CAMBRIDGE TECHNICALS

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Examiners' report

APPLIED SCIENCE

05847–05849, 05879, 05874

Unit 2 Summer 2024 series

Version 1

Contents

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. A selection of candidate answers is also provided. 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 and the mark scheme can be downloaded from OCR.

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Unit 2 series overview

This paper is a different style of assessment than many candidates are usually used to. Historically candidates do not sit a paper that contains more than one science discipline in a Level 2 or 3 paper. However, most centres are familiar with the style of paper and in general candidates' performance is improving, even considering the difficulties of the last few years. Most candidates seem prepared for this style of paper and they attempted all questions.

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

Some areas were answered well, and candidates showed good knowledge of Health and Safety regulations and microscope use. They were also able to answer questions on thin layer chromatography. They were able to label basic laboratory glassware. They struggled to calculate concentrations of a solution. They were able to interpret a calibration graph. Candidates coped better with interpreting chromatograms than on previous papers. However, very few were able to describe a method to produce serial dilutions.

Occasionally, their lack of good scientific terminology prevented them answering questions to the required standard. Some candidates did not answer in terms of the context of the question and this did impact negatively on their ability to score marks.

This is a techniques paper and so it is the techniques they need to know how to describe. They also need to explain why a technique is used and the scientific principles behind the technique. Candidates who have had the opportunity to carry out and discuss the techniques are much more able to answer the questions successfully. Good use of demonstrations and video clips is also important when reinforcing learning

.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• attempted all questions and had practised exam technique, making sure they read the question carefully and followed instructions • related their responses to the context of the questions **[Questions 1(a)(i), 2 and 4(b)]** and so were able to discuss thin layer chromatography and microscope techniques • had experience of other chromatography techniques **[Question 5**] and were able to describe procedures and use of laboratory equipment from the specification • had good understanding of titration techniques **[Question 3],** were able to calculate concentrations and were confident in using given equations, choosing and substituting numbers correctly • used accurate and precise science terminology **[Questions 1(a)(ii), 2(f), 4(a)(iii),5(b), 5e,6(a)(ii)]**.	• showed poor exam technique by not attempting all questions and not answering questions in the context they are set • were unable to interpret microscopy results **[Question 4b],** chromatograms **[Question 5(c)]** or bacterial growth results **[Question 6(b)]** • had gaps in their knowledge of titration techniques **[Question 3]** • did not seem to acquire a range of skills and knowledge as outlined in the specification, including ion chromatography and Atomic Emission Spectroscopy **[Question 5]** • struggled with calculating concentrations even where scaffolding was provided and did not show logical working. **[Question 3(c)]** • struggled to demonstrate the knowledge and skills required to respond effectively to the extended response question, choosing to give basic laboratory rules rather than specific hazards and risks **[Question 1(a)(ii)]**.

Question 1 (a) (i)

1 A new analytical chemistry laboratory is being set up.

Laws and regulations need to be followed to keep staff safe.

(a)
(i) State **two** of the employer's main duties under The Management of Health and Safety at Work Regulations 1974 (updated 1999).

....

....

....

.... **[2]**

This question was about the role of the employer. Many candidates answered in terms of expected behaviour of the employee, for example to wear correct PPE. These types of responses did not gain any marks as they did not answer the question that was asked.

Question 1 (a) (ii)

(ii) Explain the differences between hazards and risks and how the risks can be minimised.

Use **examples** that are relevant to people working in an analytical chemistry laboratory.

....

....

....

....

....

.... **[6]**

Candidates struggled to give the difference between hazards and risks. Many just described lab rules they had learnt such as bags under tables and keeping glassware away from the edge of benches. Good responses were laid out sensibly with the definition of each given first and then examples of hazards and associated risks described. They then linked these to methods to minimise the risks. Weaker responses often repeated the same ideas for minimising risks e.g. wear PPE and wear goggles but didn't link these to specific risks.

Exemplar 1

Hazards are incidences which have the potential to become a risk. The risk will be a scenario where the hazard becomes a danger. e.g. hazard is a flameable substance but the risk would be it coming in contact with an open flame and a fire spreading. A way this could be minimized is being aware of the surrounding equipment while using flamable substances and stay clear of flames. Another example of a hazard is radioactive materials like an X-ray machine. The risk linked to that is DNA mutation and radioactive poisoning from the rays. A way to minimise this is not being exposed for long periods of time and wear a lead apron.

In Exemplar 1, the candidate has tried to define hazards and risks but the definition is not clear. However, they go on to correctly give two examples of hazards, flammable substance and x-rays, and the associated risks, fire and mutation. They also link methods to minimise the risks. If the definitions had been clearer this could have gained full marks. The examples and linking of hazards to risks to method of minimising risks shows understanding and so gained 5 marks at Level 3.

