

Modified Enlarged 18 pt

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Thursday 13 January 2022 – Morning

Level 3 Cambridge Technical in Applied Science

05847/05848/05849/05874/05879

Unit 2: Laboratory techniques

Time allowed: 2 hours plus your additional time allowance

You must have:
the Data Sheet
a ruler (cm/mm)
the Periodic Table

You can use:
a scientific or graphical calculator
an HB pencil

Please write clearly in black ink.

**Centre
number**

--	--	--	--	--

**Candidate
number**

--	--	--	--

First name(s) _____

Last name _____

**Date of
birth**

D	D	M	M	Y	Y	Y	Y
---	---	---	---	---	---	---	---

READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS

Use black ink. You can use an HB pencil, but only for graphs and diagrams.

Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.

Answer ALL the questions.

INFORMATION

The total mark for this paper is 90.

The marks for each question are shown in brackets [].

ADVICE

Read each question carefully before you start your answer.

BLANK PAGE

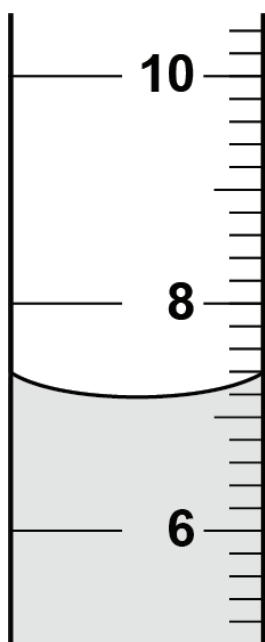
Answer ALL the questions.

- 1 It is Ali's first day as a work experience student in a chemistry laboratory.**

Eve is a technician in the laboratory and is showing Ali how to use some laboratory equipment accurately.

- (a) The first piece of equipment to be used is a measuring cylinder.**

The level of liquid in the measuring cylinder is shown in the diagram.



- (i) State TWO ways to obtain an accurate reading of the volume of liquid in the measuring cylinder.**

1

2

- (ii) State the value for the volume of liquid in the measuring cylinder shown in the diagram.

Give your answer to an **APPROPRIATE NUMBER** of significant figures.

Volume = _____ cm³ [1]

- (b) Eve then shows Ali how to use a balance. The balance has recently been calibrated.

- (i) Why is it important to calibrate scientific equipment?

_____ [1]

- (ii) Describe how Eve should check the calibration of the balance.

_____ [2]

- (iii) Eve shows Ali how to measure the mass of a powder accurately.

Write the numbers 2 TO 6 in the table to show the order of steps that Ali should follow.

The first one has been done for you. [2]

STEP	ORDER
Place a weighing boat onto the balance.	
Transfer the powder from the weighing boat.	
Add powder to the weighing boat using a clean spatula, to the correct mass.	
Ensure that the balance is clean and that there are no substances on the balance.	1
Check that no powder is left on the weighing boat by placing it back on the balance.	
Press the tare button on the balance.	

- (c) Eve then teaches Ali about methods of waste disposal.

The first column in the table lists some items for safe disposal.

Complete the table to show the best method of disposal for each item.

Tick (✓) ONE box in each row. [4]

Item for disposal	Autoclave	Sharps bin	Recycling	Rinsed down the sink
Broken glassware				
Low concentration hydrochloric acid				
Petri dishes with microbes growing on them				
Used batteries				

(d) When Eve buys chemicals they are delivered with data sheets.

State FOUR pieces of information given on a data sheet for laboratory chemicals.

1 _____

2 _____

3 _____

4 _____

[4]

BLANK PAGE

- 2 Nina is a food scientist. She is analysing amino acids and nucleotide bases in a food supplement for athletes.**

The amino acids found in the food supplement can be identified and quantified using different techniques.

