CAMBRIDGE TECHNICALS

Oxford Cambridge and RSA

CAMBRIDGE TECHNICALS LEVEL 3 (2016)

Examiners' report

APPLIED SCIENCE

05847–05849, 05879, 05874

Unit 2 January 2023 series

Version 1

ocr.org.uk/cambridgetechnicals

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. 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.

Unit 2 series overview

Candidates sitting this paper for the first time are usually unfamiliar with its approach, with multiple science disciplines being assessed. 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 seemed prepared for this style of paper.

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 sampling techniques. They were also able to answer questions on molecular biology techniques such as PCR and electrophoresis. They did not do so well when choosing apparatus to prepare standard solutions. They also found interpreting acid-base titration curves challenging. They struggled to calculate concentration of a solution.

Even though most candidates were unable to describe the principles of Atomic Emission Spectroscopy they were able to interpret spectra.

They have good understanding of aseptic techniques.

In some cases, their lack of good scientific terminology prevented them answering questions to the required standard.

Candidates also struggled with conversion of units especially related to microscopy questions.

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 and discuss the techniques are much more able to answer the questions successfully. Good use of demonstrations and video clips is also important.

Candidates who did well on this paper generally did the following:	Candidates who did less well on this paper generally did the following:
• attempted all questions • read the question carefully • had experience of laboratory techniques • had practised exam technique • had good knowledge of sampling techniques • had good understanding of magnification using microscopes • could choose appropriate apparatus • gave responses relating to context of the question • had practised mathematical skills • used accurate and precise science terminology.	• left questions blank • did not answer the question as set • evidenced little experience of the laboratory techniques required by the specification • had weak knowledge of sampling techniques • did not seem to acquire a range of skills and knowledge as outlined in the specification • struggled with calculating magnification • did not understand the importance of choosing correct apparatus • did not show mathematical working • used poor or imprecise scientific terminology.

Question 1 (a) (i)

1 Anika is leading a team of scientists in Ghana working for the World Health Organization (WHO).

She is studying sickle cell disease, a life-threatening inherited blood disorder.

Anika gives her team the following information:

- People with sickle cell disease inherit two copies of the sickle cell gene, one from each of their parents.
- Some people are carriers for this disease.
- Carriers do not have full symptoms of sickle cell disease and they have the advantage of being resistant to malaria (a serious disease that is transmitted via mosquito bites).
- Ghana is an African country with a population of 28 million people, and malaria is always present in the population.

Anika wants to know what proportion of the **entire population of Ghana** are sickle cell carriers. She and her team do this by genetically testing a sample of the population.

Anika chooses to sample a village in Ghana. The total population of the village is 250. There are 105 men, 95 women and the remaining 50 are children.

(a) Anika's first plan is to test everyone in the village.

(i) Circle the kind of sample that this represents.

biased **random** **representative** **whole**

[1]

Most candidates correctly chose 'whole'. There was no pattern to the incorrect responses.

Question 1 (a) (ii)

(ii) Put a tick (✓) in **one** box that **best** explains why it is this kind of sample.

All the people in the village would be in the sample	☐
Over 100 people would be in the sample	☐
There are more men than women in the village	☐
There would be a range of men, women and children in the sample	☐

[1]

Most candidates ticked the correct box. Those that did not gain the mark commonly ticked the bottom box, showing a misunderstanding of what a whole sample is.

Question 1 (b) (i)

(b) Anika's team of scientists do not have enough time or resources to sample everyone in the village.

Instead, they put numbered tickets into a container, each person in the village takes a ticket and only those with an even-numbered ticket are tested.

(i) Circle the **two** kinds of sample that this represents.

biased **random** **representative** **whole**

[1]

Many candidates did not read the question properly and only circled one word. There was only 1 mark for both correct answers making it very important that the question was read carefully and the instructions that followed.

Question 1 (b) (ii)

(ii) Put a tick (✓) in the **two** boxes that **best** explain your answer.

Anika did not choose the selection herself	☐
Half of the people in the village would be in the sample	☐
Over 100 people would be in the sample	☐
There would be a range of men, women and children in the sample	☐

[1]

This is another question where it is important to read the question carefully and follow the instructions. Two ticks were required for the mark. Many gave the first answer correctly but then did not tick a second box and so did not gain the mark.

Question 1 (c)

(c) A member of her team thinks that more people should be tested.

State how this would affect the reliability of the results.

.... **[1]**

The questions asks for a response relating to reliability and this caused some candidates difficulty.

Misconception

? Many candidates confused reliability with accuracy and so did not get this mark. Some also thought more people would make it less or more biased. The questions asks for a response in terms of reliability and this is what they needed to do.

Question 1 (d) (i)

(d) Two methods can be used to obtain DNA samples, either a cheek swab or a blood test.

Fig. 1.1 shows a cheek swab being taken.

Fig. 1.2 shows a hypodermic syringe being used to take a blood sample.

Fig. 1.1

Fig. 1.2

After carrying out a risk assessment for the two methods, Anika chooses the cheek swab method.

(i) Use the information shown in **Fig. 1.1** and **Fig. 1.2** to describe **one** health and safety reason why Anika chooses the cheek swab method.

.... **[1]**

Many candidates discussed contamination here which was not creditworthy. Contamination unqualified rarely gains a mark. This question asked candidates to use the information in the question to answer. There is no information in the question about contaminants and so the only correct response would be in reference to the sharp needle.

Question 1 (d) (ii)

(ii) Suggest **one** further reason, other than health and safety, why Anika chooses the cheek swab method.

.... **[1]**

Most candidates answered this correctly. However, some answered in terms of health and safety. Again this shows the importance of reading the question carefully.

