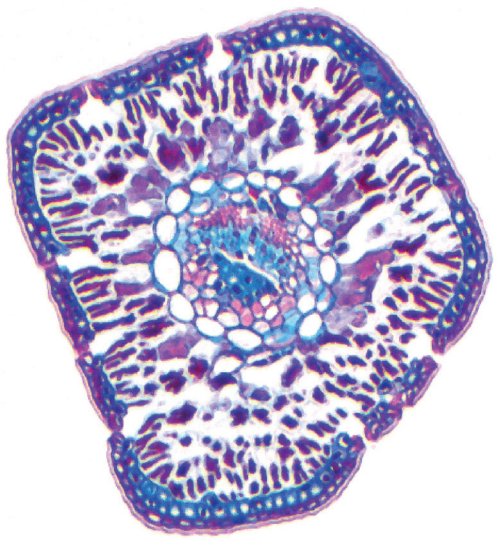


**Fig. 2.3**

*Use a sharp pencil for drawings.*
*You are expected to draw the correct shape and proportions of the different tissues.*

Draw a large plan diagram of the **whole** leaf shown in Fig. 2.3.

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

[5]

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**(d)** Fig. 2.4 shows the same photomicrograph as in Fig. 2.3, with an eyepiece graticule scale added.

The calibration of the eyepiece graticule scale is:

1 eyepiece graticule division = 39.7 μm.

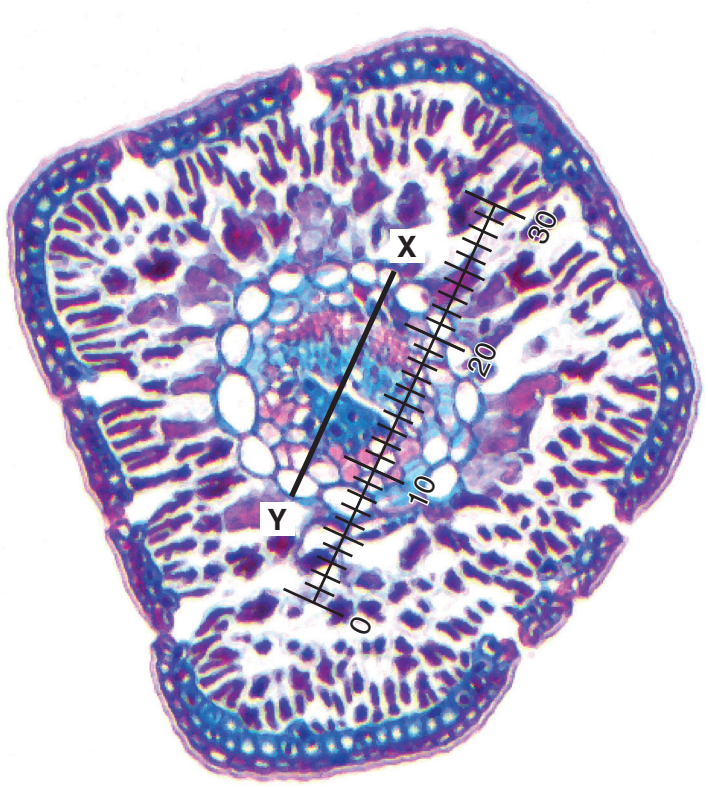



**Fig. 2.4**

Use the calibration of the eyepiece graticule scale and Fig. 2.4 to calculate the actual width of the vascular bundle, shown by line **X** - **Y**.

Show all the steps in your working and use appropriate units.

actual width of the vascular bundle = ..... [3]

[Total: 21]

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**BIOLOGY** **9700/35**

Paper 3 Advanced Practical Skills 1 **May/June 2019**

**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.
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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.

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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** the whole of Question 1 and Question 2.

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

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

**1** Blood plasma contains proteins. The concentration of protein in blood plasma may change according to the health of a person.

The concentration of protein in blood plasma can be measured to identify possible health problems.

In this investigation you will be using protein solutions, **P** and **U**, instead of blood plasma.

You will need to:

- prepare a serial dilution of solution **P**
- carry out the test for protein on each concentration of protein solution
- carry out the test for protein on the unknown concentration of protein, **U**
- estimate the concentration of protein in **U**.

You are provided with the materials shown in Table 1.1.