- (a) Which TWO techniques will allow Nina to identify and quantify the amino acids in the food supplement?**

Tick (✓) TWO boxes. [1]

Method	Identification and quantification
Paper chromatography	
PCR	
GC	
TLC	

- (b) Nina analyses the nucleotide bases found in the food supplement.**

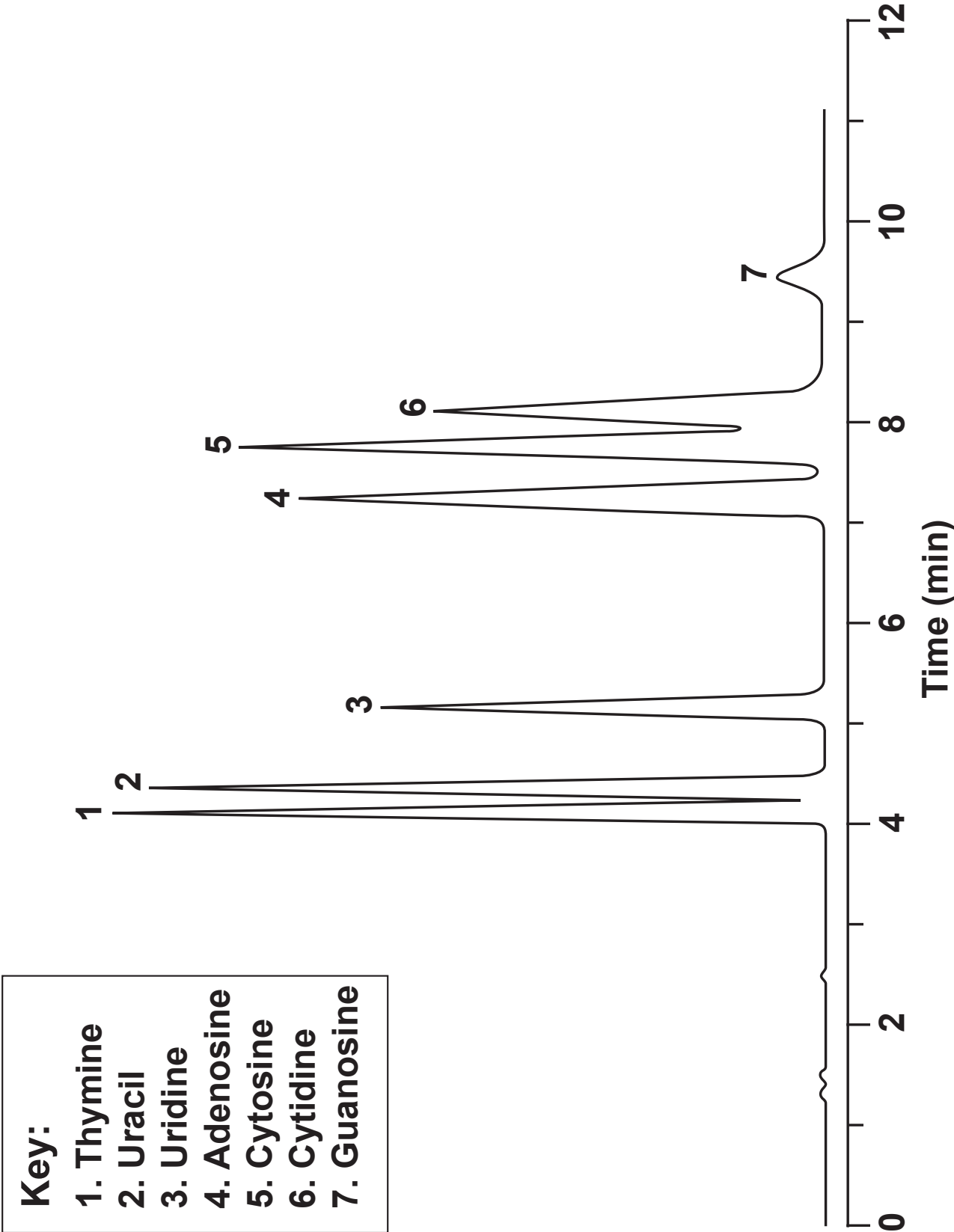
FIG. 2.1 opposite shows an HPLC chromatograph separation of nucleotide bases.

