Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8688570978

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **October/November 2021**

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].

For Examiner's Use	
1	
2	
Total	

This document has **16** pages. Any blank pages are indicated.

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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.

1 The kidneys are the organs that remove waste products from the blood and produce urine.

Urine can be tested as part of a health check.

People who have kidney disease or a urinary tract infection (UTI) may have unusually high concentrations of protein in their urine.

You will be testing a solution that represents urine and will be referred to as 'mock urine'. This represents a sample of urine from a patient with a possible kidney disease or urinary tract infection.

You will determine the concentration of protein in this sample of mock urine.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
P	1.0% protein solution	none	30
W	distilled water	none	50
C	0.15% copper sulfate solution	none	20
K	5.0% potassium hydroxide solution	harmful irritant	20
U	mock urine	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) You will need to carry out a **serial** dilution of the 1.0% protein solution, **P**, to reduce the concentration by **half** between each successive dilution.

You will need to prepare **four** concentrations of protein solution in addition to the 1.0% protein solution, **P**.

After the serial dilution is completed, you will need to have 10 cm^3 of each concentration available to use.

(i) Complete Fig. 1.1 to show how you will prepare your serial dilution.

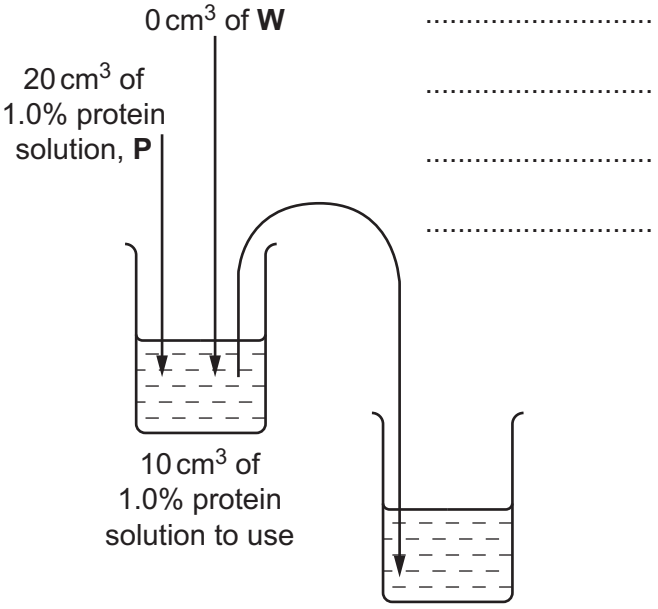
Fig. 1.1 shows the first two beakers you will use to make your serial dilution. You will need to draw **three** additional beakers.

For each beaker add labelled arrows to show:

- the volume of protein solution transferred
- the volume of distilled water, **W**, added.

Under each beaker, state the concentration of protein solution.

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

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Fig. 1.1

[3]

Carry out step 1 to step 9.

1. Prepare the concentrations of protein solution, as decided in **(a)(i)**, in the beakers provided.

   Use a glass rod to mix the protein solutions.

2. Label five of the test-tubes with the concentrations you prepared in step 1.

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

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

5. Put 1 cm^3 of **K** into each of the labelled test-tubes. Shake gently to mix.

6. Put 1 cm^3 of **C** into each of the labelled test-tubes. Shake gently to mix.

7. Leave the test-tubes for 1 minute. Shake gently to mix.

8. Observe the colour of the liquid in each test-tube.
   To see the colour more clearly, it may help to hold a piece of white paper behind the test-tube.
   You may see the same colour in more than one test-tube.

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

Table 1.2

colour	symbol
dark purple	++++++
purple	+++++
pale purple	++++
blue	+++
very pale blue/purple	++
no colour	+

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(ii) Record your results in an appropriate table.

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

[4]

(iii) State the independent variable in the investigation you have just carried out.

..... [1]

You are provided with a sample of mock urine, **U**. This represents a sample of urine from a patient being tested for possible kidney disease.