Exemplar 2

Hazards are potential things that can lead to a risk and a risk is something that could put the technitian or anyone in danger. Risks can be minimalised through constant risk and hazard assessments. Employees should also be professionaly trained. There should also be the correct disposing and waste bins around. There should be labels on all harmful substances or even or anything being tested. There should be ~~the~~ appropriate sanatizing and cleaning resources ~~avail~~. and the laboratory shoud be ~~hygie~~ ~~hygeinic~~ hygienic and should be ~~a~~ laid out/ set out in a way to prevent hazards. Fire alarms should also be in accessible reach and the alarms should be tested regularly.

Exemplar 2 is a typical Level 1 response. The candidate did not define hazards and risks clearly. Although the comments on minimising risks are creditworthy, they are not linked to specific hazards or risks. No specific hazards are given and the response is very generic. We would expect specific examples of hazards, the associated risks and then the methods to minimise the risks.

Question 1 (b)

(b) Glassware is used frequently in the laboratory.

Describe **two** procedures that should be followed when clean glassware is broken.

1 ....

....

2 ....

.... **[2]**

This question was often well answered. Incorrect answers included picking up glass or wearing gloves to pick up glass. We needed the idea of safely clearing the glass and the specific bin it would be disposed in.

Question 1 (c) (i)

(c) One procedure carried out in the laboratory involves the use of dichloromethane which is a halogenated solvent. One advantage of using halogenated solvents is that they are not flammable.

(i) Dichloromethane is a serious health hazard.

Which hazard symbol would be used to show dichloromethane is a health hazard?

Put a (ring) round the correct symbol.

[1]

In general, this was well answered. The most common incorrect answer circled was the exclamation point. Although this is the sign for health hazard, it is not the sign for serious health hazard. Candidates must make sure they read the question carefully – 'serious health hazard' is given in the question.

Question 1 (c) (ii)

(ii) The waste solvent must be disposed of safely and adequate records need to be kept.

State **three** pieces of information that should be recorded.

1 ....

2 ....

3 ....

[3]

Generally, candidates were able to gain these marks. However, it was clear that some had not read or fully understood the question and so gave answers that referred to the use of the solvent rather than its disposal. For example, they gave the name of person that used it rather than person that disposed of it. These did not gain credit. Candidates clearly did not realise these were being recorded in a disposal 'log' rather than on the bottle or packaging of the solvent.

Question 2 (a)

2 Some students are studying pigments in plant leaves.

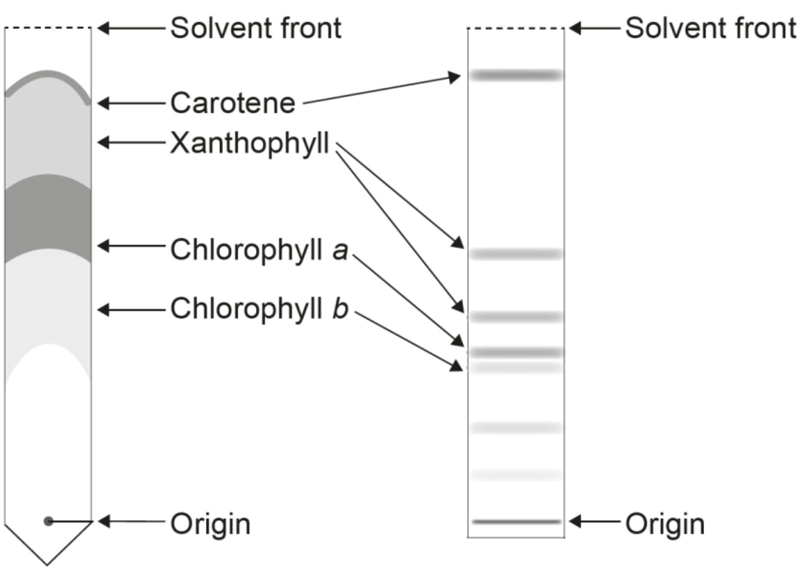
They separate the pigments using chromatography.

Fig. 2.1 shows a paper chromatogram of the leaf pigments.

Fig. 2.2 shows a TLC chromatogram of pigments from the same type of leaves.

The pigment chlorophyll *a* is labelled on both chromatograms.

Fig. 2.1 **Fig. 2.2**



(a) State what TLC stands for.

.... **[1]**

This question was well answered although some candidates forgot what the L stood for and gave responses such as Layered or they missed the word out completely. It is important to use the full name of equipment as well as the abbreviations when in the laboratory to help students.

Question 2 (b)

(b) The students note the similarities and differences between the chromatograms.

Describe **two** advantages of TLC compared to paper chromatography which can be seen in **Fig. 2.1** and **Fig. 2.2**.

1 ....

....

2 ....

....

[2]

The most common correct answer was that the separation was clear. Most candidates did not recognise that there were more pigments. Many suggested that it was easier to see but did not clarify what they meant by this and so did not gain credit. Others stated it as more accurate but did not explain why and so this did not gain a mark.

Question 2 (c)

(c) The students use **Fig. 2.2** to determine the R_f value of chlorophyll *a*.

Measure the distance from the origin to the solvent front and the distance travelled by chlorophyll *a*.

Use the two measurements to calculate the R_f value of chlorophyll *a*.