Use FIG. 2.1 opposite to estimate the retention times of adenosine and cytidine.

Retention time of adenosine = _____ min

Retention time of cytidine = _____ min
[2]

FIG. 2.1



- (c) The area under each peak can be used to determine the concentration of each nucleotide base in the mixture.

To determine the concentration of cytidine, Nina calibrates the HPLC machine using known concentrations of cytidine.

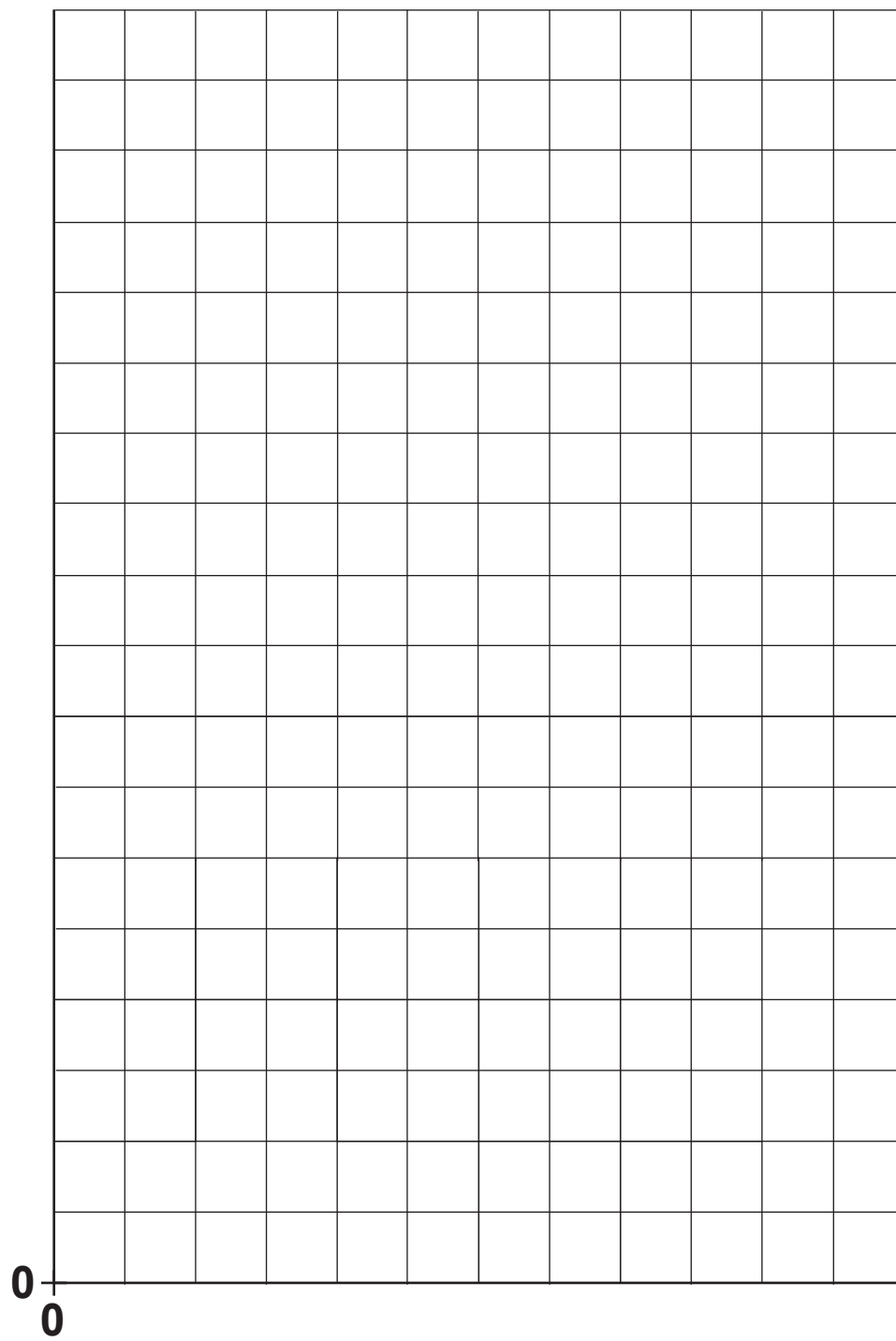
The results are shown in the table.