10. Label a test-tube, **U**.

11. Put 1 cm^3 of **U** into the test-tube.

12. Repeat step 5 to step 8 for **U**. Record your result for **U** in **(a)(iv)** using the symbols shown in Table 1.2.

(iv) Record your result for **U**.

result for **U** ..... [1]

(v) Fig. 1.2 shows a scale of protein concentrations used in this investigation. The position for 1.0% and 0.0% are shown on the scale.

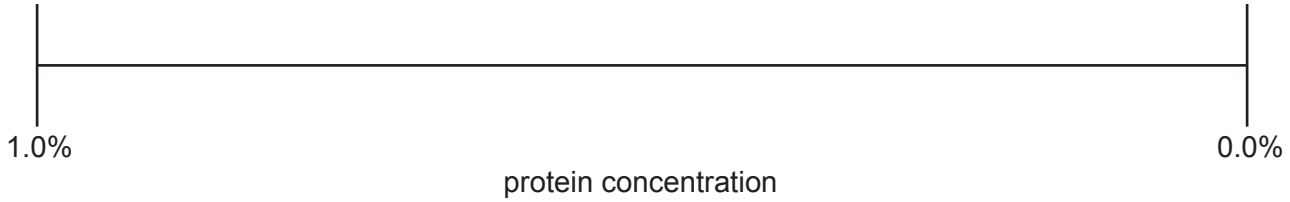


Fig. 1.2

Complete the scale in Fig. 1.2 by showing the positions of the protein concentrations you prepared in step 1. [1]

(vi) Use your results in **(a)(ii)** and **(a)(iv)** to estimate the protein concentration of **U**.
Show your estimate of **U** on Fig. 1.2 by drawing an arrow (↓) at the correct position on the scale. Label the arrow **U**. [1]

Table 1.3 shows the total mass of protein present in urine over 24 hours for people with different medical conditions.

Table 1.3

medical condition	**total mass of protein in urine / mg 24 h^{-1}**
no condition	<150
urinary tract infection	150–200
kidney tubular disease	200–500
glomerular disease	>500

The 1.0% protein solution you used in **(a)(i)** represents a urine sample collected over a period of 24 hours that contains 1000 mg of protein.

(vii) State the possible medical condition of the patient indicated by **U**, using your result in **(a)(vi)**.

..... [1]

(viii) Your result for **U** may be anomalous.

State how you could confirm that your result for **U** is correct.

.....

..... [1]

(ix) Glucose is another molecule that may be detected in urine during a health check.

A sample of urine from a patient tested positive for glucose.

Suggest how you would obtain an estimate of the **concentration** of glucose in the sample of urine.

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..... [3]

(b) *Escherichia coli* bacteria were isolated from patients with a urinary tract infection. The bacteria were tested with six different antibiotics. The percentage of resistant bacteria was calculated for each antibiotic.

Table 1.4 shows the results.

Table 1.4

antibiotic	percentage of resistant bacteria
ciprofloxacin (C)	23.5
co-trimoxazole (T)	31.5
imipenem (I)	0.0
nitrofurantoin (N)	0.5
ampicillin (A)	59.0
amoxicillin (M)	2.0

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(i) Plot a bar chart of the data in Table 1.4 on the grid in Fig. 1.3.

Use a sharp pencil for drawing bar charts.

