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Examiners' report

APPLIED SCIENCE

Cambridge TECHNICALS

05847–05849, 05879, 05874

Unit 2 Summer 2019 series

Version 1

Contents

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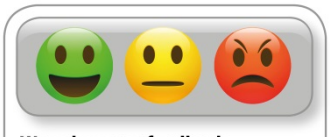

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Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

Paper Unit 2 series overview

This paper is probably very different from those seen before by some candidates. Historically candidates do not sit a paper that contains more than one science discipline in a Level 3 paper. However, it is clear that most centres are familiar with the style of paper and in general candidates' performance is improving. Most candidates seem prepared for this style of paper.

There is a lot of application and understanding of contexts that some candidates may have struggled with. Centres are encouraged to use sample papers and any previously sat live papers available with the candidates in order to give them practice at the style of paper and the questions within.

Some areas were answered well and candidates showed good knowledge of safe working practice, use of microscopes and growing cultures. It is important that candidates give answers specific to the questions and not just generic safe working practices. They were able to carry out calculations related to titrations and give answers to specified number of decimal places. Candidates did not do as well on questions about chemical tests. They struggled to interpret tables of data correctly.

This is a techniques paper and so it is the techniques they need to know how to describe. Candidates who have had the opportunity to carry out the techniques are much more able to answer the questions successfully.

Question 1 (a)

1 Athletes can be tested for banned substances to ensure they are not cheating by taking samples of their blood.

The blood samples are analysed in a laboratory.

(a) Suggest why laboratory technicians must complete health and safety training before they are allowed to work in the laboratory.

.....

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

Many candidates answered this question in terms of blood sampling and talked about stopping cross contamination which is not a health and safety issue. Candidates need to read the question carefully and answer the question asked.

Question 1 (b)

(b) Hazard warning signs are displayed in laboratories.

Identify the meaning of each sign shown below.

Write your answer below each sign.

…… ……

[2]

COSHH symbol meanings have been updated in the last few years and our mark scheme reflects that. It is important that the correct current meaning is taught. The exclamation mark now means health hazard. However, it also can be used for general caution.

Question 1 (c)

(c) A number of hazards may be experienced when taking and analysing blood samples.

State **two** of these hazards and suggest precautions to be taken by the technicians to reduce the risks.

Complete the table.

	Hazard	Precaution
1		
2		

[4]

The answers had to be specific to taking and analysing blood. Many candidates discussed cross contamination of the blood showing a lack of understanding of the question. They needed to answer in terms of the risks to the technicians. Many gave vague answers in terms of spillages and talked about being careful. This is not creditworthy.

Question 1 (d) (i)

(d) Blood samples taken from the athletes are "booked in" at the laboratory and labelled correctly so that they are not mixed up.

(i) The name of the athlete is not stated on the blood sample label.

Suggest why it is important to ensure that the name of the athlete is **not** stated on a blood sample.

.....

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

In general candidates understood the need for confidentiality. Some answered in terms of lack or bias and this was also seen as a good answer.

Question 1 (d) (ii)

(ii) Suggest **three** pieces of information that must be recorded for each sample.

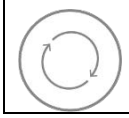
1 .....

2 .....

3 .....

[3]

Surprisingly many candidates suggested the Name of the Athlete. This showed they had not understood that 1di and 1dii were related questions.

	**AfL**	Centres should help candidates with exam technique so they understand how questions on a paper are linked.

Question 1 (e) (i)

(e) (i) Technicians must calibrate scientific instruments used in the laboratory.

Describe how thermometers can be calibrated.

.....

.....

.....

.....

.....

.....**[4]**

This was answered very well for boiling point. However, it was not clear that candidates knew they should calibrate for $0^{o}C$ using melting ice and so many lost that mark point.

Question 1 (e) (ii)

(ii) **Table 1.1** and **Table 1.2** shows the results of a stopwatch calibration test carried out by the technicians.

Two types of stopwatch were tested: analogue and digital.

The stopwatches were tested by the direct comparison method for exactly 180 seconds and then for exactly 600 seconds.

Each test was carried out four times.

