Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

12503572112

BIOLOGY **9700/31**

Paper 3 Advanced Practical Skills 1 **May/June 2022**

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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1 Plant extracts contain molecules which have many uses in industry and as medicines.

It is important for scientists to be able to estimate the concentration of these molecules in plant extracts.

You will estimate the concentration of molecule **R** in a sample of plant extract **U**.

You are provided with the materials shown in Table 1.1.

Table 1.1

labelled	contents	hazard	volume / cm^3
10R	10% solution of molecule **R**	none	100
W	distilled water	none	100
U	unknown concentration of molecule **R** in a plant extract	none	40
A	sulfuric acid solution	harmful irritant	20
K	potassium manganate(VII) solution	irritant	20

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

It is recommended that you wear suitable eye protection and wear gloves to protect your hands when using **A** and **K**.

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[Turn over

(a) You will need to carry out a **serial** dilution of the 10% molecule **R** solution, **10R**, to reduce the concentration by **half** between each successive dilution.

You will need to prepare **four** concentrations of molecule **R** solution in addition to the **10% molecule R** solution, **10R**.

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.

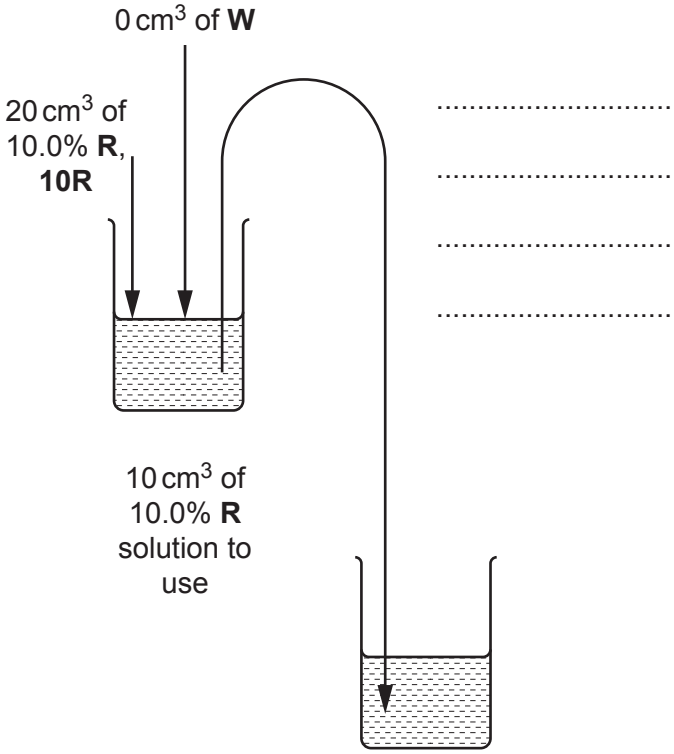
Fig. 1.1 shows the first two beakers you will use to make your serial dilution. You will need to draw **three** additional beakers.

For each beaker add labelled arrows to show:

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

Under each beaker, state the concentration of molecule **R** solution.

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Fig. 1.1

[3]

Molecule **R** changes an acidified potassium manganate(VII) solution, **K**, from a pink colour to colourless.

The lower the concentration of molecule **R**, the greater the volume of **R** needed to change the potassium manganate(VII) from pink to colourless (the end-point).

Carry out step 1 to step 12.

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

step 2 Label 5 test-tubes with the concentrations of **R** you prepared in step 1.

step 3 Put 1 cm^3 of **A** into the test-tube labelled 10%.

step 4 Put 1 cm^3 of **K** into the same test-tube and mix well.

step 5 Put the nozzle of a clean 10 cm^3 syringe into the beaker containing 10% **R**.

step 6 Pull the plunger out to the 5 cm^3 mark so that 5 cm^3 of 10% **R** enters the syringe.

step 7 Put the syringe containing 10% **R** into the test-tube from step 4 as shown in Fig. 1.2.