Question 1 (d) (iii)

(iii) Describe **one** hazard that the scientists in Anika's team may encounter as they take cheek swab samples from the patients.

....

.... **[1]**

Although few candidates gave the expected response 'pathogens', most were able to explain that there may be a disease/bacteria etc present and these were sufficient as a hazard. Again, some wrote contamination but did not qualify what by or who was contaminated.

Question 1 (d) (iv)

(iv) Suggest **one** hazard that **all** members of Anika's team may encounter in Ghana, even those not taking samples from the patients.

.... **[1]**

It was good to see many candidates using the information in the stem to find the answer of malaria or mosquitos. However, several suggested sickle cell anaemia, showing they had not read in the stem that this was an inherited disease. Other reasonable responses were credited, e.g. hot weather causing heatstroke.

Question 1 (e) (i)

(e) Anika's team takes the waste sample materials to a nearby university laboratory for disposal.

(i) The waste must be labelled with a hazard warning symbol.

Put a tick (✓) under the correct hazard warning symbol.




....

[1]

The symbol for toxic was a common incorrect response. Many candidates did not follow the instructions and instead of giving a tick, labelled all the symbols. Even if labelled correctly, this did not answer the question and so no marks were given.

Question 1 (e) (ii)

(ii) Complete the sentences about disposal of the waste sample materials using words from this list.

The words may be used once, more than once or not at all.

audio	**autoclaving**	**burying**	**freezing**	**patient**
serial number	**video**	**waste operator**	**written**	

1 The used cheek swabs should be disposed of by ....

2 .... records of the type and quantity of waste must be kept. These records should also include the date and time that the waste was processed and the name of the ....

[2]

In general, this was well answered with many candidates gaining at least 1 mark. The most common incorrect answer was patient rather than waste operator for the last point.

Question 1 (f) (i)

(f) Anika's team tested 125 people in the village. They found that 22 of the people tested were sickle cell disease carriers.

(i) Estimate the percentage of people in the village who are carriers.

% of people who are carriers = ... % **[1]**

This was well answered. Common mistakes were incorrect rounding or calculating the percentage and then doing another step, e.g. multiplying by 2.

Question 1 (f) (ii)

(ii) Suggest why this percentage might not be a very accurate estimate of the percentage of people in the whole of Ghana who are sickle cell disease carriers.

.... **[1]**

Candidates struggled to answer this fully. Many said only one village was sampled without expanding on this. The question tells them one village is sampled so this could not be credited.

Question 2 (a)

2 Amit is learning about the molecular biology techniques of PCR and gel electrophoresis.

(a) Draw a line to link the name of each technique to its function.

Technique	Function
PCR	To amplify specific sequences of nucleic acid
Gel electrophoresis	To purify sequences of nucleic acid
	To extract nucleic acid from cells
	To separate nucleic acid according to size

[2]

In general, this was well answered. Where only 1 mark was awarded it was mostly for a correct link to gel electrophoresis. There was no pattern to the incorrect responses.

Question 2 (b)

(b) A PCR mixture requires a number of essential components.

Complete the sentences about the PCR components using words from this list.

The words may be used once, more than once or not at all.

amino acids	**amylase**	**glucose**	**nucleotides**
polymerase	**primers**	**sucrase**	

The enzyme that synthesises DNA strands in PCR is called ....

The monomers used in DNA synthesis are ....

[2]

Candidates did well here in general. Incorrect responses included choosing the wrong enzyme or suggesting primers for either answer.

Question 2 (c)

(c) PCR requires three steps repeated many times.

Draw a line to link the name of each step to its correct description.

Step	**Description**
Denaturation	Primers bind to specific complementary sequence
Annealing	Double stranded DNA separated into single strands
Elongation	Nucleotide monomers assembled into a DNA strand

[2]

Most candidates gained at least 1 mark here, usually for correct link to either denaturation or annealing.

Question 2 (d)

(d) The number of DNA copies obtained from one gene via PCR can be calculated using the equation:

Number of copies = 2^n where n is the number of PCR cycles

Calculate how many copies can be produced from 30 cycles of PCR.

Give your answer to **one** significant figure.

.... **[1]**

Here 1 000 000 000 was a common correct answer. Fewer gave the answer in standard form.

Misconception

A common wrong response was 60 where the candidate had just multiplied 2 by 30. Others misunderstood one significant figure and gave an answer of 1.

Question 2 (e)

(e) Explain why heat-stable enzymes are used in PCR.

....

....

.... **[2]**

Candidates mostly gained 1 mark here for enzymes not denaturing. Some used incorrect language and stated they were damaged or killed. This would not gain the mark. Very few recognised this meant additional enzymes would not need to be added but a few did know that PCR generates heat. Many wrote that it was carried out at hight temperature which did not gain the mark.

Question 2 (f) (i)

(f) The DNA fragments obtained from PCR are separated by gel electrophoresis.

(i) Draw **one** line to link the charge of the DNA fragments to the correct electrode they migrate towards.