Type of stopwatch	180 s stopwatch test (min:s)			
	Repeats			
	1	2	3	4
Analogue	3:01	3:02	3:01	2:59
Digital	3:01.44	3:01.55	2:59.80	3:00.88

Table 1.1

Type of stopwatch	600 s stopwatch test (min:s)			
	Repeats			
	1	2	3	4
Analogue	9:58	10:03	10:02	10:03
Digital	10:01.30	9:59.92	10:01.11	10:00.17

Table 1.2

A student has a work placement at a laboratory. She carries out an experiment to investigate the rate of reaction between magnesium and hydrochloric acid.

The student plans to measure the volume of gas produced every 30 seconds over a period of 10 minutes.

Suggest which stopwatch the student should use.

Justify your choice using the information in **Table 1.1** and **Table 1.2**.

.....

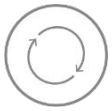
.....

.....

.....

.....

.....**[3]**

	**AfL**	It was clear that many candidates did not know how to interpret the tables. This is a skill centres should practise with them. Very few answered in terms of the 3 minute or the 10 minute test. They thought they should compare the watches for each repeat rather than look at the variability for each watch at both times. Those who gained marks usually did so for the idea of precision.

Question 2 (a)

2 A biochemical company analyses the chemical composition of substances in food.

The composition of amino acids in a diet supplement is determined using thin-layer chromatography (TLC).

Table 2.1 shows the R_f values of some amino acids in a mobile phase using solvent A.

Amino acid	R_f value in solvent A
Alanine	0.53
Arginine	0.13
Threonine	0.53
Tyrosine	0.92

Table 2.1

Fig. 2.1 is a chromatogram of the amino acids in **Table 2.1**.

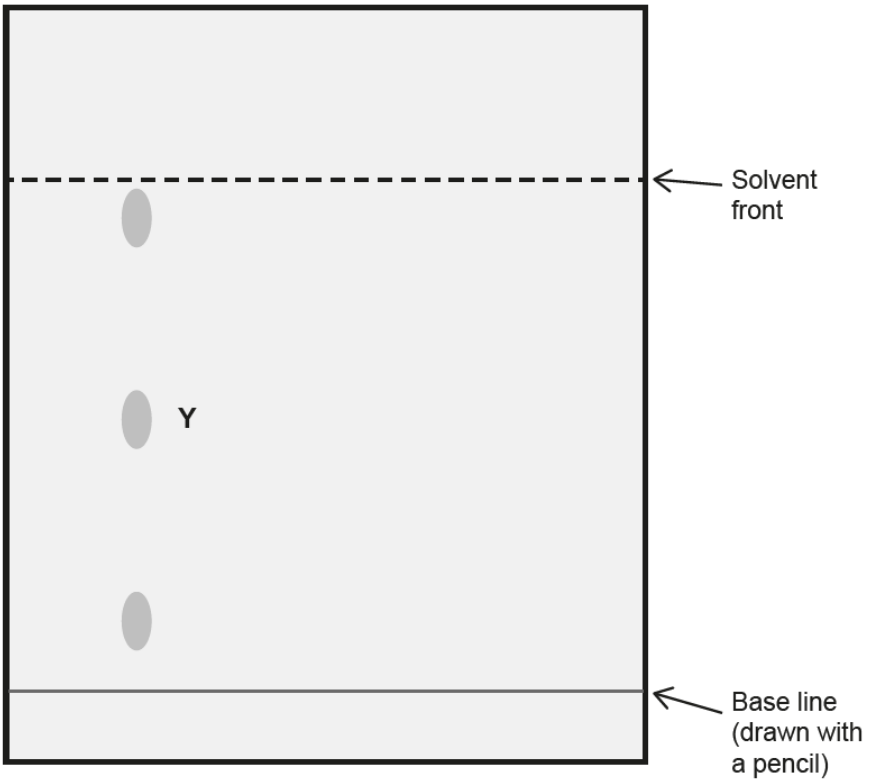


Fig. 2.1

(a) Suggest why a pencil is used to mark the base line on the solid phase.

.....

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

Many candidates answered this well.

Question 2 (b)

(b) Give **two** reasons why gloves must be worn when analysing amino acids by TLC.