R_f value = ... **[3]**

It was important for candidates to show their working for this question. There was a mark for distance travelled by solvent and a mark for distance travelled by chlorophyll a. The final mark was for the calculation of the Rf value based on their measurements. This meant that even if candidates had incorrect measurements, as long as it was clear the numbers they used in the calculation was the two distances they could gain the error Rf calculation mark. Several candidates inverted the calculation and so could not gain the Rf mark; they could gain the other two mark points as long as it was clear what measurement each number was.

Question 2 (d)

(d) The chromatograms shown in **Fig. 2.1** and **Fig. 2.2** were produced using the same solvent as the mobile phase.

Tick (✓) **one** box that explains why the R_f value for chlorophyll *a* is smaller in **Fig. 2.2** than in **Fig. 2.1**.

Chlorophyll *a* has a greater affinity for the stationary phase in paper chromatography.	☐
Chlorophyll *a* has a lower affinity for the stationary phase in paper chromatography.	☐
In TLC the solvent runs faster than paper chromatography.	☐
Paper chromatography uses a lid.	☐
The chlorophyll *a* is different in the two chromatograms.	☐

[1]

This was a well answered question. The most common wrong answer was 'paper chromatography uses a lid.'

Question 2 (e)

(e) Explain why the R_f value for chlorophyll *a* determined from TLC (**Fig. 2.2**) is more accurate than from paper chromatography (**Fig. 2.1**).

....

....

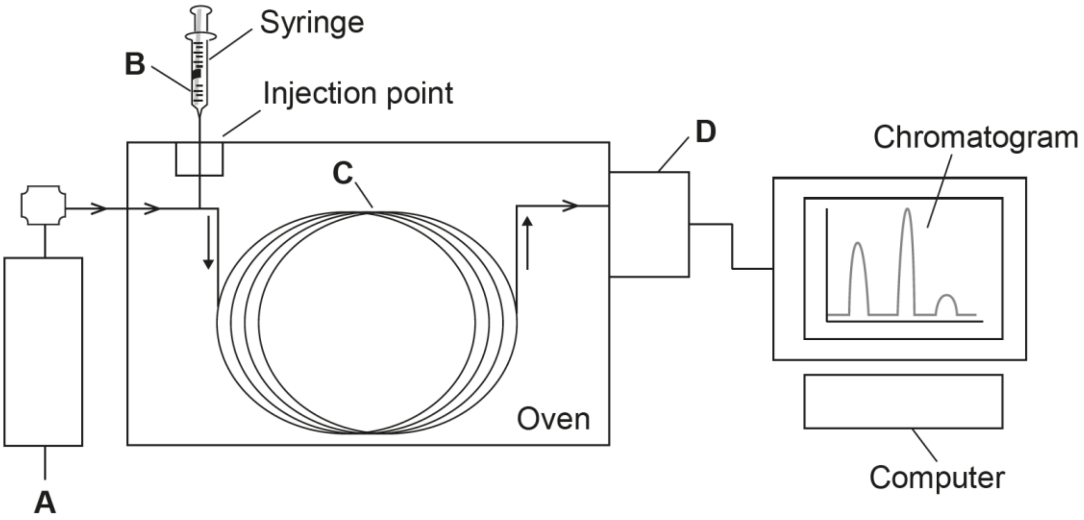
.... **[2]**

Responses needed to explain why it is easier to obtain an accurate R_f value from TLC. Many candidates thought you could measure the Rf value directly off the paper; this was not creditworthy. Others also gave vague response in terms of accuracy. It is important to be specific in answers, so thinner lines, better separation etc gain marks as these lead to better accuracy. The question asks why it is more accurate and so accuracy alone would not gain a mark.

Question 2 (f) (i)

(f) Gas chromatography linked to a mass spectrometer (GC-MS) is an instrumental technique used in chemical analysis.

(i) The image below is a block diagram of the equipment used in gas chromatography.



Identify parts **A**, **B**, **C**, and **D**.

A ....

B ....

C ....

D ....

[4]

Candidates need to be careful when answering questions like this that they are not just copying what they see. Many candidates gave syringe as the response to B. This is already labelled and so could not gain the mark.

Question 2 (f) (ii)

(ii) State **two** advantages of gas chromatography compared to TLC.

1 ....

....

2 ....

.... **[2]**

Many candidates gave cost as an answer. This would not gain credit. Speed was another common incorrect answer. Many suggested accuracy without explaining what made it more accurate. It is important for candidates to be familiar with all the techniques in the specification and they should know the scientific reasons for using each technique.

Question 2 (f) (iii)

(iii) Explain why gas chromatography is usually linked to a mass spectrometer.

....

....

.... **[2]**

Many candidates suggested this would make it quicker. Very few knew the reasons why they are linked. The better candidates had read the question carefully and made suggestions based on mass. Unfortunately, only a few recognised that it was relative formula mass that could be given and they just suggested mass or amount. There were also quite a few blank answers. It is possible candidates have not seen or used this equipment.

