OCR
Oxford Cambridge and RSA

Cambridge **TECHNICALS LEVEL 3**

Cambridge TECHNICALS 2016

LABORATORY SKILLS

Combined feedback on the June 2017 exam paper (including selected exemplar candidate answers and commentary)

Unit 2 – Laboratory techniques

Version 1

CONTENTS

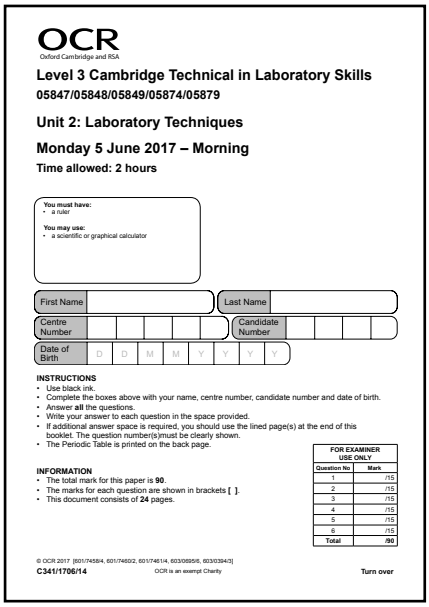
INTRODUCTION

This resource brings together the questions from the June 2017 examined unit (Unit 1), the marking guidance, the examiners comments and the exemplar answers into one place for easy reference.

We have also included exemplar candidate answers with commentary for Questions 3b, 4a (ii) and 5b (iii).

The marking guidance and the examiner's comments are taken from the Report to Centre for this question paper.

The Question Paper, Mark Scheme and the Report to Centre are available from:
https://interchange.ocr.org.uk/Modules/PastPapers/Pages/PastPapers.aspx?menuindex=97&menuid=250



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Level 3 Cambridge Technical in Laboratory Skills
05847/05848/05849/05874/05879

Unit 2: Laboratory Techniques

Monday 5 June 2017 – Morning
Time allowed: 2 hours

You must have:
- a ruler

You may use:
- a scientific or graphical calculator

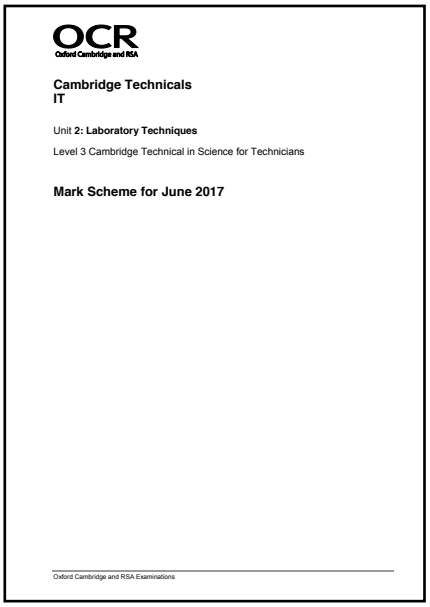
First Name | Last Name
Centre Number | Candidate Number
Date of Birth (D D M M Y Y Y Y)

INSTRUCTIONS
- Use black ink.
- Complete the boxes above with your name, centre number, candidate number and date of birth.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- If additional answer space is required, you should use the lined page(s) at the end of this booklet. The question number(s)must be clearly shown.
- The Periodic Table is printed on the back page.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- This document consists of **24** pages.

FOR EXAMINER USE ONLY	
Question No	Mark
1	/15
2	/15
3	/15
4	/15
5	/15
6	/15
Total	/90