1.....

2.....

[2]

Many candidates thought amino acid would harm the technician rather than the ninhydrin. One mark was usually given for not contaminating the chromatogram.

Question 2 (c)

(c) Which spot in **Fig. 2.1** is arginine?

Draw **X** next to the correct spot in **Fig. 2.1**.

[1]

Most candidates were able to do this.

Question 2 (d)

(d) Use a ruler to measure the distance that tyrosine moved during chromatography.

Distance = ... mm

[1]

Many candidates gave an answer that was clearly in cm but because they did not change the units could not gain the mark.

	AfL	Candidates need to be careful to read the whole question carefully, including any units given. Centre should practise using rulers and correct measurements.

Question 2 (e)

(e) Explain how the R_f value of the spot labelled **Y** is approximately 0.53.

.....

.....

.....

.....

.....**[3]**

This question could be answered fully by using the Rf equation correctly. Some candidates were not sure what to do and gave long inappropriate descriptions of the spots without using any measurements.

Question 2 (f)

(f) Suggest why it is not possible to separate alanine from threonine in the TLC plate shown in **Fig. 2.1**.

.....

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

Most were able to answer this in terms of Rf value. Other good answers given were in terms of solubility.

Question 2 (g)

(g) State **two** alternative chromatography methods that could be used to determine the **amounts** of each amino acid in the diet supplement.

1.....

2.....

[2]

This is a recall question. Candidates should be familiar with these techniques. Gas chromatography was the most common answer. Few candidates got both right.

Question 2 (h) (i)

(h) A mass spectrometer can be coupled to chromatography equipment.

(i) Give an **advantage** of using a mass spectrometer when coupled to chromatography equipment.

.....

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

This recall question was not answered well.

Question 2 (h) (ii)

(ii) Describe the principles of how a mass spectrometer works.

.....

.....

.....

.....

.....

.....**[4]**

It was clear where the candidates had studied this as they tended to get either no marks or 3 or 4 marks. Even if centres do not have access to some equipment, candidates must still know about it if it is on the specification

Question 3 (a)

3 Cleanezi Ltd manufacture and sell household cleaning products.

One of their products, Flushisafe, is a toilet cleaner that contains phosphoric acid.

The amount of phosphoric acid in Flushisafe is measured by titration with a 0.5 mol dm^{-3} solution of sodium hydroxide.

Phosphoric acid is a strong acid.

(a) Which **two** descriptions apply to sodium hydroxide?

Tick (✓) **two** boxes.

Acid	☐
Alkali	☐
Base	☐
Organic solvent	☐
Salt	☐

[1]

This was not well answered. Most ticked alkali but then contradicted by ticking acid or salt. This showed a lack of understanding.

Question 3 (b) (i)

(b) (i) Use the Periodic Table to calculate the molar mass of sodium hydroxide (NaOH).

Molar mass of NaOH = ... $g\ mol^{-1}$

[1]

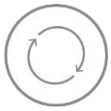
Most candidates gained a mark here.

Question 3 (b) (ii)

(ii) Calculate the mass of sodium hydroxide needed to make 1 dm^3 of a 0.5 mol dm^{-3} solution of sodium hydroxide.

Mass = ... g

[2]

	**AfL**	Although a good number of candidates could answer this correctly there were quite a few who did not know what to do and over complicated it. Many divided 1 by 0.5. They used n=c x v incorrectly. Practising these types of calculations would benefit candidates in future.

Question 3 (c) (i)

(c) **Table 3.1** shows the results of three titrations of 10.0 cm^3 samples of a batch of Flushisafe.

(i) Calculate the titres of 0.5 mol dm^{-3} **sodium hydroxide** in each titration.

Write your answers in **Table 3.1**.

	Rough titration	Accurate titration 1	Accurate titration 2
Final burette reading (cm^3)	31.70	30.55	30.75
Initial burette reading (cm^3)	0.8	0.10	0.20
Titre (cm^3)			

Table 3.1

[1]

In general, this was answered correctly.

Question 3 (c) (ii)

(ii) Describe how you could ensure the accuracy of the burette measurements.

.....