Equipment and techniques

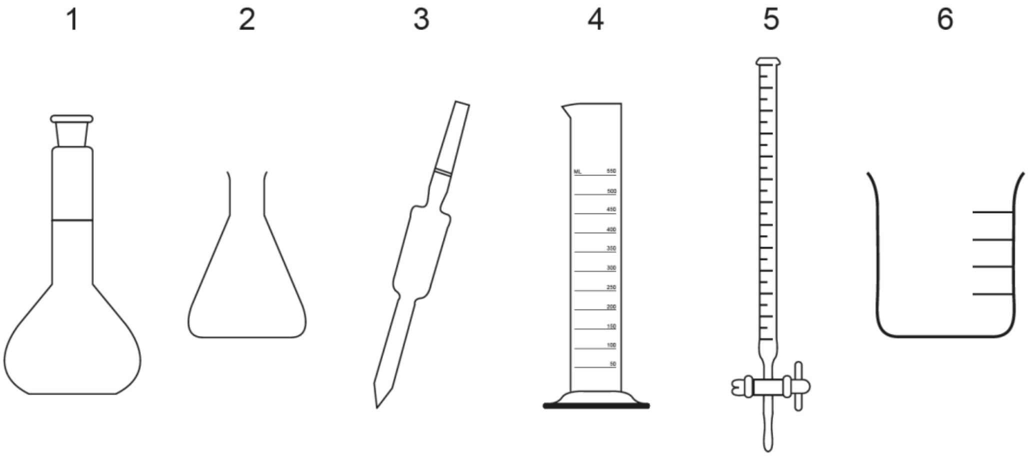
It is key students have experience of **all equipment and techniques** in the specification, even if only via a video or demonstration.

Question 3 (a) (i)

3 Dilute ammonia solution, $NH_{3\ (aq)}$, is a weak alkali. It is an ingredient in many household cleaning agents.

(a) A scientist does a titration to determine the concentration of ammonia in a brand of window cleaning solution.

The diagram shows the equipment the scientist uses.



(i) Name the pieces of equipment labelled 1 to 6 in the diagram.

1 ....

2 ....

3 ....

4 ....

5 ....

6 ....

[3]

A surprising number of candidates did not know the names of this basic laboratory glassware. It is important to use correct names for equipment when carrying out practical work. The use of correct terminology is important. The volumetric pipette and the burette were the most incorrectly identified. Graduated pipette was another common error.

OCR support

OCR will be shortly releasing a range of integrate practical instructions for our suggested practicals in the GCSE specification. These would be useful for reinforcing key skills, equipment names and diagrams, especially during transition lessons with new students. We would also recommend resources like E229 - Illustrations of basic lab equipment from CLEAPSS or ASE’s Equipment Flashcards.

Question 3 (a) (ii)

(ii) The scientist titrates the window cleaning solution against 0.100 mol dm^{-3} hydrochloric acid.

Methyl orange is used as the indicator for the titration.

Tick (✓) **one** box that shows the colour change of methyl orange.

Acidic conditions	Basic conditions	
Yellow	Blue	
Colourless	Pink	
Red	Yellow	
Pink	Colourless	

[1]

Most candidates gained the mark here. The most common wrong answer was yellow and blue.

Question 3 (a) (iii)

(iii) The pH range of methyl orange is 3.2 to 4.4.

Explain why methyl orange is a suitable indicator for this titration.

....

....

.... **[2]**

Precise language was key for this question.

Many candidates gained the first mark point of strong acid-weak base but they struggled with the rest of the explanation. They needed an idea of a clear colour change at the end point or that the pH range of the indicator is within the range of rapid pH change.

Many stated the pH range from the question and this gained no credit. Many just stated it showed a colour change but did not explain it was at end point. Many answers said that the end point was within the pH range, which was not sufficient.

Question 3 (b)

(b) An auto-titrator can be used to obtain more accurate results.

State how the equivalence point of the titration is determined using an auto-titrator.

....

.... **[1]**

All that was expected here was to suggest a pH probe or to measure the pH. However, many candidates did not get this mark. Instead they stated that the auto-titrator stopped adding solution when the colour changes showing a misunderstanding of how the auto-titrator works.

Question 3 (c) (i)

(c) The scientist uses an auto-titrator to determine the concentration of ammonia in a brand of window cleaning agent.

The scientist follows the method below:

Step 1 Dilution

Measure out 5.00 cm^3 of the cleaning agent and make up to a volume of 250.0 cm^3 with deionised water.

Step 2 Auto-titration

Titrate 10.0 cm^3 of the diluted cleaning agent from **step 1** against 0.100 mol dm^{-3} HC*l*.

The mean volume of 0.100 mol dm^{-3} HC*l* required to neutralise 10.0 cm^3 diluted cleaning agent was found to be 3.62 cm^3.

The equation for the reaction is:

$NH_3\ (aq) + HCl\ (aq) \rightarrow NH_4Cl\ (aq)$

Use the following steps to calculate the concentration of ammonia in the window cleaning agent.

(i) Calculate the number of moles of HC*l* in 3.62 cm^3 of 0.100 mol dm^{-3} HC*l*.