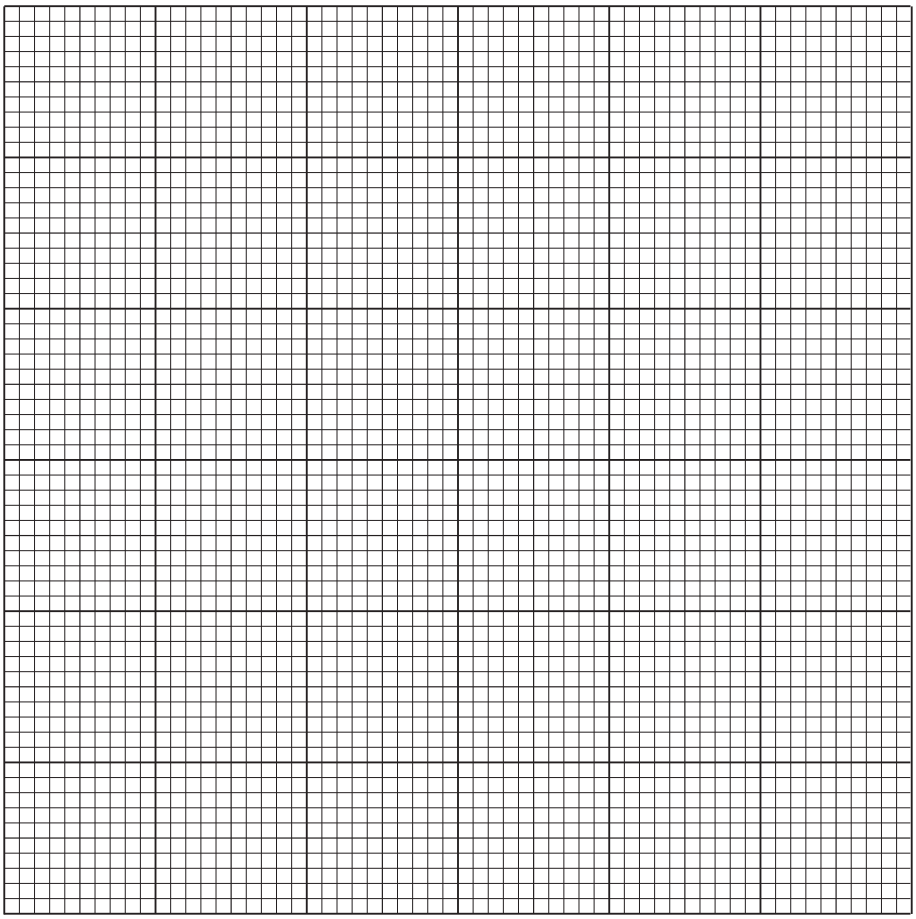


Fig. 1.3

[4]

(ii) Ampicillin was first used in 1961 and imipenem was first used in 1985.

Suggest why the percentage of resistant bacteria is higher for ampicillin than imipenem.

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..... [3]

[Total: 23]

2 **J1** is a slide of a stained transverse section through a plant leaf.

(a) Set up the microscope so that you can observe the section on **J1**.

Observe the different tissues in the area on **J1** shown by the shaded region in Fig. 2.1 (midrib).

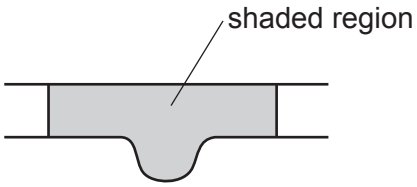


Fig. 2.1

Use a sharp pencil for drawing.

(i) Draw a large plan diagram of the area of the section on **J1** shown by the shaded region in Fig. 2.1.

Your drawing should show the correct shapes and proportions of the different tissues.

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

[5]

(ii) Observe the cells in the layer below the upper epidermis of the midrib of the section on **J1**.

Select **four** adjacent 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]

(b) Fig. 2.2 is a photomicrograph of a stained transverse section through a leaf of a different type of plant.

Fig. 2.2 has been annotated to describe **one** observable difference between the leaf section in Fig. 2.2 and on **J1**.

Annotate Fig. 2.2 to describe **three** other observable differences between the leaf section in Fig. 2.2 and on **J1**.