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

This was not answered well. Many candidates suggested repeating the experiment which showed they had not read the question and also did not understand how to ensure accuracy.

Question 3 (d)

(d) Suggest why a measuring cylinder would not be a suitable piece of equipment to measure the 10.0 cm^3 batches of Flushisafe.

.....

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

Many candidates gained this mark. Those that didn't gain the mark didn't understand it was about the need for accuracy.

Question 3 (e)

(e) Name a suitable indicator for the titration in **(c)**, and state the colour change.

Indicator .....

Colour change .....

[2]

Many named a correct indicator. However, some lost the second mark because they did not give the colour change and just gave the final colour. Others lost it because they had not read the question. In this titration, the alkali was added to the acid. They may have only carried out titrations the other way round. This meant they gave the colour change where the indicator showed acid to alkali, which was not correct for this experiment. It is important that centres use a range of titrations to measure both acid and alkali concentration.

Question 3 (f) (i)

(f) The balanced equation for the reaction between phosphoric acid and sodium hydroxide is:

$H_3PO_4 + 3NaOH \rightarrow Na_3PO_4 + 3H_2O$

The titration results can be used to find the concentration of phosphoric acid in Flushisafe.

(i) Use the accurate titration results in **Table 3.1** to calculate the mean titre.

Mean titre = ... cm^3
[1]

Many candidates lost the mark here because they included the trial result.

Question 3 (f) (ii)

(ii) Use your answer to **f(i)** to calculate the mean number of moles of NaOH used in the titration.

Use the equation: number of moles = $\frac{\text{concentration (mol dm}^{-3}\text{) x mean titre (cm}^3\text{)}}{1000}$

Mean number of moles of NaOH = ... mol
[1]

There was an error carried forward (ECF) from 3(f)(i) so candidates were not penalised for using an incorrectly calculated titre. Most were able to substitute their mean titre correctly.

Question 3 (f) (iii)

(iii) In the reaction between phosphoric acid and sodium hydroxide, **1 mole** of H_3PO_4 reacts with **3 moles** of NaOH.

Use the reacting ratio to calculate the number of moles of H_3PO_4 in 10.0 cm^3 of Flushisafe.

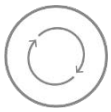
Number of moles of H_3PO_4 = ... mol
[1]

Again ECF was allowed. It was good to see many candidates understanding they needed to divide by 3. Many who did not recognise this attempted to answer but it was not clear where their working was coming from.

Question 3 (f) (iv)

(iv) Calculate the concentration, in mol dm^{-3}, of the phosphoric acid in Flushisafe.
Give your answer to **3** significant figures.

Concentration of phosphoric acid = …… mol dm^{-3}
[2]

	**AfL**	Again ECF was allowed. Candidates found this a harder question than the rest of 3(f). many did not attempt it. This is a standard calculation and it would be worth practising these with your candidates for future series. The answer had to be given to 3 significant figures and some candidates also found this difficult. This is another skill they could practice.

Question 4 (a) (i)

4 A greyish brown powder was found in a laboratory, but its container did not have a label.

(a) A series of tests was carried out on the powder to find out what it was.

- When a flame test was carried out on a sample of the powder, the substance burned with a blue-green flame.
- A second sample of the powder was then dissolved in water, and the solution was divided into two portions.
- Barium chloride solution was added to one portion, and silver nitrate solution was added to the other.

The results of the tests for the second sample are shown in **Table 4.1**.

Test	Observation
Addition of barium chloride	No change
Addition of silver nitrate	Cream precipitate

Table 4.1

(i) Name the unknown substance in the greyish brown powder.

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

Many candidates had not realised the unknown substance was a compound. This meant they could not answer this question. They need to read the question carefully and apply their knowledge.

Question 4 (a) (ii)

(ii) Write the formulae of the **two** ions present in the unknown substance.

.....**[2]**

There was an ECF from 4(a)(i). Candidates could give the symbols but did not know how to show the charges on the ions. Some candidates just wrote a formula for a compound.

Question 4 (b)

(b) Give **three** reasons why ion chromatography is used to analyse drinking water, rather than using the tests described in **(a)**.

1.....

2.....