Charge	**Electrode**
Positive	Anode
Neutral	Cathode
Negative	Dynode
Dipole	Cestode

[1]

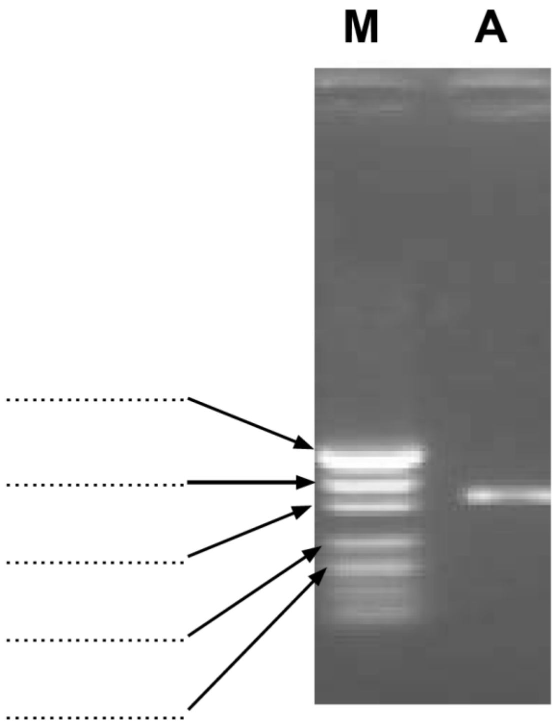
The main issue here was that candidates had not read the instructions carefully. Many drew lines from each box on the left to a box on the right. They were only meant to draw one line. Many that followed instructions gained the mark. Incorrect responses using one line tended to be starting at positive or a line from negative to cathode.

Question 2 (f) (ii)

(ii) Gel electrophoresis of a PCR reaction is shown below.

The size markers are in lane **M**.

The PCR fragment is in lane **A**.



The size markers are:

110bp **404bp** **331bp** **242bp** **489bp**

Label the markers with the correct sizes in the spaces to the left of the figure.

[1]

Candidates that lost the mark here either put the sizes in reverse order or had the first three correct and then put the rest in reverse order.

Question 2 (f) (iii)

(iii) Use the size markers in lane **M** to estimate the size of the PCR fragment in lane **A**.

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

Most candidates were able to gain this mark and there was no pattern to incorrect responses.

Question 2 (g)

(g) Suggest why shorter DNA fragments move faster through the agarose gel during electrophoresis.

.... **[1]**

A lot of candidates repeated the question and so did not gain the mark, or they stated the fragments were smaller which is also a repeat of the question just using different wording. Those that gained the mark generally did for the idea of the fragments being less dense. Very few said there would be less resistance in the gel. Some did try to answer in this way but discussed holes or pores in the gel as if it was a filter. This did not gain credit.

Question 3 (a) (i)

3 (a) Sara is a student learning about acid–base titrations.

The pieces of laboratory glassware that she could use are listed in **Fig. 3.1**.

Fig. 3.1

- 50 cm^3 burette
- 100 cm^3, 250 cm^3 and 1 dm^3 beakers
- 10.0 cm^3 and 25.0 cm^3 one-mark pipettes
- 10 cm^3 and 25 cm^3 measuring cylinders
- 100.0 cm^3, 250.0 cm^3 and 1.0 dm^3 volumetric flasks
- 250 cm^3 conical flask.

She has been asked to carry out a titration to determine the concentration of a solution of ammonia, $NH_3(aq)$. She decides to titrate a known volume of the ammonia solution against a standard solution of 0.100 mol dm^{-3} hydrochloric acid.

(i) Sara is provided with 10.0 mol dm^{-3} hydrochloric acid.

Describe how she would use this solution to prepare 1 dm^3 of 0.100 mol dm^{-3} hydrochloric acid.

In your answer you should name the two pieces of glassware from **Fig. 3.1** that she would need.

....

....

....

....

....

.... **[3]**

Very few candidates gained marks here. Many tried to describe a titration method so had not read or understood the question. If they had suggested the correct apparatus they could still gain marks. Most did not because they did not understand the importance of selecting the most appropriately sized measuring equipment.

Assessment for learning

It is important for students to have the opportunity to choose equipment when carrying out practical work. They should also have the opportunities to justify their choices. This would help with their practical skills and understanding as well as with exam questions.

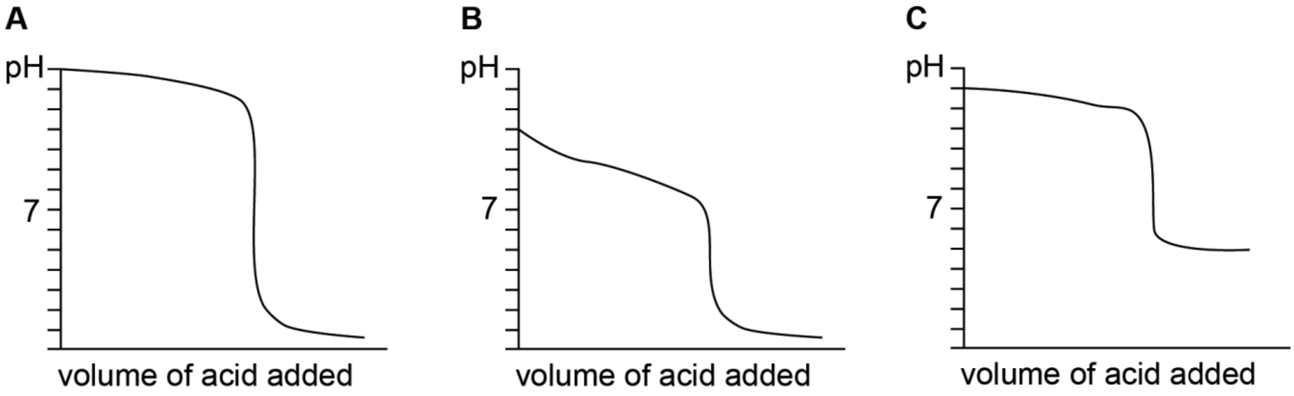
Question 3 (a) (ii)

(ii) Ammonia solution is a weak base and hydrochloric acid is a strong acid.

Three sketches, **A**, **B** and **C** of acid–base titration curves are shown below.