**Table 1.1**

| labelled | contents | hazard | volume/cm$^3$ |
|---|---|---|---|
| **P** | 1% protein solution | none | 30 |
| **U** | protein solution of unknown concentration | none | 10 |
| **W** | distilled water | none | 100 |
| **K** | 5% potassium hydroxide solution | harmful irritant | 20 |
| **C** | 0.15% copper sulfate solution | none | 20 |

If any solution 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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**[Turn over**

**(a)** You will need to:

- make a **serial** dilution of 1.0% protein solution, **P**, which reduces the concentration by **half** between each successive dilution
- prepare 10 $cm^3$ of each concentration of protein solution.

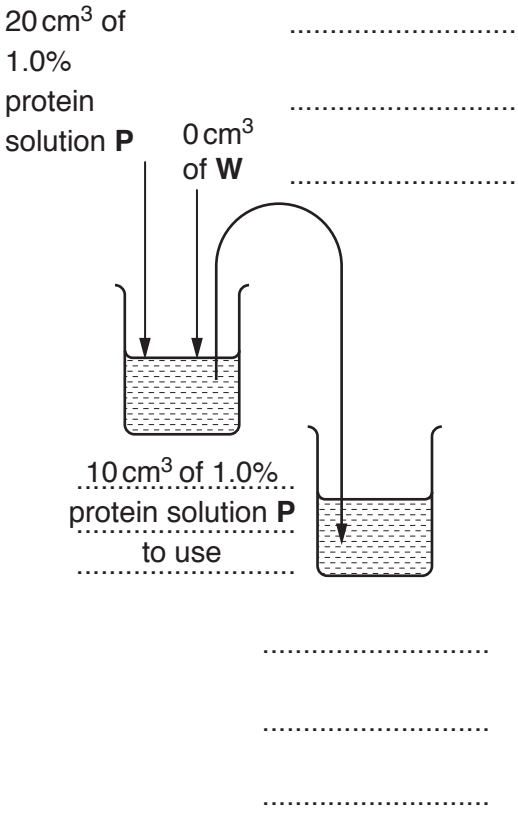
Fig. 1.1 shows the first two beakers you will use to make your serial dilution.

**(i)** Complete Fig. 1.1 by drawing as many extra beakers as you need for your serial dilution.

For each beaker:

- state, under the beaker, the volume and concentration of protein solution available for use in the investigation
- use one arrow with a label, above the beaker, to show the volume and concentration of protein solution added to prepare the concentration
- use another arrow with a label, above the beaker, to show the volume of **W** added to prepare the concentration.

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20 cm3 of 1.0% protein solution P
0 cm3 of W
10 cm3 of 1.0% protein solution P to use

[3]

**Fig. 1.1**

Carry out the test for protein on the different concentrations of protein using step 1 to step 7.

1. Prepare the concentrations of protein solution as decided in **(a)(i)** and shown in Fig. 1.1.
   *Use a glass rod to mix the protein solutions and water.*

2. Label the test-tubes with the concentrations of the protein solutions prepared in step 1.

3. Put 1 $cm^3$ of each concentration into the appropriately labelled test-tube.

4. Label another test-tube **0.0%** and put 1 $cm^3$ of **W** into this test-tube.

5. Put 1 $cm^3$ of **K** into each test-tube. Shake gently to mix.

6. Put 1 $cm^3$ of **C** into each test-tube. Shake gently to mix.

7. Leave the test-tubes for at least 2 minutes. Shake gently to mix.

You will see a range of colours depending on the concentration of protein present.

Table 1.2 shows the range of colours and the letters you will use to record your observations in **(a)(ii)**.

**Table 1.2**

| colour | letters to use |
|---|---|
| very pale blue/colourless | VP |
| pale blue | PB |
| blue | B |
| pale purple | PP |
| purple | P |
| dark purple | DP |

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**(ii)** After step 7 you will see some of the colours in Table 1.2.

Record the colours, in an appropriate table, by using the letters in Table 1.2.

You may use the same letters for more than one test-tube.

*It may help to observe the colour with a piece of white card behind the test-tube.*

[5]

You now need to estimate the concentration of **U** using your results.