Concentration of cytidine / mmol dm ⁻³	Relative Peak Area
0	0.00
2	0.15
4	0.32
6	0.48
8	0.63
10	0.78

- (i) Plot a calibration graph of relative peak area (y-axis) against the concentration of cytidine (x-axis) on FIG. 2.2 opposite.

Label the axes, use an appropriate scale, and draw a line of best fit. [5]

FIG. 2.2



- (ii) An unknown sample of cytidine was then tested. The relative peak area was 10.4.

Suggest how Nina should prepare the sample further before she can determine the concentration.

[1]

- (iii) After further preparation the sample was analysed again.

The relative peak area was 0.52.

Use FIG. 2.2 to determine the concentration of cytidine in this sample.

Concentration = _____ mmol dm⁻³ [1]

- (iv) Calculate the concentration of cytidine in the ORIGINAL sample.

Concentration = _____ mmol dm⁻³ [1]

(d) Mass spectrometry can be used in conjunction with chromatography to identify the substances present in a mixture.

(i) State FOUR key principles of mass spectrometry.

1

2

3

4

[4]

(ii) Identify ONE piece of information that mass spectrometry tells us about a substance in a mixture.

Tick (✓) ONE box. [1]

Colour

☐

Concentration

☐

Molar mass

☐

- 3 Acetic acid, CH_3COOH , is the main component in vinegar. It is a weak acid.**

James is doing a project to find the concentration of acetic acid in a sample of white vinegar.

The concentration of acetic acid can be determined by titration against sodium hydroxide (NaOH), a strong base.

- (a) James first prepares 250.0 cm^3 of 0.5 mol dm^{-3} NaOH(aq) .**

- (i) Calculate the molar mass of sodium hydroxide.**

Use the Periodic Table.

Molar mass = _____ g mol^{-1} [1]

- (ii) Calculate the mass of sodium hydroxide James should weigh out in order to prepare 250 cm^3 of 0.5 mol dm^{-3} NaOH (aq).

Use the Data Sheet and the equation:

$$\text{number of moles} = \frac{\text{mass (g)}}{\text{molar mass (g mol}^{-1}\text{)}}$$

Mass = _____ g [2]

- (b) He pipettes 25.0 cm^3 of a sample of white vinegar into a conical flask and then titrates this with 0.5 mol dm^{-3} NaOH (aq).

- (i) What is the most suitable indicator for this titration?

Put a ring around the correct answer. [1]

phenolphthalein

bromothymol blue

methyl orange

- (ii) State the colour **CHANGE** at the end point for the indicator chosen in (b)(i).

Assume that the white vinegar sample is colourless.

Colour change from _____
to _____ [1]

- (c) James repeats the titration twice.

The volumes of 0.5 mol dm^{-3} sodium hydroxide needed to reach the end point in the three titrations are shown in the table.

	Titration 1	Titration 2	Titration 3
Volume of 0.5 mol dm^{-3} NaOH required / cm^3	31.30	31.10	31.05

- (i) Name the piece of equipment used to determine the volume of NaOH required.

_____ [1]

- (ii) Calculate the mean titre that James should use in his calculation.

Give your answer to 2 decimal places.

Mean titre = _____ cm³ [2]

- (iii) Calculate the number of moles of sodium hydroxide required to reach the end point.

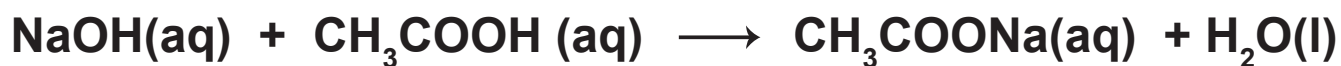
Use the equation:

$$\text{number of moles} = \frac{\text{mean titre (cm}^3\text{)} \times \text{concentration (mol dm}^{-3}\text{)}}{1000}$$

Use your answer to (c)(ii).