Which curve **A, B** or **C** applies to the titration of ammonia with hydrochloric acid?

Circle the correct letter.



[1]

B was the only correct answer but was not given by many candidates. There was no pattern to the incorrect responses.

Question 3 (a) (iii)

(iii) Sara must choose the correct indicator for the titration between ammonia and hydrochloric acid.

The pH range of some common indicators are shown in the table.

Indicator	pH range
Methyl Orange	3.2 - 4.4
Litmus	5.0 - 8.0
Bromothymol Blue	6.0 - 7.6
Phenolphthalein	8.2 - 10.0

Use your answer to **(a)(ii)** and the table to determine which indicator Sara should use.

Explain your answer.

- Choice of indicator ....
- Explanation ....

....

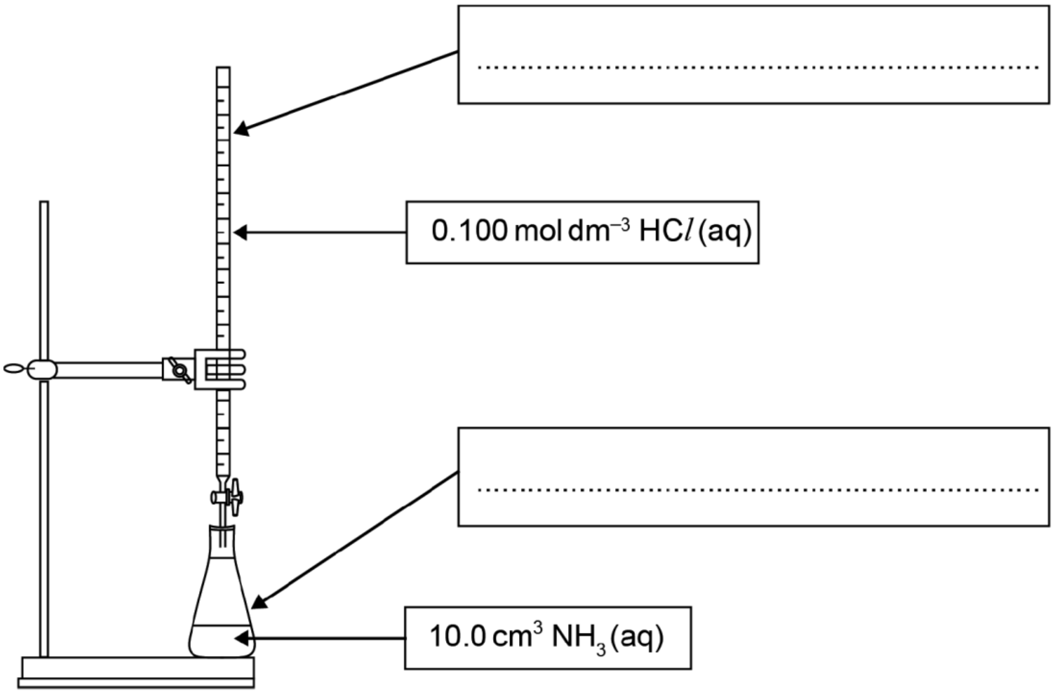
[2]

Many candidates were able to select the correct indicator for the graph they chose in Question 3(a)(ii). There were a surprising number of candidates that suggest litmus even though that was not an option and would not work. Again this shows the importance of good exam technique as the first mark was a multiple choice style question. Few candidates gained the second marking point. Many described the endpoint of the reaction but did not link it to the rapid pH change on the graph.

Question 3 (a) (iv)

(iv) Sara sets up the apparatus to carry out a titration, as shown in **Fig. 3.2**.

Fig. 3.2



Use **Fig. 3.1** to select the two pieces of glassware shown in **Fig. 3.2**.

Write the name of each piece of glassware in the two boxes in **Fig. 3.2**.

[1]

This was well answered. Common errors were pipette or measuring cylinder instead of burette, and volumetric flask instead of conical flask. Many candidates did not spell **conical** correctly but this did not prevent them gaining the mark.

Assessment for learning

Again, the more opportunity candidates have to carry out practical work and discuss the apparatus and techniques used the better they will be at this type of question.

Question 3 (a) (v)

(v) Use the data below to calculate the concentration, in mol dm^{-3}, of the ammonia solution.

- Volume of ammonia solution = 10.0 cm^3
- Volume of 0.100 mol dm^{-3} HCl used in the titration = 16.1 cm^3
- 1 mole of ammonia reacts with one mole HCl

Concentration of ammonia solution = ... mol dm^{-3} **[3]**

It was good to see most candidates attempt this question. Most gained at least 1 mark for a correct step. A common 1 mark answer was 1.61 for 16.1 x 0.1 and forgetting to divide by 1000.

Assessment for learning

The more practice candidates get at this type of calculation the easier they will find them. The context in this type of question will always be different but the general calculation skill will often be similar if not the same.

Question 3 (b) (i)

(b) Zac is a technician working in a pharmacology laboratory.

- A common drug for the treatment of malaria is *mefloquine*. *Mefloquine* is a weak base and is given to the patient as a tablet.
- One of Zac's tasks is to determine the mass of *mefloquine* in one tablet.
- Zac dissolves one tablet of *mefloquine* in water and makes up the solution to 100.0 cm^3.
- He uses an autotitrator to determine the concentration of *mefloquine* in the solution by titrating 5.0 cm^3 portions of the solution against 0.01 mol dm^{-3} $HCl(aq)$.

(i) State why it is not necessary to use an indicator when using an autotitrator.

.... **[1]**

Many candidates did not gain this mark because they stated that the autotitrator 'did it for you'. They did not state how the autotitrator determined the endpoint without using an indicator.