8. Label a test-tube **U** and put 1 $cm^3$ of **U** into this test-tube.

9. Repeat step 5 to step 7 then record the colour of **U** in **(a)(iii)**.

**(iii)** State the colour of **U** after step 7. ..... [1]

**(iv)** Complete Fig. 1.2 to show the position on the line of each of the percentage concentrations of protein solution in **(a)(i)**.

Using your results in **(a)(ii)** and **(a)(iii)**, put the label **U** on Fig. 1.2 to show an estimate of the concentration of protein in **U**.

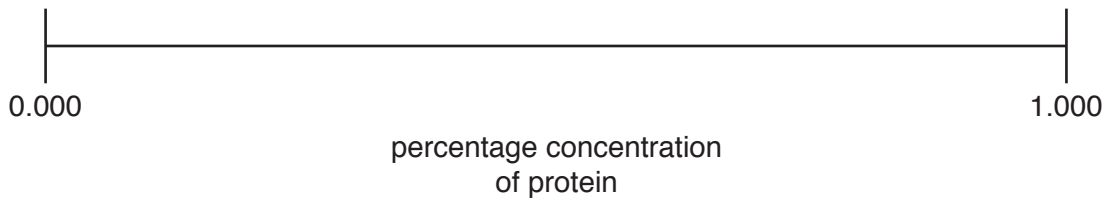



**Fig. 1.2**

[1]

**(v)** Suggest how you could change the independent variable to have more confidence in your estimate of the concentration of protein in **U**.

.....

.....

.....

.....

..... [2]

**(vi)** Suggest the apparatus that could be used to measure the concentration of protein in **U** more accurately.

..... [1]

**(b)** The concentration of protein in blood plasma from five people with the same infection was measured for 11 days.

The results are shown in Table 1.3.

**Table 1.3**

| time / days | concentration of protein in blood plasma / g dm$^{-3}$ | | | | | |
|---|---|---|---|---|---|---|
| | person 1 | person 2 | person 3 | person 4 | person 5 | mean |
| 0 | 57 | 53 | 52 | 59 | 54 | 55 |
| 3 | 91 | 89 | 94 | 90 | 86 | 90 |
| 6 | 120 | 115 | 115 | 120 | 130 | 120 |
| 8 | 87 | 106 | 82 | 81 | 86 | |
| 11 | 53 | 62 | 59 | 54 | 57 | 57 |

**(i)** Complete Table 1.3 by calculating the mean at 8 days.

*Space for working*.

[1]

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**(ii)** Plot a graph of the mean values shown in Table 1.3 on the grid in Fig. 1.3.