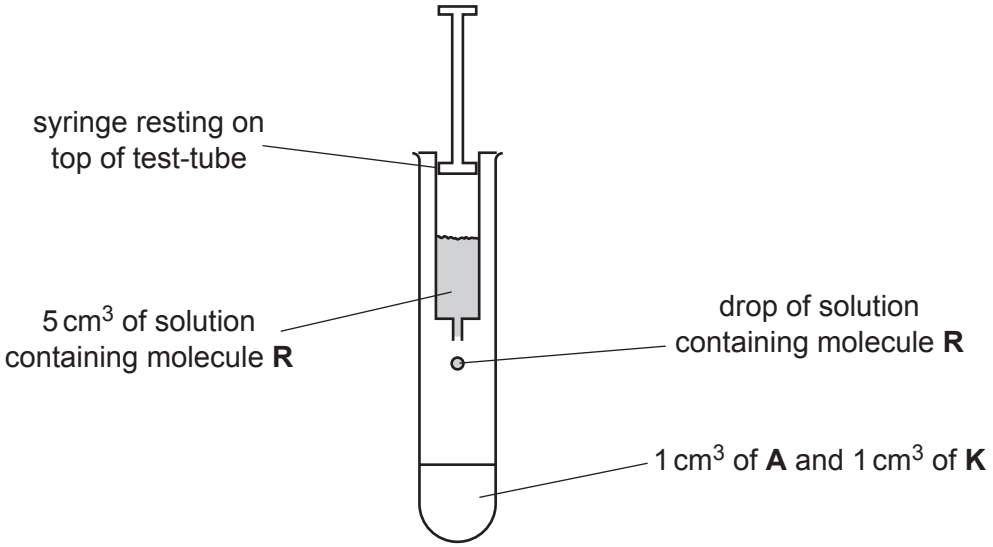


Fig. 1.2

You will be counting the number of drops needed to change **K** from pink to colourless (the end-point).

step 8 Gently press the plunger to add one drop of solution containing molecule **R**.

step 9 Mix well.

step 10 If the mixture stays pink repeat step 8 and step 9. Count the number of drops released to reach the end-point. If the number of drops needed to reach the end-point is more than 100, record as 'more than 100'.

step 11 Record the results in **(a)(ii)**.

step 12 Repeat step 3 to step 11 for each of the concentrations of molecule **R** prepared in step 1.

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(ii) Record your results in an appropriate table.

[5]

(iii) State **two** significant sources of error when measuring the dependent variable in this investigation.

.....

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..... [2]

(iv) Suggest how you could improve the procedure to reduce **one** of the errors stated in **(a)(iii)**.

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.....

..... [1]

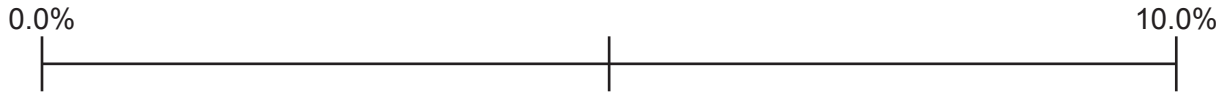
step 13 Repeat step 3 to step 10 with **U**, the unknown concentration of molecule **R**.

step 14 Record your result in **(a)(v)**.

(v) State the number of drops of **U** needed to reach the end-point ..... [1]

(vi) Complete Fig. 1.3 to show the positions of each of the percentage concentrations of molecule **R** solution recorded in **(a)(ii)**.

[1]



percentage concentration of molecule **R**

Fig. 1.3

(vii) Use your results in **(a)(ii)** and **(a)(v)** to estimate the concentration of molecule **R** in solution **U**.

Show this estimate of the concentration of **U** on Fig. 1.3, by placing the letter **U** on the line in the correct position.

[1]

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(b) A student investigated the concentration of molecule **R** in extracts from different plants.

The student added a fixed volume of the extract to acidified potassium manganate(VII) and timed how long it took to reach the end-point.

The results are shown in Table 1.2.

Table 1.2

plant extract	time / s
B	15
C	59
D	42
E	10
F	7

(i) Plot a bar chart of the data shown in Table 1.2 on the grid in Fig. 1.4.

Use a sharp pencil.