You will need to use the following equation in your calculation.

$$\text{Number of moles} = \frac{\text{concentration in mol dm}^{-3} \times \text{volume in cm}^3}{1000}$$

Number of moles HC*l* = ... mol **[1]**

Many candidates did gain this mark. Those that did not failed to substitute the numbers correctly. Others did not divide by 1000 even though they were given this in the question.

Assessment for learning

It is important to practise these maths skills so that candidates do not struggle with these questions. Creating homework or SLOP booklets using Exambuilder is now quicker and easier, and you can also include content from our science GCSEs and A levels.

Question 3 (c) (ii)

(ii) Calculate the concentration of NH_3, in mol dm^{-3}, in the **diluted** cleaning agent.

Concentration of diluted cleaning agent = ... mol dm^{-3} **[2]**

Many candidates realised that the number of moles of ammonia was the same as their answer to 3(c)(i). This meant they gained the first mark. Few were able to take this any further. Again, it is important to practise these type of calculations as the skills are the same even if the chemicals are different.

Question 3 (c) (iii)

(iii) The cleaning agent was diluted in **step 1**.

Calculate the dilution factor and use this value to calculate the concentration of NH_3 in mol dm^{-3} in the undiluted cleaning agent.

Dilution factor = ...

Concentration of undiluted cleaning agent = ... mol dm^{-3} **[2]**

Many were able to calculate the dilution factor. But again, some could not take it further and did not multiply their answer from the previous question by this factor.

Question 3 (c) (iv)

(iv) Concentrations in household products are usually given as a percentage.

A 1% ammonia solution means that there is 1.00 g of ammonia in 100 cm^3 of solution.

The molar mass of NH_3 is 17 g mol^{-1}.

Use your value for the concentration of NH_3, in mol dm^{-3}, to calculate the percentage of ammonia in the cleaning agent.

% NH_3 = ... **[2]**

Quite a few candidates did not attempt this question. Exam practice on maths questions is key to help build confidence with this sort of question. It was good to see those that did attempt it recognise that they needed to use 17 (from the question) in their response. Few managed to gain full marks.

Question 3 (d)

(d) Explain why an auto-titrator delivers more accurate results than a manual titration using an indicator.

....

....

....

.... **[2]**

Many candidates recognised that human error is eliminated with the use of the auto-titrator - but that alone did not get a mark. They needed to explain with specific examples. Not depending on opinion or on skill could both have gained marks.

Question 3 (e)

(e) A brand of window cleaning agent contains a blue dye. Suggest why a manual titration involving an indicator cannot be used to determine the ammonia concentration.

....

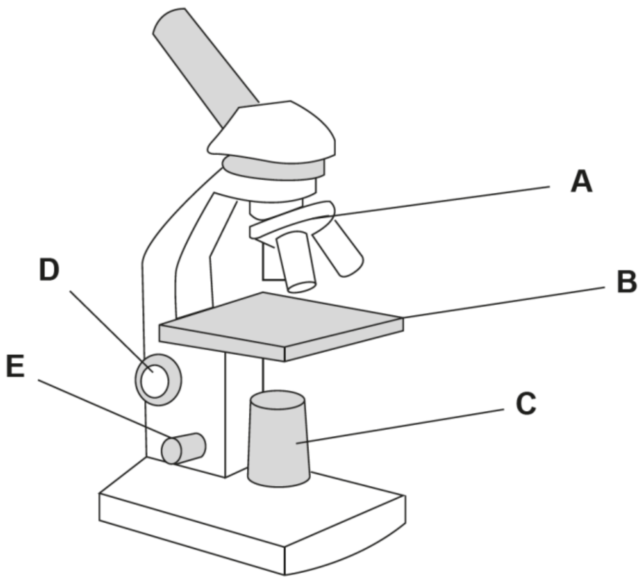
.... **[1]**

Although most candidates understood it was the colour that was the problem, they did not suggest why the colour was the issue. Answers such as 'disrupt the indicator' were common but not credited. We were looking for the idea that the blue masks the colour of the indicator so the end point colour change could not be seen.

Question 4 (a) (i)

4 Forensic biologists often use light microscopy in their work.

(a) The diagram shows a light microscope with 5 parts labelled **A** to **E**.



(i) Name the part labelled **B**.

.... **[1]**

Most candidates gained a mark here. Common wrong answers included platform, slide or plate.

Question 4 (a) (ii)

(ii) State the purpose of the part labelled **C**.

.... **[1]**

Most candidates gained a mark here. Common wrong answers suggested it was a support for the stage.

Question 4 (a) (iii)

(iii) Explain why there are two focussing knobs (**D** and **E**).

....

....

....

.... **[3]**

Few candidates knew the correct names for these knobs. Most made generic statements about changing magnification without linking to coarse or fine focus. When using equipment in the lab it is important for candidates to know the correct terminology for the equipment they are using and the purpose of the equipment.

Question 4 (a) (iv)

(iv) Label **A** shows the objective lenses.

Explain why there are **three** objective lenses on this microscope.

....

....

....

.... **[2]**

Most candidates gained a mark for multiple magnifications. Very few were able to explain that this gave a range of field of views. Most just stated it made it bigger or smaller which did not gain credit.