C341/1706/14 OCR is an exempt Charity **Turn over**



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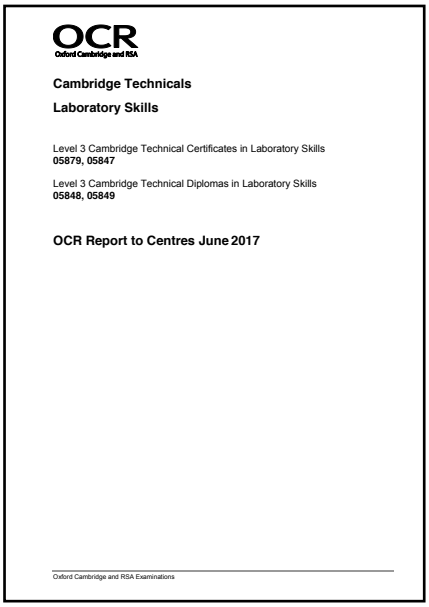
IT

Unit **2: Laboratory Techniques**

Level 3 Cambridge Technical in Science for Technicians

Mark Scheme for June 2017

Oxford Cambridge and RSA Examinations



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Cambridge Technicals
Laboratory Skills

Level 3 Cambridge Technical Certificates in Laboratory Skills
05879, 05847

Level 3 Cambridge Technical Diplomas in Laboratory Skills
05848, 05849

OCR Report to Centres June 2017

Oxford Cambridge and RSA Examinations

GENERAL EXAMINER COMMENTS ON THE PAPER

This paper was very different than has probably been seen before by candidates or Centres. Historically candidates do not sit a paper that contains more than one science discipline in a level 3 paper. There is also a lot of application and understanding of contexts that candidates may have struggled with. Centres are encouraged to use sample papers and in future this paper 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 microscopy and chromatography. Candidates showed good skills when drawing the graph.

Other areas were weaker. The chemistry based questions were generally poorly answered and showed a lack of basic knowledge.

Candidates also found it difficult to explain why certain laboratory procedures are carried out.

Resources which might help address the examiner comments:

From the link below, you'll find 'The OCR guide to examinations' (along with many other skills guides)
http://www.ocr.org.uk/i-want-to/skills-guides/

Command verbs definitions
http://www.ocr.org.uk/Images/273311-command-verbs-definitions.pdf

Questions 1(a)(i) and (ii)

Answer **all** the questions.

1 Appropriate laboratory procedures are essential at all times.

(a) For each of the following laboratory situations, state:

- a potential hazard
- a risk linked to the hazard
- one control measure to minimise the risk.

(i) Working with swabs from a suspected case of food poisoning.

Hazard .. Pathogenic/disease causing/microorganisms/bacteria .....

Risk ..... Infection (of laboratory worker) .....

.....

Control measure.... Aseptic technique/swabbing bench/good hygiene/ washing hands after work .....

.....

[3]

(ii) Investigating the cleaning activity of a biological washing powder.

Hazard .. Enzymes .....

Risk ..... Allergic reaction/sensitising/irritation/dermatitis .....

.....

Control measure.... Avoid contact with skin/exposure to washing powder/ avoid breathing dust .....

.....

[3]

Questions 1(a)(iii), (b) and (c)

(iii) A radiographer looking for a possible fracture by producing an image of a patient's skeleton.

Hazard ..... X-rays/**ionizing** radiation/irradiation .....

Risk ..... Damage to DNA/ carcinogenic/ teratogenic/cell death/mutation .....

.....

Control measure.... Follow radiological guidelines/training/reduce (time/ frequency/dose of) exposure/do not receive primary exposure/limit distance/monitor use from another room/ use/shielding/wear lead apron/check integrity of PPE .....

....

[3]

(b) A forensic scientist is calibrating a pH meter for use in her analyses.

It is essential that the readings taken from the pH meter are accurate.

State **three** procedures she must follow to achieve this accuracy.

1 .....

Any three from:
Accepted measurement system in place;
Evaluation of measurement system/assessment of uncertainty/comparison with standard measurement system;
Use of accepted equipment;
Traceability of reference solutions/buffer solutions (for calibration);
Internal laboratory monitoring programme of measurement system/reference materials;
Lab establishes unbroken chain of comparison with standards.

2 .....

3 .....

.....

[3]

(c) Describe how incubated agar plates are disposed of after use.