Question 3 (b) (ii)

(ii) Autotitrators have advantages and disadvantages in comparison to manual titrations.

Put a tick (✓) in the box(es) next to **all** the advantages of using an autotitrator.

It is not necessary to make up accurate standard solutions	☐
Less titrant is used	☐
Results can be exported electronically to another device	☐
Smaller sample is required	☐
The equipment is cheaper	☐
The results are more accurate	☐

[3]

Candidates did well on this question. A common incorrect response was the first box 'it is not necessary to make up accurate standard solutions'. As with (b)(i), candidates seem to think autotitrators do everything for you and do not need setting up correctly. It would be useful if they got the opportunity to use an autotitrator, or see a video demonstration of one being used so they understood the procedure needed.

Question 3 (b) (iii)

(iii) Zac uses his titration results to calculate that the concentration of the *mefloquine* solution was 0.0066 mol dm^{-3}. The molar mass of *mefloquine* is 378 g mol^{-1}.

Calculate the mass in mg, of *mefloquine* in one tablet.

Give your answer to **3** significant figures.

Mass of *mefloquine* in one tablet .... mg **[3]**

This question involved candidates carrying out a conversion and giving the answer to 3 significant figures. Most candidates were able to do the calculation correctly but many did not do the conversion to mg and most forgot to write their answer to 3 significant figures.

Assessment for learning

Good exam technique would be to tick off each instruction in a question so that they knew they had done everything asked.

Question 4 (a)

4 **(a)** AIDS is caused by the Human Immunodeficiency Virus (HIV).

Layla is a researcher investigating HIV.

She is using microscopy to identify the features of HIV particles and cells infected with HIV.

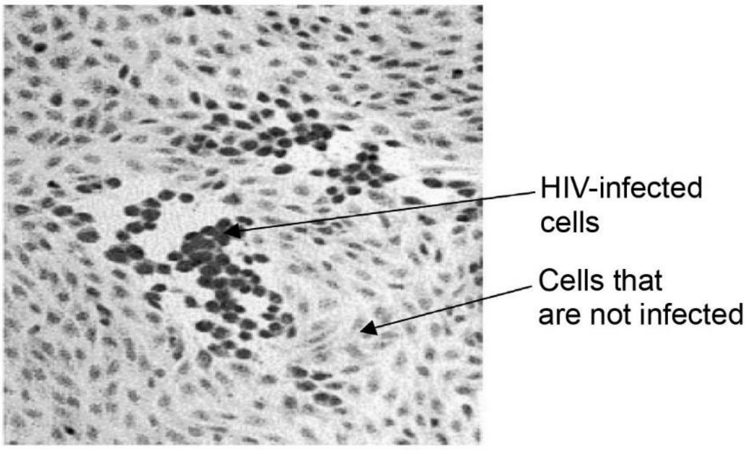
Fig. 4.1 shows an electron micrograph of an HIV particle.

Fig. 4.2 is a light micrograph of cells, some of which are infected with HIV.

Fig. 4.1

Item removed due to third party copyright restrictions

Fig. 4.2



(i) Measure the diameter of the HIV particle shown in **Fig. 4.1**.

Measurement = ... units .... **[2]**

This was a well answered question. Many candidates gave their answer in centimetres which was acceptable.

Question 4 (a) (ii)

(ii) The magnification of the electron microscope used to obtain the image in **Fig. 4.1** is ×300,000.

Use your answer to **(a)(i)**, to calculate the actual diameter of the HIV particle in mm.

Actual diameter of HIV particle = ... mm **[1]**

Error carried forward was given on this question. However, if candidates answered 4(a)(i) in cm they needed to make sure they converted their answer to mm.

Assessment for learning

It is good exam practice to circle the units on the answer line so the candidate knows if a conversion is needed.

Question 4 (a) (iii)

(iii) Draw a scale bar on **Fig. 4.1** that represents 100 nm.

[1]

Very few candidates gained a mark here. Many drew a 1 cm scale. Very few showed how they did their working. Working was not necessary but may have helped them get the right answer. Again circling the units may also have helped as it would have prompted them to do a correct conversion.

Question 4 (a) (iv)

(iv) Describe **one** feature of an HIV particle that can be seen in **Fig. 4.1**.

.... **[1]**

Candidates seemed to recognise that it was the 'spikes' that was being asked for. However, most used incorrect terminology and so did not gain the mark. Cilia and flagellum were common incorrect responses.

Question 4 (v)

(v) Which organelle appears to be more dense in the HIV-infected cells in **Fig. 4.2**?

.... **[1]**

Nucleus was a common (correct) response. However, many candidates repeated the question and said they infected cells and so did not gain a mark. Another common incorrect response was ribosome.

Question 4 (a) (vi)

(vi) Describe **and** explain **one** advantage of light microscopy in comparison to electron microscopy.

....

....

.... **[2]**

This was a 'describe AND explain' question. Most candidates suggested one or two advantages but did not explain the advantage, and so only gained 1 mark. Some candidates misread the question and gave an advantage and a disadvantage and so also only gained 1 mark. Very few gave the answer on the left-hand side of the mark scheme. Most gained marks for the allowable responses of cheap or portable.

Question 4 (a) (vii)

(vii) Explain why individual HIV particles cannot be seen using a light microscope.

....

....

.... **[2]**

Most candidates gained 1 mark for the idea that the magnification or resolution of a light microscope was not high enough. A few also stated the particles were too small to be seen for a second mark. Almost no candidate gave the other response that particles are less than half the wavelength of visible light.