Question 4 (b) (i)

(b) A forensic biologist uses microscopy to view fibres found at a crime scene so that the crime scene fibres can be compared to reference fibres.

A suspect can be linked to the crime scene if fibres from the crime scene match those found on the suspect.

There are six suspects for the crime. Fibre samples are taken from their clothes.

The fibre diameter (mm) and colour are shown in the table.

Suspect	Fibre diameter / mm	Fibre colour
A	0.060	Red
B	0.040	Blue
C	0.010	Red
D	0.030	Blue
E	0.020	Red
F	0.020	Blue

Fig. 4.1 shows some reference fibre types.

Fig. 4.1

Item removed due to third party copyright restrictions

Coarse wool Silk Cotton
Cashmere Linen Polyester

A sample of fibre is found at the crime scene and viewed using a scanning electron microscope (SEM).

The detailed, microscopic appearance of the fibre is shown in **Fig. 4.2**.

Fig. 4.2

Item removed due to third party copyright restrictions

(i) The forensic biologist concludes that the fibre found at the crime scene is cashmere.

Explain how the forensic biologist came to this conclusion.

....

.... **[1]**

Many candidates talked about using a microscope to look at the fibres. However, many missed the point that they could make the conclusion because the fibres matched or looked similar.

Question 4 (b) (ii)

(ii) Use the scale bar in **Fig. 4.2** to estimate the diameter in **mm** of the fibre.

1 mm = 1000 μm.

Diameter = ... mm **[1]**

This was generally well answered. Wrong answers included those where the conversion was incorrect or they had measured the wrong thing, possibly the length, which would not be appropriate for this context.

Question 4 (b) (iii)

(iii) Identify which **two** suspects could have been at the crime scene.

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

This was well answered, although some candidates did not give answers that matched their answer to 4(b)(ii) so were possibly guessing and did not know how to use their previous answer.

Question 4 (b) (iv)

(iv) Take a suitable measurement from **Fig. 4.1** and calculate the magnification of the image.

Magnification .... x **[3]**

Some candidates struggled with this question. It was clear they had not read the instructions and so had not taken a measurement from Fig. 4.1.

It helps candidates if they practise exam techniques. It would have helped them here if they had underlined the instructions to take a measurement and calculate as this would have meant they did not miss out a step.

Other candidates had not realised they needed to use their number from the previous question.

Calculation questions on this paper are often scaffolded in this way to support candidates so it is important they read all the instructions carefully.

Question 4 (c) (i)

(c)
(i) State **one** advantage of using SEM compared to light microscopy.

....

.... **[1]**

Many candidates suggested 3D images for this question. This is not correct but would not be penalised as SEM images can be manipulated to become 3D. Most candidates recognised that higher resolution or magnification was the advantage.

Question 4 (c) (ii)

(ii) Tick (✓) **one** box to explain why light microscopy would be better to determine which of the suspects from **(b)(iii)** was at the crime scene.

Light microscopy can reveal the colour of the fibres. ☐

Light microscopy can determine the chemical composition of the fibres. ☐

Light microscopy can be used to estimate the diameter of the fibres more accurately. ☐

[1]

Most candidates ticked the correct box. There was no obvious common wrong answer.

Question 5 (a)

5 Ion Chromatography (IC) and Atomic Emission Spectroscopy (AES) can be used to analyse water samples.

(a) Use ticks (✓) to show which features apply to IC and AES.

Each row can have **one or two** ticks.

Feature	**IC**	**AES**
Can detect anions **AND** cations.		
Can detect very low concentrations.		
Can determine concentrations of ions in solutions.		
Uses a flame as a heat source.		

[2]

This question was not well answered with most candidates not gaining either mark. There was no pattern to the wrong answers. As stated previously candidates must be familiar with all equipment and techniques in the specification.

Question 5 (b)

(b) Use words from this list to describe the principles of IC.

absorbed	**affinity**	**detected**	**dissolved**	**eluent**
higher	**lower**	**plate**	**tube**	

The ions are .... by a resin matrix.

.... is passed through the column.

Ions with a .... affinity for the resin matrix pass through the column more slowly.

As they leave the column, the ions are .... by measuring their electrical conductivity.