3.....

[3]

?	**Misconception**	Many candidates understood it would be quicker. Few candidates realised it could analyse more than one ion at once. Many thought it meant the water would no longer be drinkable. Many said that water would not catch fire. Overall, there was a lot of misunderstanding of how tests work.

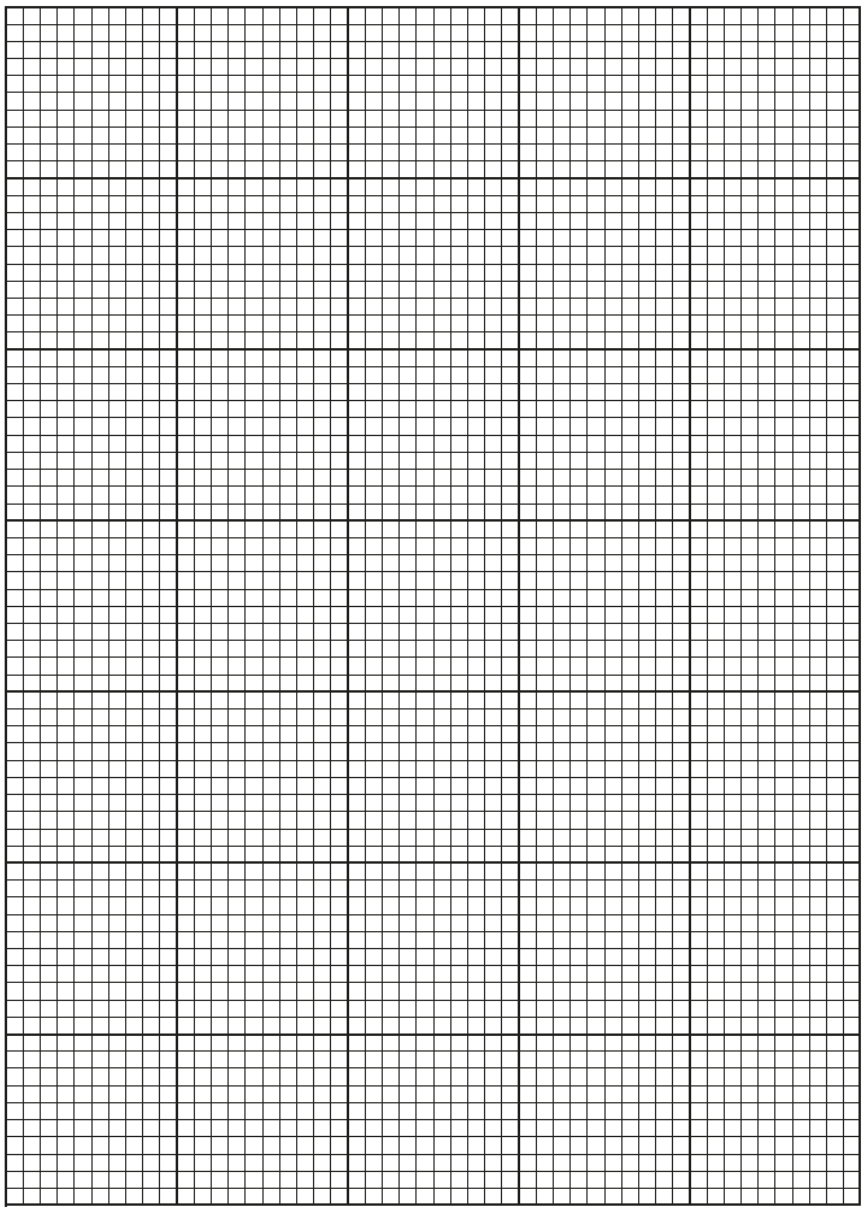
Question 4 (d) (i)

(d) **Table 4.2** shows ICP-AES results for standard lead solutions, and for a sample of tap water taken from an old house.

Lead concentration in standard lead solutions (μg dm^{-3})	Intensity (arbitrary units)
0	0.00
5	0.32
10	0.68
15	1.00
20	1.30
Tap water sample	0.50

Table 4.2

(i) Use the results shown in **Table 4.2** to plot a calibration graph of the **standard lead solutions** and draw a line of best fit.