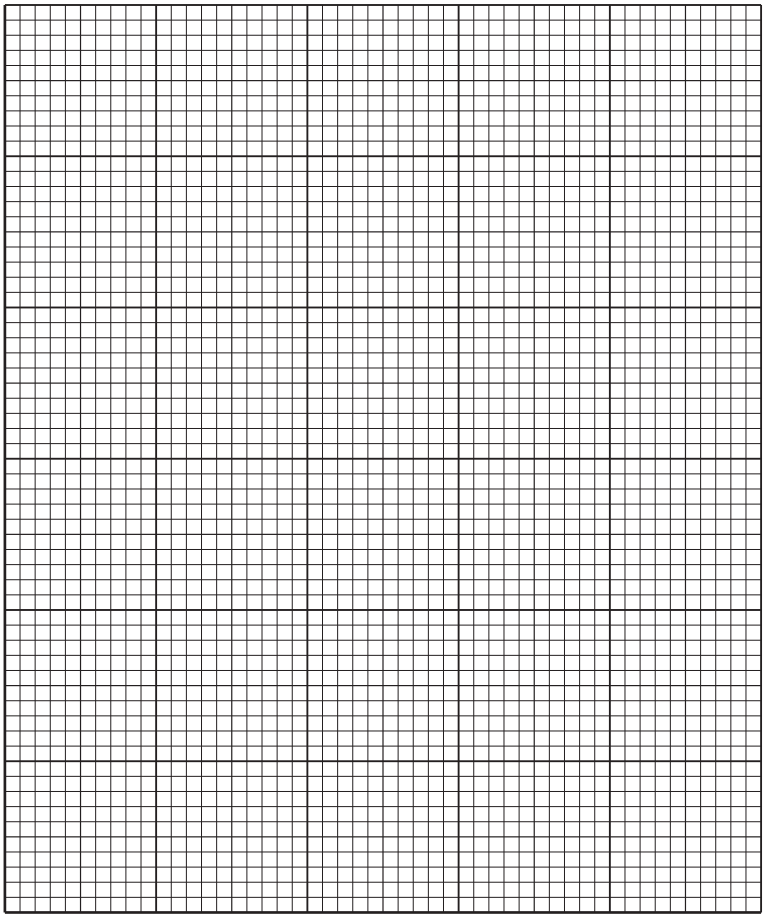


Fig. 1.4

[4]

(ii) Suggest which plant extract would contain the highest concentration of **R**.

..... [1]

(c) Scientists have suggested that a different molecule in the plant extract might act as an antibiotic.

The scientists tested this by:

- spreading bacteria over the surface of agar gel containing nutrients
- putting small drops ($3\,\mu m^3$) of different concentrations of the plant extract into separate wells in the agar gel
- incubating the agar gel for 20 hours
- measuring the inhibition area (where the bacteria were not observed) for each concentration of plant extract.

The results are shown in Fig. 1.5.