Number of moles of NaOH = _____ mol [1]

(iv) The equation for the reaction is



State the number of moles of acetic acid in the 25.0 cm³ sample.

Number of moles = _____ mol [1]

(v) The molar mass of acetic acid is 60 g mol⁻¹.

Calculate the mass of acetic acid in the 25.0 cm³ sample.

Use your answer to (c)(iv).

Use the equation:

$$\text{number of moles} = \frac{\text{mass (g)}}{\text{molar mass (g mol}^{-1}\text{)}}$$

Mass of acetic acid = _____ g [1]

- (vi) The concentration of acetic acid in a bottle of vinegar is normally shown on the label as a percentage. This is equivalent to mass of acetic acid in 100 cm^3 of vinegar.

Calculate the percentage of acetic acid in the vinegar.

Give your answer to 2 significant figures.

Use your answer to (c)(v).

Percentage of acetic acid = _____ % [1]

- (d) James decides to determine the concentration of acetic acid in red vinegar.

- (i) Explain why he cannot use an indicator to determine the end point of this titration.

_____ [1]

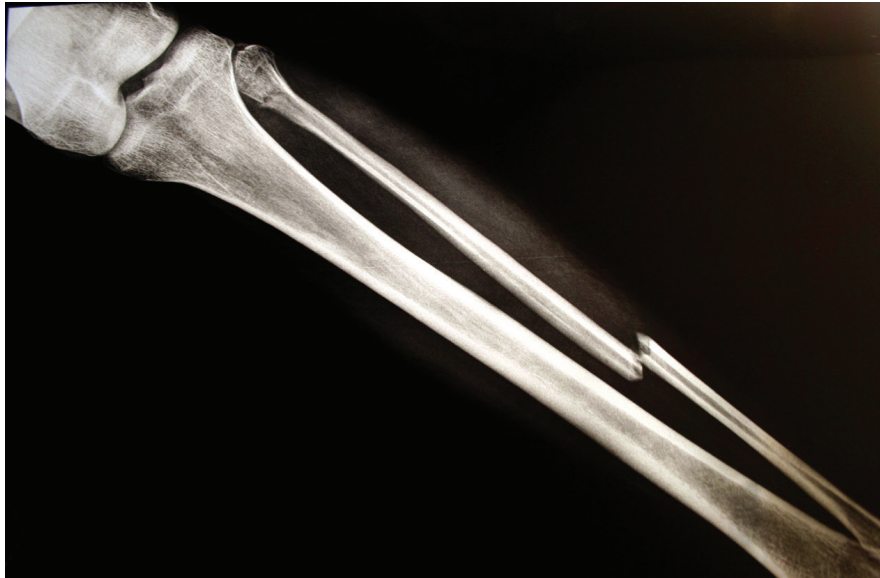
- (ii) Suggest an alternative technique he could use to determine the end point of this titration.

_____ [1]

- 4 Images for medical diagnosis can show structures hidden inside the human body.**

(a) FIG. 4.1 shows a medical image.

FIG. 4.1



- (i) State the name of the imaging technique used to create FIG. 4.1.**

[1]

- (ii) Describe the medical condition revealed in FIG. 4.1.**

[1]

- (iii) Describe ONE disadvantage of the medical imaging technique used to create FIG. 4.1.**

[1]

- (iv) Explain why some areas of FIG. 4.1 appear white and other areas appear black.

[2]

- (b) FIG. 4.2 shows a medical image produced by a different technique.

FIG. 4.2



- (i) Name the technique used to obtain the image in FIG. 4.2.

[1]

- (ii) State what is shown in FIG. 4.2.

[1]

- (c) The techniques used in FIG. 4.1 and FIG. 4.2 have different features.