[5]

In general the graph was done very well. Common mistakes were: having the axis the wrong way round; not adding the units to the labels; having difficult scales; not plotting a cross at zero; line not going through origin. Candidates need to take care when choosing appropriate scales and appropriate lines of best fit.

Question 4 (d) (ii)

(ii) Use the calibration graph you plotted to determine the concentration, in µg dm^{-3}, of lead in the tap water.

Show on the graph how you arrived at your answer.

Concentration of lead in tap water = ... µg dm^{-3}

[2]

Even if candidates got this incorrect, they still gained a mark if they showed their working lines on the graph. Showing this sort of technique in their answer is important in order to gain marks. If they had just given the concentration without the lines, they would have been credited only 1 mark.

Question 5 (a)

5 An epidermal strip of onion epithelial cells is obtained.

A stain is added to the onion epithelial cells.

The cells are then photographed when magnified under a light microscope.

Fig. 5.1 shows a photograph of the magnified onion epithelial cells.

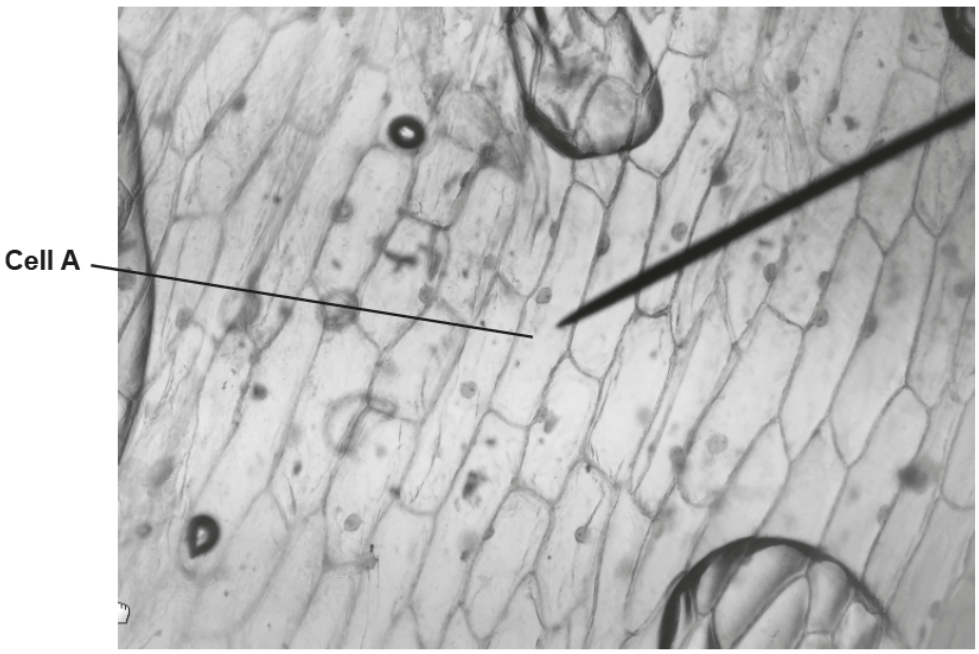


Fig. 5.1

(a) Suggest why a stain was added to the onion epithelial cells.

.....

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

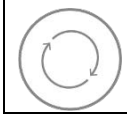
This was a well answered question.

Question 5 (b) (i)

(b) The photograph shown in **Fig. 5.1** was obtained using a **x10** eyepiece lens and **x60** objective lens.

(i) Calculate the magnification used in **Fig. 5.1**.

Magnification = x .....
[1]

	**AfL**	Candidates need to practise this style of calculations.

Question 5 (b) (ii)

(ii) A pointer is used in the eye piece of the microscope to show the location of **cell A**.

Use a ruler to measure the magnified length, in mm, of **cell A**.

Length of cell A = ... mm
[1]

Question 5 (b) (iii)

(iii) Calculate the actual length of **cell A**.

Use the formula: magnification = measured size ÷ actual size

Show your working.

Actual length of **cell A** = ... mm
[2]

It is important that the measurements are taken using the correct units. There is ECF between 5(b)(i), 5(b)(ii) and 5(b)(iii). Candidates should practise these types of calculations.