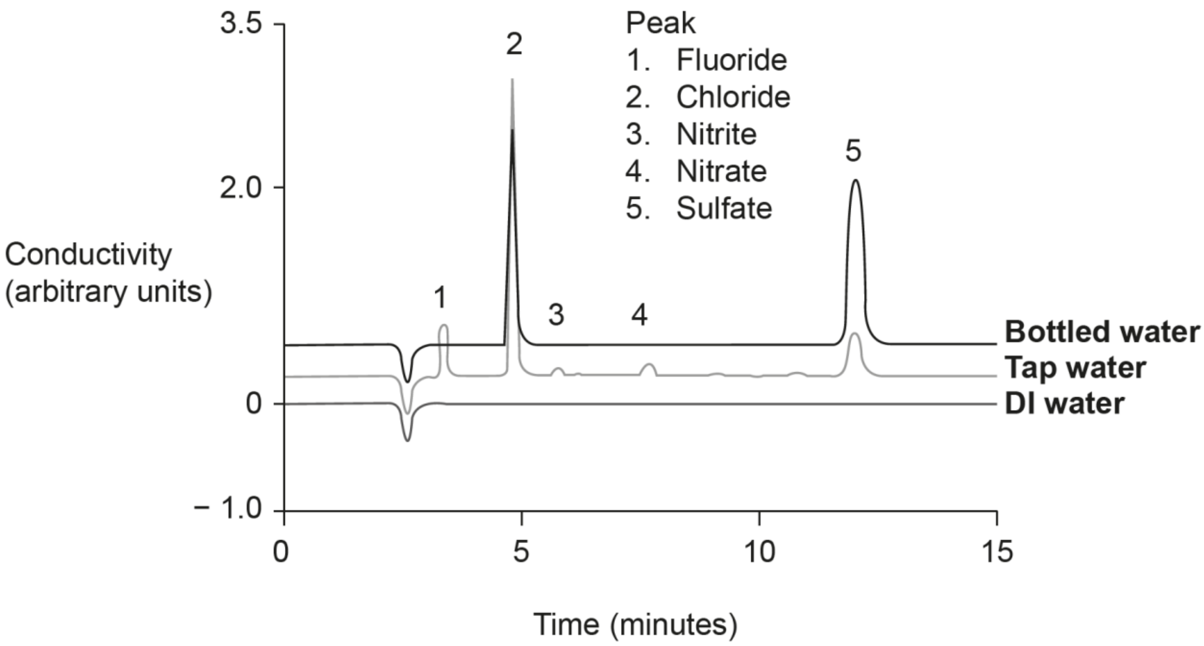
[3]

Most candidates gained 2 or 3 marks here. 'Lower' was a common incorrect answer. Candidates must understand the principles behind techniques in the specification.

Question 5 (c) (i)

(c) A chemist uses IC to compare the anions present in tap water, bottled water and deionised (DI) water.

A printout of the chromatogram is shown below.



(i) Which **two** ions are present in bottled water and in tap water?

.... **[1]**

Most candidates gained marks here as they were able to interpret the chromatogram. Candidates should take more care when naming ions as some lost the mark, suggesting chlorine rather than chloride.

Question 5 (c) (ii)

(ii) Three other ions are also present in tap water. Which of these other three ions has the highest concentration?

Explain your answer.

....

....

.... **[2]**

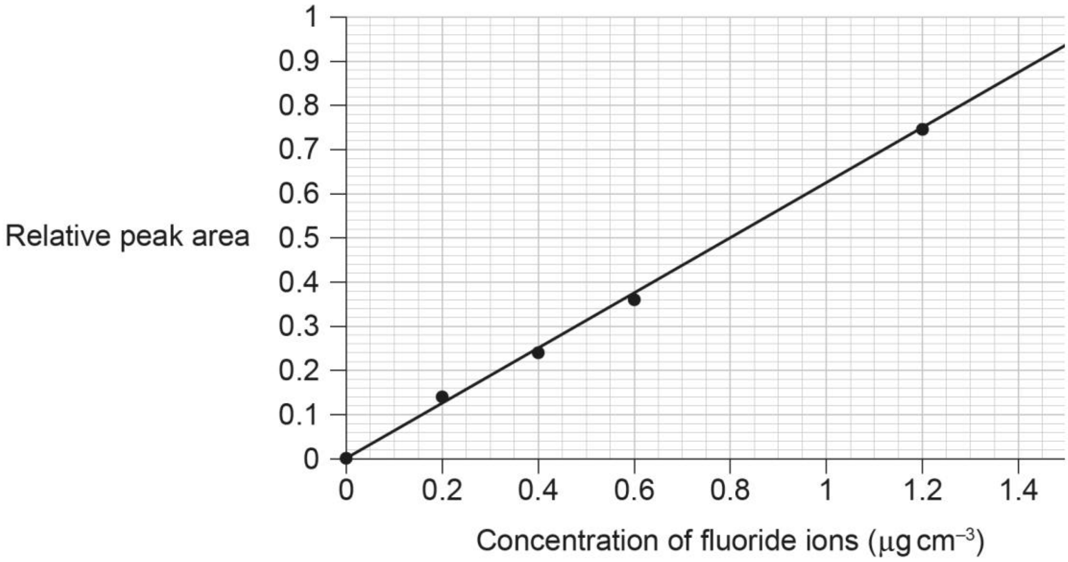
Most candidates gained the mark for fluoride. A high number also gained the second mark. However, some did not gain this mark because they stated it had a high concentration which is just a repeat of the stem.

Question 5 (c) (iii)

(iii) Fluoride is added to tap water in the UK to help protect people's teeth. The recommended range of fluoride ions in tap water is between 0.7 and 1.5 μg cm^{-3}.

The chemist is testing a water supply to check whether the fluoride ion concentration is within the recommended range.

The chemist first uses IC to produce a calibration graph as shown below.



The chemist then determines the relative peak area of a sample from the water supply. The relative peak area of the water sample was found to be 0.52.