Complete the table. Tick (✓) at least ONE box in each row. [5]

Feature	Technique used in FIG. 4.1	Technique used in FIG. 4.2
Uses reflected waves		
Requires protection for the radiographer		
Can show moving structures		
Can show soft tissues with a higher resolution		
No limit to the number of images a patient can have taken		

- 5 Alex is a technician in a scientific laboratory. One of her jobs is to do tests to identify different chemicals.**

The tests Alex can use are listed in FIG. 5.1:

FIG. 5.1

<p>Adding aqueous sodium hydroxide</p> <p>Adding aqueous barium chloride</p> <p>Flame test</p> <p>Adding hydrochloric acid</p> <p>Adding aqueous silver nitrate</p>
--

- (a) The labels of two bottles, each containing a white powder, are missing. Alex knows that one of the powders is potassium chloride and the other is sodium chloride.**
- (i) Select a suitable test from the list in FIG. 5.1 to enable Alex to identify the white powder in each bottle.**

[1]

- (ii) Describe how Alex should do the test selected in (a)(i).**

[2]

- (iii) State the expected result for each of the chemicals:

Potassium chloride _____

Sodium chloride _____

[2]

- (b) Alex has another bottle containing a white powder.

Alex is not sure whether the powder is potassium bromide or potassium iodide. She uses aqueous silver nitrate to identify the white powder.

- (i) Describe how Alex should do this test.

_____ [2]

- (ii) State the expected results for each of the chemicals when using the test described in (b)(i).

Potassium bromide _____

Potassium iodide _____

[2]

(c) Alex needs to test another substance to confirm that it is a carbonate.

(i) Select the most appropriate test from FIG. 5.1 to confirm that the substance is a carbonate.

[1]

(ii) State the positive result for this test.

[1]

(iii) Describe how Alex can confirm that one of the products of this test is carbon dioxide.

[2]

(d) (i) Aluminium nitrate dissolves in water to give a colourless solution.

Alex gradually adds aqueous sodium hydroxide to the solution of aluminium nitrate until there is no further change.

Describe what Alex would observe.

[3]

- (ii) Iron(II) sulfate dissolves in water to give a pale green solution.

When Alex adds aqueous barium chloride to the solution, a precipitate is formed.

Draw ONE line to connect the colour of the precipitate formed with the correct chemical name of the compound formed. [1]

Colour of the precipitate formed

White

Blue

Green

Chemical name of the compound formed

Iron(II) hydroxide

Iron(II) chloride

Barium sulfate

**6 Kofi is a researcher using plant tissue cultures.
He must use aseptic technique in the laboratory.**

**(a) Explain why aseptic technique is important
when creating plant tissue cultures in
a laboratory and describe the range of
sterilisation techniques available for this
purpose.**

[6]

- (b) Kofi is using the plant tissue cultures to obtain clones.

What is the correct definition of a clone?

Tick (✓) ONE box. [1]

They are all the same size.

☐

They are all the same species.

☐

They are all genetically engineered.

☐

They are all genetically identical.

☐

- (c) FIG. 6.1 shows one of the tissue culture vessels used by Kofi.

Some samples of an African violet plant are seen in the image.

FIG. 6.1



**Sample of
African violet
plant**

**Tissue culture
vessel**

Complete the sentences about FIG. 6.1. Use the words.

You can use each word once, more than once or not at all. [5]

contaminated
offices
explants
environment
cabinet

pathogens
centrifuged
irrigated
autoclaved

The problem with the tissue culture vessel in FIG. 6.1 is that it is _____ .

This tissue culture should now be _____ to

prevent people coming in direct contact with

Working in a controlled airflow

_____ can help prevent contamination from the

- (d) Describe how to sterilise a wire inoculation loop before a plate is streaked.

[3]

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined pages. The question numbers must be clearly shown in the margins – for example, 5(a)(ii) or 6(a).

This image shows a single page of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There is no handwriting, printing, or other markings on the paper.



Oxford Cambridge and RSA

Copyright Information:

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, OCR (Oxford Cambridge and RSA Examinations), The Triangle Building, Shaftesbury Road, Cambridge CB2 8EA.

OCR is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.