Question 5 (b) (iv)

(iv) Which **three** key features of the onion epithelial cells can be clearly seen in **Fig. 5.1**?

Tick (✓) **three** boxes.

Cell wall	☐
Chloroplast	☐
Cytoplasm	☐
Mitochondrion	☐
Nucleus	☐
Plasma membrane	☐
Vacuole	☐

[3]

Candidates answered this based on what they know about plant cells rather than what they could see in the diagram and so did not gain marks. It is important to read the question carefully and follow the instructions.

Question 5 (c)

(c) Light microscopes are also used to observe the key features of cells sampled from human patients.

However, ultrasound and X-ray scanners must be used to observe the features of structures such as organs within human patients.

Compare the advantages **and** disadvantages of using ultrasound and X-ray scanners to view internal structures of a human patient, **and** explain how this makes them suitable for viewing different structures.

.....

.....

.....

.....

.....

.....**[6]**

Candidates struggled with this question. Most candidates were familiar with X-rays and ultrasound but gave vague answers which were repetitive. They need to make sure they answer the question fully. A Level 3 answer would give at least two advantages and disadvantages of each as well as suggesting suitable uses for each. Most knew X-rays were used to see broken bones and ultrasound to see foetuses. Other than the effects of radiation, they struggled to give disadvantages of both. Answers were generally very vague. It is important to read the question carefully, understand what is required and give specific points. The command word here is 'compare' so they should give examples relating to both and compare them.

Question 6 (a) (i)

6 *Agrobacterium* is a bacterium that can be used by plant biotechnology companies to produce genetically engineered crops.

(a) **Fig. 6.1** is a photograph of *Agrobacterium* streaked onto an agar plate.

The streaking technique involves the use of a metal wire inoculation loop.

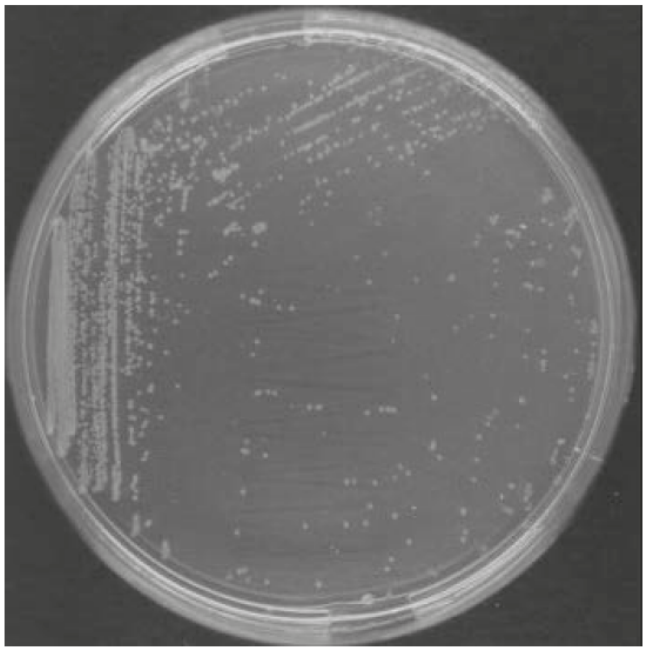


Fig. 6.1

(i) Give **two** reasons why bacteria are streaked onto an agar plate in this way.

1 .....

2 .....

[2]

Question 6 (a) (ii)

(ii) Suggest why the inoculation loop must be flamed immediately before inoculating the plate.

.....

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

Question 6 (a) (iii)

(iii) Give **two** reasons why the loop must be cooled before streaking.

1 .....

.....

2 .....

.....

[2]

Question 6 (a) (iv)

(iv) Suggest why the loop must be flamed in between each phase of streaking.

.....

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

Question 6 (a) (v)

(v) State what you would expect to see if the plate had become contaminated.

.....

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

Candidates showed a really good understanding of aseptic techniques. This section was answered well and it is clear that they have carried out these techniques.

Question 6 (b)

(b) It is possible to add genes from *Agrobacterium* to tissue cultures of plants such as cabbages.