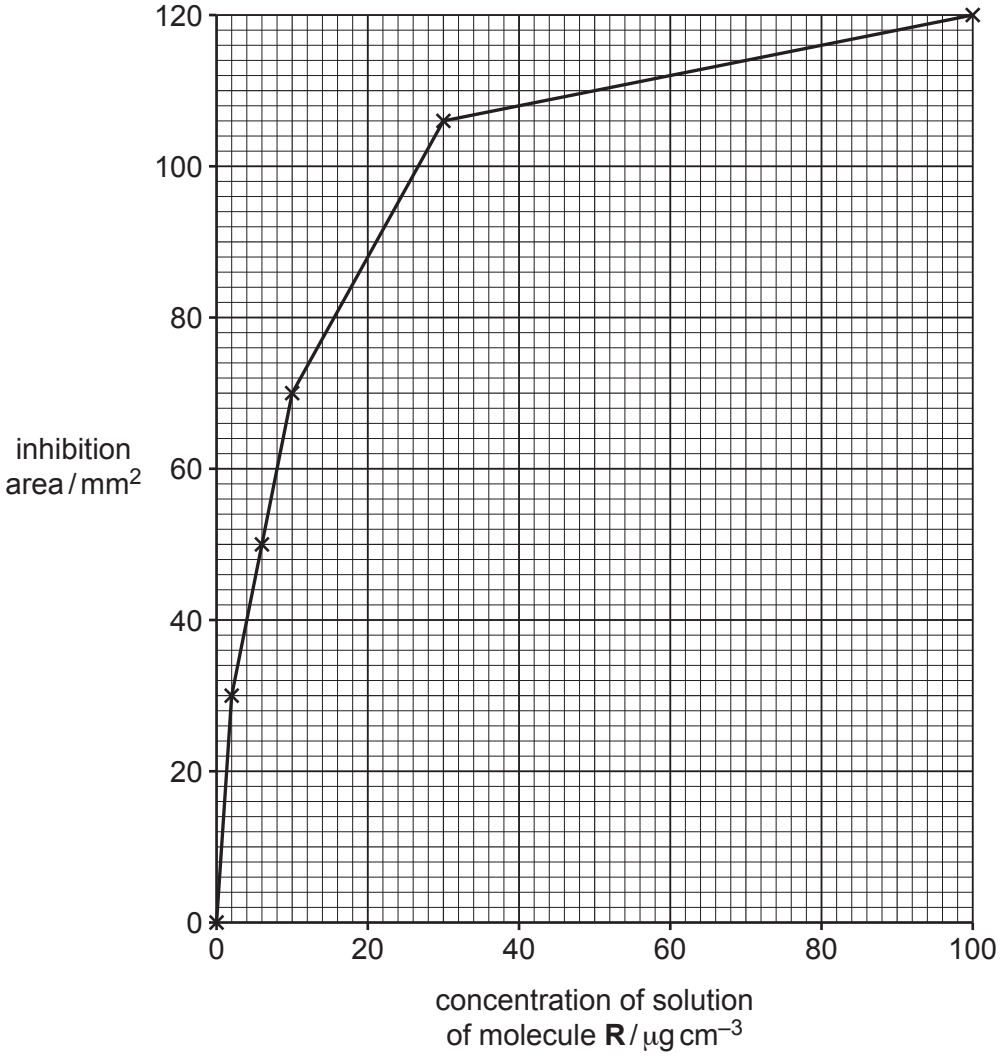


Fig. 1.5

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(i) Use the graph in Fig. 1.5 to estimate the concentration of plant extract that results in an inhibition area of 92 mm^2.

concentration of plant extract = ... [1]

(ii) Suggest how the molecule in the plant extract may inhibit the growth of the bacteria.

.....

.....

.....

.....

..... [2]

[Total: 22]

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

(a) **(i)** Draw a large plan diagram of the whole section on **J1**. Use a sharp pencil.

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

[5]

(ii) The leaf section on **J1** is from a plant that lives at high altitudes in very cold conditions. In the winter the ground is often frozen and plants are unable to take up water.

Suggest **one** observable feature of the leaf section on **J1** which enables it to survive in these conditions.

.....

..... [1]

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(iii) Observe the cells in the epidermis of the section on **J1**.

Select a line of 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. 2.1 is a photomicrograph of a stained transverse section through a different type of leaf from **J1**.