*Use a sharp pencil for drawing graphs.*

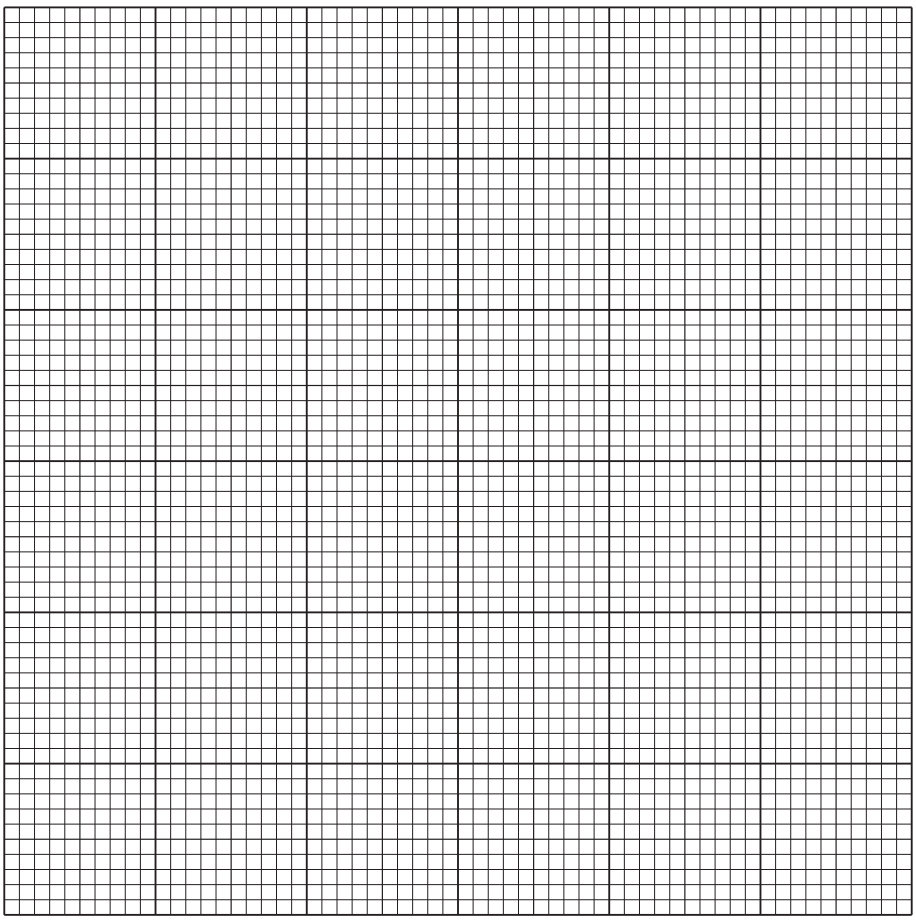


**Fig. 1.3**

[4]

**(iii)** Explain, using your knowledge of the immune system, the increase in the concentration of protein in blood plasma between day 0 and day 6.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 21]

**2** **L1** is a slide of a stained transverse section through a plant leaf.
You are not expected to be familiar with this specimen.

The transverse section may contain more than one bulge, as shown in Fig. 2.1.

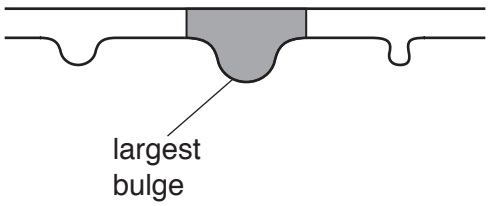



**Fig. 2.1**

**(a)** Select a field of view so that you can observe:

- the **largest** bulge
- the different tissues shown by the shaded area in Fig. 2.1.

*Use a sharp pencil for drawing.*

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

**(i)** Draw a large plan diagram from the selected field of view which has:

- part of the epidermis
- the vascular tissue
- any other observable tissues.

Use **one** ruled label line and label to identify the upper epidermis.

[6]

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**(ii)** Observe the upper epidermis of the leaf on **L1**.

Select **a line** of **four** adjacent, touching cells that make up this tissue.
Each cell must touch at least one of the other cells.

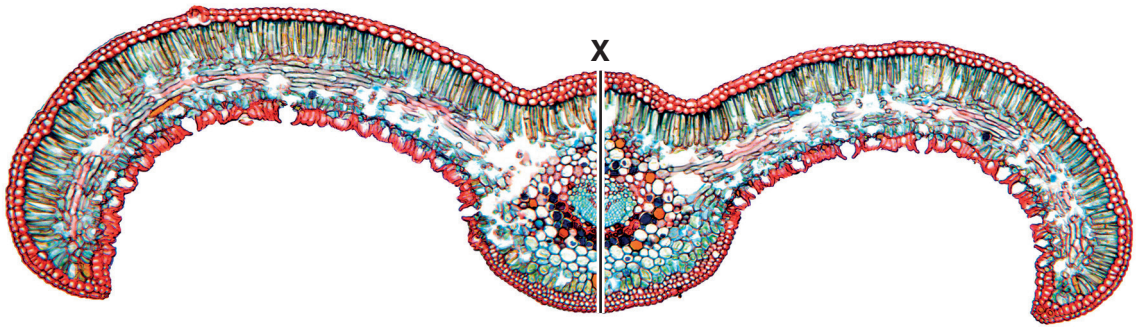
Make a large drawing of this line of **four** cells.

Use **one** ruled label line and label to identify the cell wall of **one** cell.

[5]

Fig. 2.2 is a photomicrograph of a stained transverse section through the leaf of a different type of plant.

You are not expected to be familiar with this specimen.




magnification ×14

**Fig. 2.2**

**(b)** Use the magnification and the line **X** on Fig. 2.2 to calculate the actual depth of the midrib.

Show all the steps in your working and use appropriate units.

actual depth of midrib = ..... [5]

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**(c)** Identify the observable differences between the leaf on **L1** and the leaf in Fig. 2.2.

Record the observable differences in Table 2.1.

**Table 2.1**

| feature | L1 | Fig. 2.2 |
|---|---|---|
| | | |

[3]

[Total: 19]

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