The cabbage plants grown from the tissue cultures are now transformed (genetically engineered).

The transformed cabbage plants can be cloned.

The procedure for cloning the plants can involve five steps as shown below.

The steps are **not** in the correct order.

Step	Action
A	Place each explant onto a plate of sterile agar.
B	Incubate the explants in the light and at a suitable temperature.
C	Dip each explant in sterilising fluid.
D	Use sterile forceps to remove a small piece of tissue (explant) from a cabbage leaf.
E	Observe the agar plates each day to check the growth of new cloned plants.

Write a letter for one step in each box to show the **correct** order.

Start → End

[4]

Nearly all candidates gained full marks here.

Question 6 (c)

(c) A technician working with one biotechnology company clones some plant material as shown in **Fig. 6.2** and **Fig. 6.3**.

The explants in **Fig. 6.3** are contaminated.

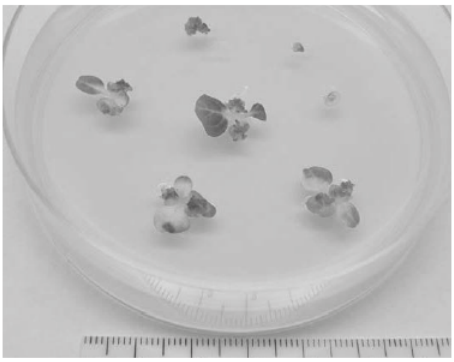


Fig. 6.2

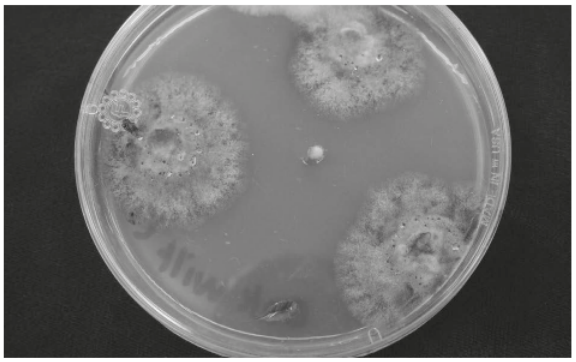


Fig. 6.3

Aseptic techniques are often carried out in controlled airflow cabinets.

Suggest **three** precautions that should be taken to maintain aseptic techniques in controlled airflow (laminar airflow) cabinets.

1.....

.....

2.....

.....

3.....

.....

[3]

Candidates did not do so well here. They gave vague answers in terms of wearing PPE and ensuring cabinet was working. They need to be specific with use of ethanol or disinfectant on surfaces; sterilising equipment etc. Many talked about using a Bunsen burner which is not appropriate for this technique. They seemed to confuse this with other techniques and generally showed a lack of understanding.

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Your route to OCR's teacher training

Attend one of our popular CPD courses to hear exam feedback directly from a senior assessor or drop in to an online Q&A session.

https://www.cpdhub.ocr.org.uk

The small print

OCR Resources: *the small print*

OCR's resources are provided to support the delivery of OCR qualifications, but in no way constitute an endorsed teaching method that is required by OCR. Whilst every effort is made to ensure the accuracy of the content, OCR cannot be held responsible for any errors or omissions within these resources. We update our resources on a regular basis, so please check the OCR website to ensure you have the most up to date version.

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Our documents are updated over time. Whilst every effort is made to check all documents, there may be contradictions between published support and the specification, therefore please use the information on the latest specification at all times. Where changes are made to specifications these will be indicated within the document, there will be a new version number indicated, and a summary of the changes. If you do notice a discrepancy between the specification and a resource please contact us at: resources.feedback@ocr.org.uk.

Whether you already offer OCR qualifications, are new to OCR, or are considering switching from your current provider/awarding organisation, you can request more information by completing the Expression of Interest form which can be found here: www.ocr.org.uk/expression-of-interest

Please get in touch if you want to discuss the accessibility of resources we offer to support delivery of our qualifications: resources.feedback@ocr.org.uk

Looking for a resource?

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Vocational qualifications

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Facsimile 02476 851633
Email vocational.qualifications@ocr.org.uk

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