Question 4 (b) (i) and (ii)

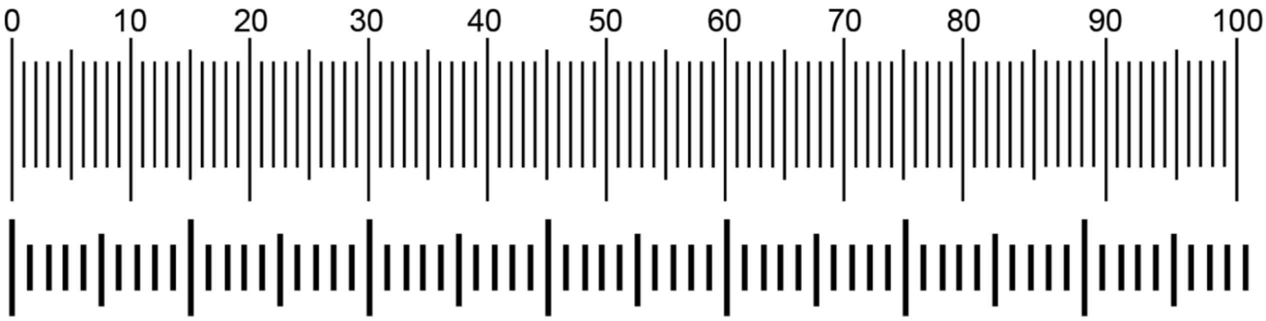
(b) Tom is also a researcher using microscopes.

He is measuring the size of animal cells using a light microscope fitted with an eyepiece graticule.

The figure below shows an eyepiece graticule alongside a stage micrometer. They are seen when using a light microscope.

The smallest graduations on the stage micrometer are 10 µm.

Eyepiece graticule



Stage micrometer

(i) Draw a double-headed arrow on the stage micrometer scale to represent 0.5 mm.

[1]

(ii) Select **two** suitable lines on the stage micrometer scale that would be useful for calibrating the eyepiece graticule.

Label the lines as **X1** and **X2**.

[1]

Candidates struggled with both these questions. They could not convert between micrometres and millimetres.

Assessment for learning

Giving students opportunities to practice unit conversions will help them use equipment correctly as well as answer exam questions. They could have more practice using stage micrometers and eyepiece graticules during microscope work which would help them with their unit conversions.

Question 4 (b) (iii)

(iii) Calculate the actual length, in μm, that **one** graduation on the eyepiece graticule represents.

Actual length = ... μm **[2]**

Most candidates did not show their working here. Most did not give the correct answer but some of those that showed their working gained a calculation mark. Again, this question relied on conversion skills.

Question 4 (b) (iv)

(iv) Tom then measures the cells using the light microscope set at a different magnification.

State what Tom should do before he takes his measurements.

.... **[1]**

Several candidates discussed refocusing rather than recalibrating. Others suggested starting with the lowest magnification. This shows they did not read the question carefully. Some candidates did understand they had to recalibrate although they did not always use that term.

Question 4 (b) (v)

(v) To set the light microscope at a different magnification, Tom changes the objective lens from 40× to 100× but keeps the eyepiece lens and graticule the same.

Circle the correct word(s) to complete the sentences.

- The size of the scale on the eyepiece graticule appears:

  smaller **the same** **bigger**

- The size of the cells appears:

  smaller **the same** **bigger**

- Each graduation on the eyepiece graticule now represents:

  a shorter length **the same length** **a greater length**

[3]

Most candidates gained at least 1 mark here. 'The same' in the first set was the most common correct response. The most common incorrect answer was circling 'the same length' in the final set.

Question 5 (a)

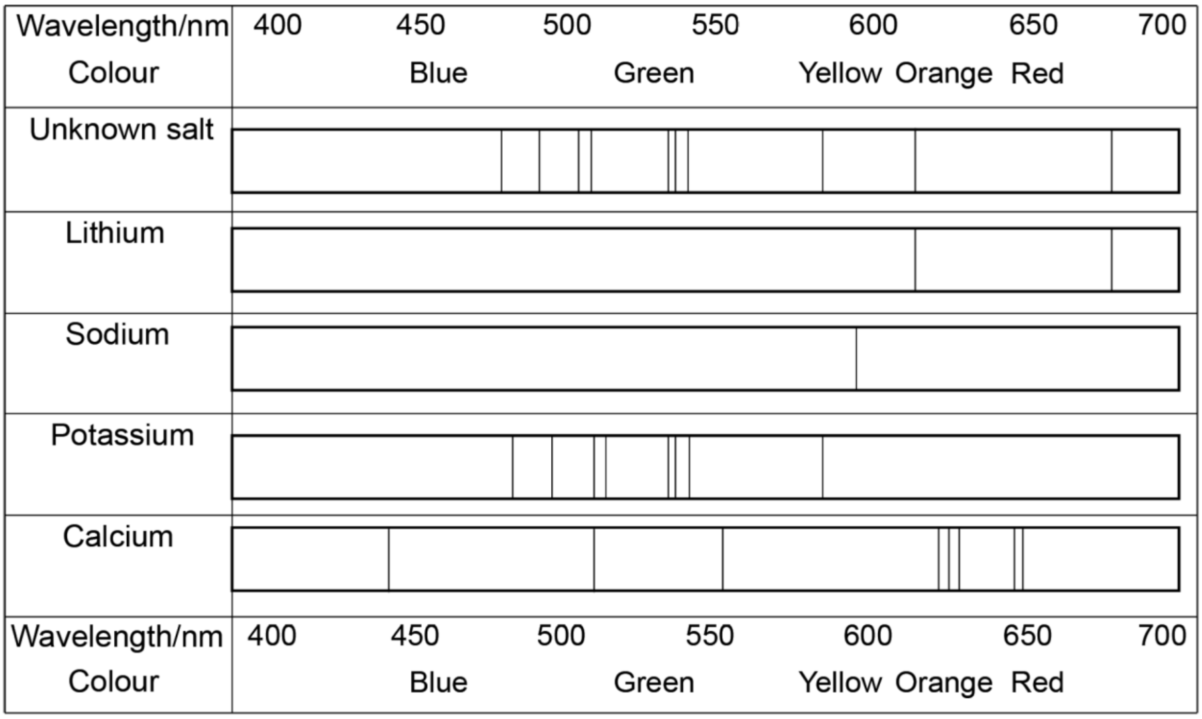
5 Ali is learning about Atomic Emission Spectroscopy (AES) and ion chromatography.