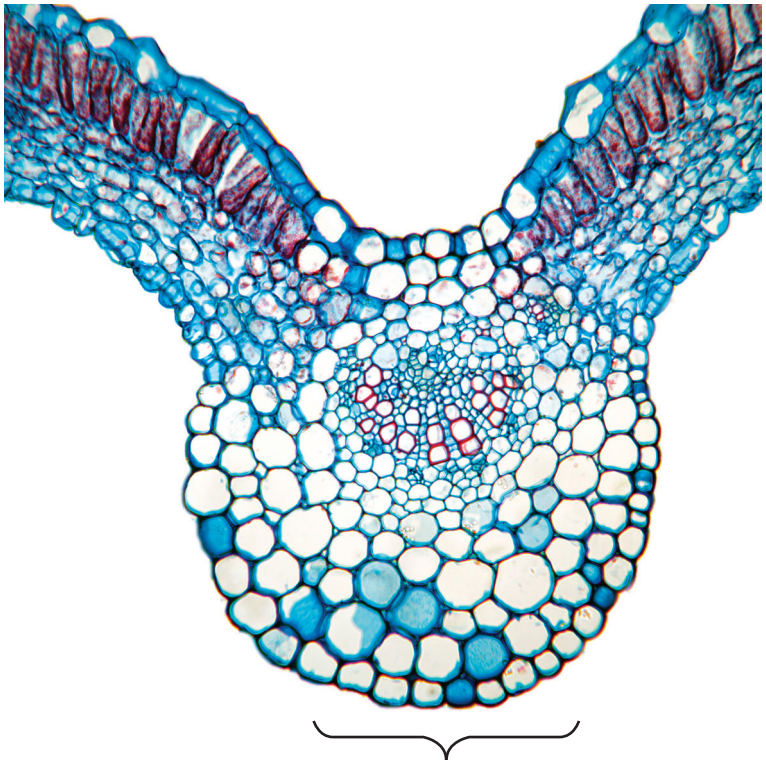


Fig. 2.2

[3]

(c) Fig. 2.3 is a photomicrograph of the same leaf section as in Fig. 2.2, viewed using a microscope with an eyepiece graticule placed across the section.

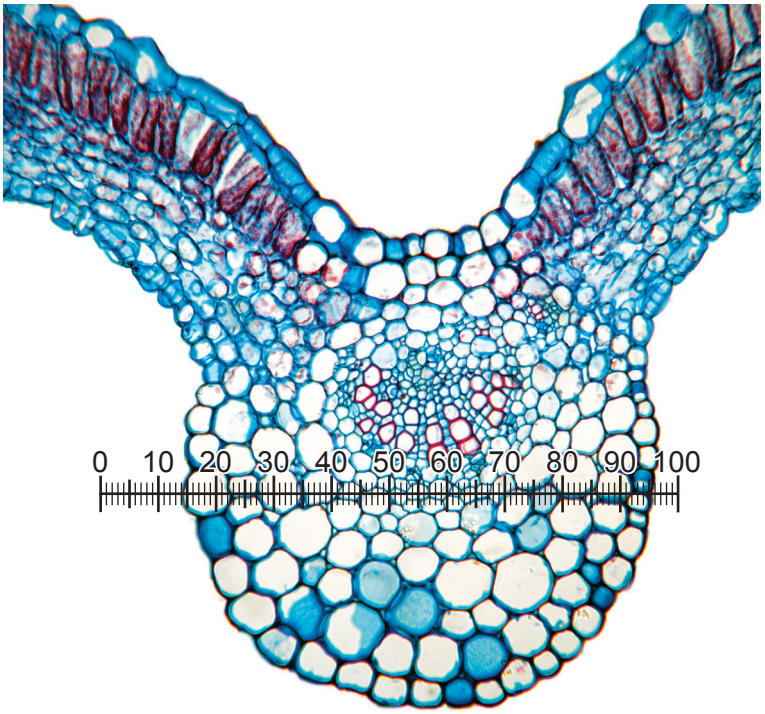


Fig. 2.3

An eyepiece graticule scale is shown on Fig. 2.3.
The calibration of the eyepiece graticule scale is:
1 eyepiece graticule division = 13.7 μm

Use the calibration of the eyepiece graticule scale to calculate the actual width of the midrib, shown in Fig. 2.3.

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

actual width of the midrib = ... [4]

[Total: 17]

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