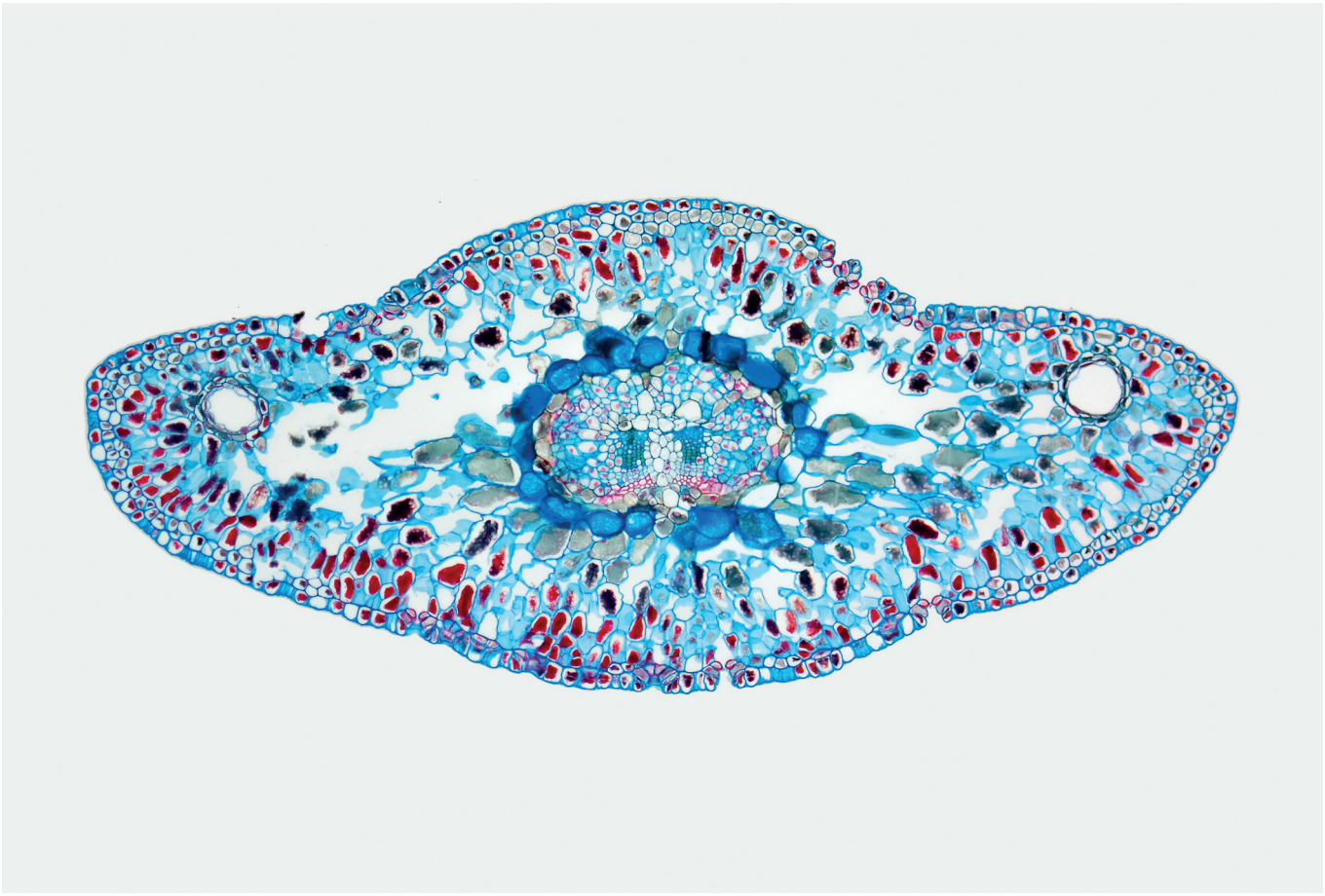


Fig. 2.1

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Identify **three** observable **differences** between the leaf section on **J1** and the leaf section in Fig. 2.1.

Record these three observable differences in Table 2.1.

Table 2.1

feature	J1	Fig. 2.1

[3]

(c) Fig. 2.2 is the same photomicrograph as that in Fig. 2.1, with the line **X**–**Y** drawn across its width.

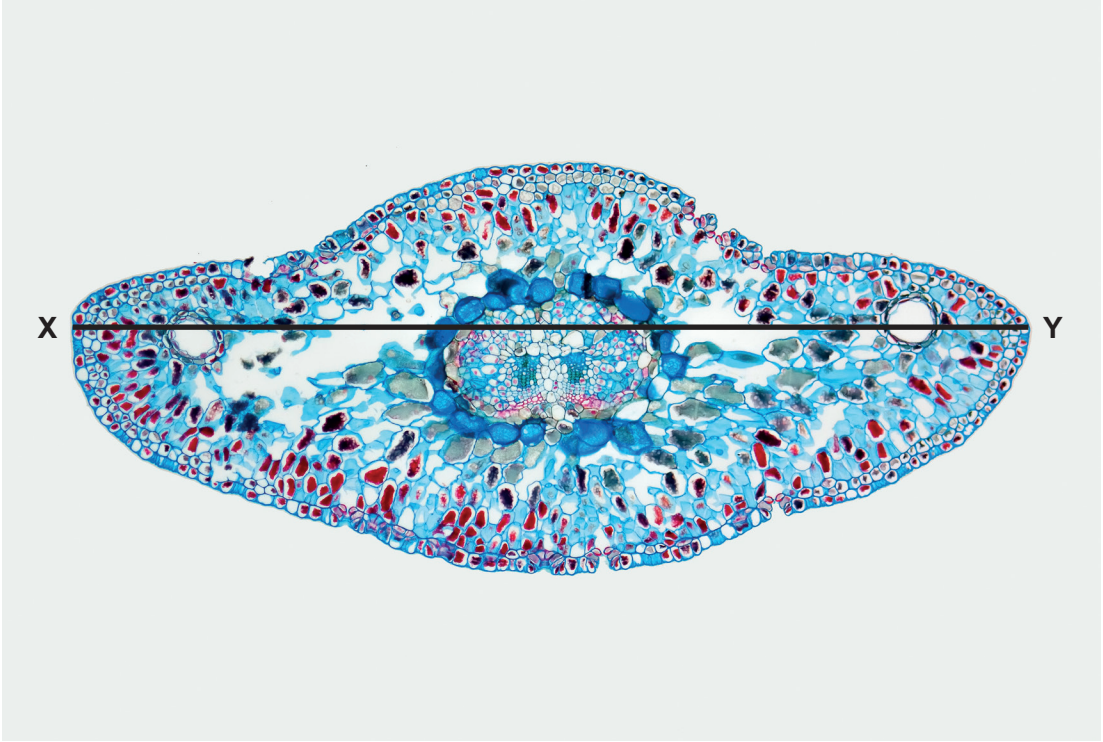


Fig. 2.2

In Fig. 2.2 the line **X**–**Y** is drawn across the width of the leaf. Use the line **X**–**Y** and the scale bar to calculate the actual width of the leaf.

Show your working.

actual width of leaf = ... [4]

[Total: 18]

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