(a) Ali uses Atomic Emission Spectroscopy (AES) to identify the cations present in a sample of an unknown salt.

He compares the spectrum of the unknown salt with spectra of known cations.

His results are shown in **Fig. 5.1**. The position of each line indicates the observed colour.

Fig. 5.1



Describe the key principles of AES and use the information in **Fig. 5.1** to identify the cations in the unknown salt.

Explain with reference to the spectra how you reached your conclusion.

....

....

....

....

....

.... **[6]**

It was clear that not all candidates knew what AES was. Many discussed flame tests in relation to the colours on the spectrum. It is important that students have opportunities to see and/or use all the procedures and techniques in the specification. Few correctly described the principles of AES.

However, despite this, it was good to see most candidates were able to gain credit for interpreting the spectrum. Most were able to identify lithium and sodium as the ions present. A few thought calcium was also present but the better responses also recognised there were no lines corresponding to sodium or calcium. The best responses also discussed the lines in terms of wavelength and some gave examples of matching wavelengths.

Question 5 (b) (i)

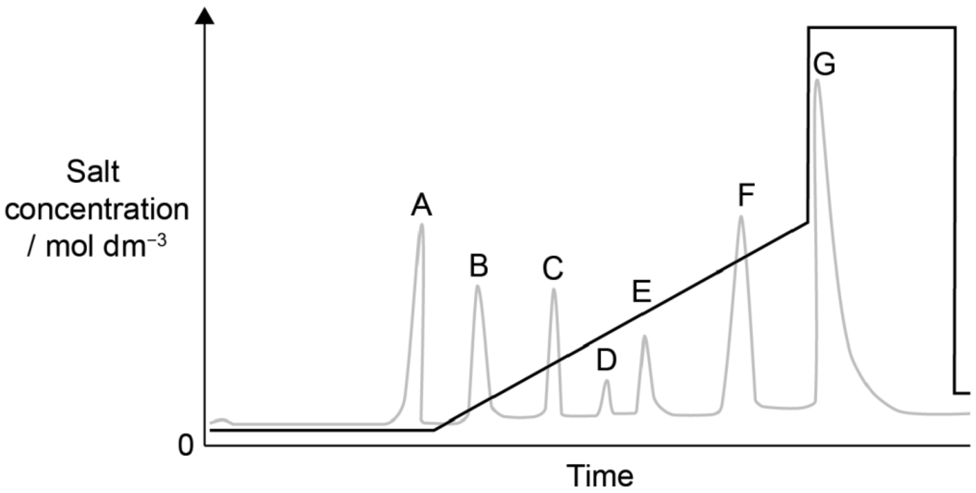
(b) Ali uses ion chromatography to separate proteins in a sample of brain tissue.

He follows the steps listed below:

- The sample is loaded onto an ion exchange column at a particular pH.
- The different proteins in the sample bind to the ion exchange resin, some binding more easily than others.
- Impurities are removed by washing the column with a very low concentration of salt solution before the salt gradient is applied.
- By gradually increasing the salt solution concentration, the different proteins are eluted (washed out) from the column at different times.
- A UV detector is used to detect each protein as it leaves the column.

Having completed the steps, Ali obtains the chromatogram shown below.

The grey line indicates the substances (**A** to **G**) eluted from the column, and the black line indicates the salt concentration.



(i) Complete the following sentences using words from the list to explain how this type of ion chromatography separates proteins.

charged	**high**	**impurities**	**low**
neutral	**salts**	**strongest**	**weakest**

- .... proteins will bind to the oppositely charged groups in the resin.
- A salt gradient is used to elute the different proteins. At .... salt concentrations, proteins having few charged groups are eluted and at .... salt concentrations, proteins with several charged groups are eluted.

[3]

This question was well answered and there was no pattern to incorrect answers.

Question 5 (b) (ii)

(ii) State the letter of the protein that binds to the column the strongest.

.... **[1]**

This question was well answered and there was no pattern to incorrect answers.

Question 5 (b) (iii)

(iii) State the letter of the protein which is the least abundant in the sample.

.... **[1]**

This question was well answered and there was no pattern to incorrect answers.

Question 5 (b) (iv)

(iv) State the letter which indicates the impurities present in the sample.

.... **[1]**

This question was less well answered than (b)(ii) and (b)(iii). F was a common incorrect response.

Question 5 (b) (v)

(v) Explain why a UV detector can be used to detect the proteins as they emerge from the column.

.... **[1]**

Very few candidates answered this correctly. Common incorrect responses were the ideas that ultraviolet (UV) light detects or reflects proteins, or that proteins are easier to see in UV light.

Question 5 (b) (vi)

(vi) Give **two** uses of ion exchange chromatography other than separating and purifying proteins.

....

....

.... **[2]**

Very few candidates gained both marks here. The most common correct response was water purification. The other correct responses were rarely seen, with most candidates suggesting it is used to identify proteins.