Use the graph to determine whether the fluoride ion concentration is within the recommended range.

.... **[2]**

Candidates had to show their working on the graph, give the correct concentration and then state whether it was within range. Where candidates did not gain the second mark it was because they did not either read off their interpolation lines correctly or they drew lines incorrectly and so their answer was not within tolerance. Candidates should practise this skill as it is the same skill independent of the data.

Question 5 (d)

(d) State **two** other uses for IC, in addition to measuring ion concentrations.

1 ....

....

2 ....

....

[2]

Very few candidates gained marks here. They had not read the question and so did not give other uses. Common correct answers were protein and water purification.

Exemplar 3

1 Detecting anions and Cations

2 Shows how high or low Concentrations of the ions are.

Exemplar 3 shows that this candidate has not read the question; both of their responses are about ions which have already been given in the question. It is important that candidates use good exam technique and practise reading questions and following instructions.

Question 5 (e)

(e) The chemist uses AES to determine which metal ions are present in the water supply.

Outline the scientific principles involved in this technique.

....

....

.... **[2]**

Some candidates misunderstood this question and answered in terms of what AES did or the processes involved. We were looking for the principles. It is important that candidates understand the principles behind the techniques. Some candidates did not gain marks because their use of scientific terminology was weak. Others described a flame test which did not gain credit.

Question 6 (a) (i)

6 One important role of a food technologist is to check that food safety standards are met.

A food technologist uses a plate count method to estimate the number of colonies of bacteria in a sample of food.

Method

1 Blend 25.0 g of the food sample with a sterile buffer solution and make up the volume to 50.0 cm^3 with the buffer solution. This is a 1x solution.

2 Prepare a ten-fold dilution series from this 1x solution to make 1/10, 1/100 and 1/1000 dilutions. Sterile buffer solution is used for all dilutions.

3 Spread 0.5 cm^3 of each dilution of the sample onto separate agar plates and incubate to allow any colonies to grow.

4 Spread 0.5 cm^3 of the sterile buffer solution onto an agar plate.

(a)
(i) The equipment used by the food technologist to make this dilution series is shown in the table below.

Put **one** tick (✓) in each row to show the correct procedure to sterilise that equipment.

Each procedure can be used once, more than once or not at all.

	Procedure		
	Autoclaving	**Dry heat**	**Flaming**
Agar for the agar plates			
Glass pipettes			
Sterile buffer solution			

[3]

Most candidates gained marks here. Some put more than one tick in a row so had not followed instructions.

Question 6 (a) (ii)

(ii) Outline the steps the food technologist should follow to obtain the ten-fold dilution series.

....

....

....

....

....

....

.... **[3]**

Very few candidates scored any marks here. Many described aseptic techniques, which was not appropriate. Those that did try to describe serial dilution did not gain marks because the solutions they were making up were not correct. They were adding 1cm^3 to 10 cm^3. Just stating repeat this did not gain the mark. It had to be clear that they were repeating with 1/10 dilution and 1/100 dilution.

Question 6 (a) (iii)

(iii) Explain why an agar plate is spread with 0.5 cm^3 of **sterile** buffer solution.

.... **[1]**

Many candidates misunderstood the reason for using sterile buffer and stated it was to kill bacteria. Unqualified answers related to contamination or cross contamination did not gain marks.

Question 6 (b) (i)

(b) The diagrams below show colonies of bacteria growing on the three spread plates after they were incubated.

The dots (○ and •) show different colonies of bacteria.

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1/10 dilution **1/100 dilution** **1/1000 dilution**

(i) Explain why the 1/10 plate cannot be used to calculate the number of colonies on the food sample.

....

.... **[1]**

Many candidates misinterpreted the plate images. They thought the 1/10 dilution had been contaminated. It was clear they did not understand the purpose of dilution.

Question 6 (b) (ii)

(ii) Explain why the 1/100 plate is more effective than the 1/1000 plate for determining the number of colonies per gram.

....

.... **[1]**

Most candidates recognised that 1/100 dilution did not show enough colonies to be accurate.

Question 6 (c) (i)

(c) The maximum permitted number of colonies in the food sampled is 1×10^7 colonies per gram.

(i) Use the 1/100 plate to calculate the number of colonies per gram.

The number of colonies in the 1/100 plate is 53.

Number of colonies per gram = ... **[3]**

Most candidates gained MP1 for 5300 but did not add anything else creditworthy. This is an example of why it is so important to show working. Those that showed working were able to gain the mark for 5300. Very few candidates carried out the second conversion but some did go onto divide by 25 and so also gained that mark.

Question 6 (c) (ii)

(ii) What can you conclude from your calculation of the number of colonies per gram of food growing on the 1/100 plate?

Tick (✓) **one** box to show the correct answer.

The number of colonies in the food is **less than** the allowed maximum number. ☐

The number of colonies in the food is **the same** as the allowed maximum number. ☐

The number of colonies in the food is **more than** the maximum allowed number. ☐

[1]

Most candidates gained this mark. The **more than** response was the most common incorrect answer.

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