Question 6 (a) (i)

6 (a) Kareem is a student learning how to culture bacteria in a laboratory.

He finds out that some bacteria are parasitic and must be cultured in a medium containing living animal cells.

It is important that Kareem uses aseptic technique to establish and maintain his cultures. To do this he learns how to sterilise equipment and materials correctly.

(i) Draw lines to link each equipment or material to be sterilised to the correct method of sterilisation.

Equipment or material to be sterilised	Method of sterilisation
Hard surfaces inside the work area	Filtering through a sterile membrane filter
Glassware	Autoclaving
Protein growth factors to add to the animal cell culture medium	Refrigeration
	Wiping with bactericidal solution

[3]

Many candidates gained all 3 marks here. A common incorrect response was linking 'protein growth factors' to refrigeration.

Question 6 (a) (ii)

(ii) Kareem works at a controlled air flow cabinet.

Suggest **two** reasons for doing this.

1 ....

2 ....
[2]

It is important that candidates answered this question in terms of airborne contamination. Many just stated 'to prevent contamination' but did not say of what or by what. Many also thought air flow cabinets were used to keep the temperature constant. It is important that students are taught the reason for using specific equipment.

Question 6 (a) (iii)

(iii) Kareem wears disposable gloves when working at the controlled air flow cabinet.

Suggest the likely impact of this on his bacterial cultures.

....

.... **[1]**

Although most candidates realised this was to prevent contamination of the cultures, few recognised that it was to prevent contamination from Kareem's hands. It was not enough to say prevent contamination by Kareem as gloves would not prevent contamination from other parts of Kareem. Others assumed the gloves would cause contamination either on the cultures or in the lab. Some candidates did not read the question carefully and did not answer in relation to the cultures but discussed vague contamination of lab or people.

Question 6 (a) (iv)

(iv) Give **two** other examples of laboratory work, not including the culture of microorganisms, that require aseptic technique.

1 ....

2 ....
[2]

Most candidates gained both marks here. Tissue cultures and surgery were the most common correct responses.

Question 6 (b) (i)

(b) Alex is also learning about aseptic technique in microbiology at college.

She is streaking bacteria onto an agar plate from a stock culture grown on an agar slope.

(i) Tick (✓) **one** box that shows why Alex first heats an inoculating loop in a flame until it glows red.

To avoid killing the inoculum ☐

To check for contamination ☐

To obtain clones of bacteria ☐

To prevent aerosols containing bacteria ☐

To sterilise the inoculating loop ☐

To test for lithium ions ☐

[1]

All candidates gained this mark.

Question 6 (b) (ii)

(ii) Tick (✓) **two** boxes that show why Alex allows the inoculating loop to cool down before dipping it into the stock culture of bacteria on an agar slope.

To avoid killing the inoculum	☐
To check for contamination	☐
To obtain clones of bacteria	☐
To prevent aerosols containing bacteria	☐
To sterilise the inoculating loop	☐
To test for lithium ions	☐

[2]

Most candidates gained 1 mark for the top box. Quite a few did not read the question correctly and so only gave one tick. The second and third boxes were the most common incorrect responses.

Question 6 (c)

(c) The streaked plate is cultured in an incubator at 30 °C for 24 hours.

The plate is shown below.

A cluster of individual colonies have grown on the streaked plate.

Suggest **two** ways in which the individual colonies have grown on the plate.

1 ....

....

2 ....

....

[2]

This was not well answered. Many candidates thought they had to describe streaking technique as they had not read or understood the question properly. The most common correct response was 'the inoculating loop has lost most of the bacteria towards the end of the streak'.

Copyright information

Supporting you

Reviews of marking

If any of your students' results are not as expected, you may wish to consider one of our post-results services. For full information about the options available visit the OCR website.

Keep up-to-date

We send a monthly bulletin to tell you about important updates. You can also sign up for your subject specific updates. If you haven't already, sign up here.

OCR Professional Development

Attend one of our popular CPD courses to hear directly from a senior assessor or drop in to a Q&A session. Most of our courses are delivered live via an online platform, so you can attend from any location.

Please find details for all our courses on the relevant subject page on our website or visit OCR professional development.

Signed up for ExamBuilder?

ExamBuilder is the question builder platform for a range of our GCSE, A Level, Cambridge Nationals and Cambridge Technicals qualifications. Find out more.

ExamBuilder is **free for all OCR centres** with an Interchange account and gives you unlimited users per centre. We need an Interchange username to validate the identity of your centre's first user account for ExamBuilder.

If you do not have an Interchange account please contact your centre administrator (usually the Exams Officer) to request a username, or nominate an existing Interchange user in your department.

Need to get in touch?

If you ever have any questions about OCR qualifications or services (including administration, logistics and teaching) please feel free to get in touch with our customer support centre.

Call us on
01223 553998

Alternatively, you can email us on
support@ocr.org.uk

For more information visit
- **ocr.org.uk/qualifications/resource-finder**
- **ocr.org.uk**
- **facebook.com/ocrexams**
- **twitter.com/ocrexams**
- **instagram.com/ocrexaminations**
- **linkedin.com/company/ocr**
- **youtube.com/ocrexams**

We really value your feedback

Click to send us an autogenerated email about this resource. Add comments if you want to.
Let us know how we can improve this resource or what else you need. Your email address will not be used or shared for any marketing purposes.

I like this **I dislike this**

Please note – web links are correct at date of publication but other websites may change over time. If you have any problems with a link you may want to navigate to that organisation's website for a direct search.

CAMBRIDGE
UNIVERSITY PRESS & ASSESSMENT