... Enclose in biohazard/autoclaving bag/container; .....
Sterilise/autoclave (at 121°C for 15 minutes);
... Dispose of according to laboratory guidelines/ingeneral waste. .....

.....

.....

[3]

Mark scheme guidance

Question 1(a)(i):

Ignore food poisoning for risk.

Allow disinfectant/disinfecting.

Ignore gloves.

Ignore dispose of carefully.

Mark independently.

Question 1(a)(ii):

Do not allow answers related to bacteria.

Allow degradation of body tissue = risk.

Allow wear gloves = control.

Ignore dispose of carefully.

Question 1(a)(iii):

Allow cells killed/cells become cancerous/cancer/radiation poisoning.

Allow wear protective clothing.

Allow radiographer stands outside room/behind screen.

Ignore dispose of carefully.

Question 1(b):

Allow calibrate with known pH solutions.

Question 1(c):

Only allow MP3 for in general waste if either MP1 or 2 already awarded.

Examiner comments

Question 1(a)(i) to (iii) – This group of question is looking at basic laboratory health and safety. It is important that candidates do not confuse hazards and risks. The hazard is the substance/object that might cause an injury and the risk is the type of injury. Candidates did get these confused for example staing bacteria was a risk for ai. It is important that candidates did not just repeat the stem especially in ai. Many wrote food poisoning as the risk but as this is in the question they needed to show an understanding of what this is.

It is important that candidates learn hazards and risks that are in the specification. Many did not know enzymes were the risk in a biological washing powder. Many were able to score a mark of X-rays for aiii but those who just wrote radiation did not get the hazard mark. This was too generic and ionizing radiation or irradiation was necessary.

It is important that candidates give control measures specific to the hazard. General use of PPE would not score. Aiii was the best answered of these questions.

Question 1(b) – This question was about the importance of laboratory procedures and was not asking for a description of the procedure itself. Many candidates misunderstood this question and answered in terms of how a pH meter is calibrated.

Question 1(c) – Candidates lost marks here because their answers were too vague. For example they wrote "heat and put in bin" rather than "sterilise and dispose of according to laboratory guidelines". Heat was insufficient unless they stated 121oC for 15 minutes. Almost no candidate stated to enclose it in a biohazard bag. many just stated "seal and throw away" and this did not gain marks.

Question 2(a)

2 Olivia is analysing the lipids found in samples of a cosmetic.

(a) She carries out a preliminary analysis of the samples using chromatography.
She can choose to use either paper chromatography or thin-layer chromatography (TLC).

(i) What is the stationary phase in paper chromatography?

The paper

[1]

(ii) State **two** stationary phases used in TLC.

1 ..
2 ..

Any two from:
Silica gel;
Alumina/aluminium oxide;
Cellulose

[2]

(iii) Discuss the **advantages** and **disadvantages** of both paper chromatography and TLC.

Answers related to advantages of TLC/advantages of paper chromatography.
Any three from:
TLC has a faster run;
TLC gives better separation/greater resolution of spots;
TLC plate easier to manipulate;
TLC plate more durable than paper/TLC on glass or plastic plate;
Paper chromatography is cheaper

Disadvantages of both techniques.
Any one from:
(Neither) give positive identification;
(Usually used as) qualitative technique/(usually) not quantitative

[4]

Questions 2(b) and (c)

(b) Olivia uses a solvent system for TLC chromatography.
The solvent system contains the following solvents:

Hexane	60 parts
Diethyl ether	39 parts
Ethanoic acid	1 part

The chromatography tank requires approximately 150 cm^3 of the solvent system.

Calculate the required volume of hexane.

Hexane = 90 (cm^3)

volume of hexane = ... cm^3

[1]

(c) Olivia locates the spots on the TLC plate using iodine vapour.
Suggest a **non-destructive** method of visualising the spots.

.....
Fluorescence;
(Under) ultraviolet light.
.....

[2]

Question 2(d)

(d) Olivia runs her chromatogram in the solvent.

The completed chromatogram is shown in **Fig. 2.1**.

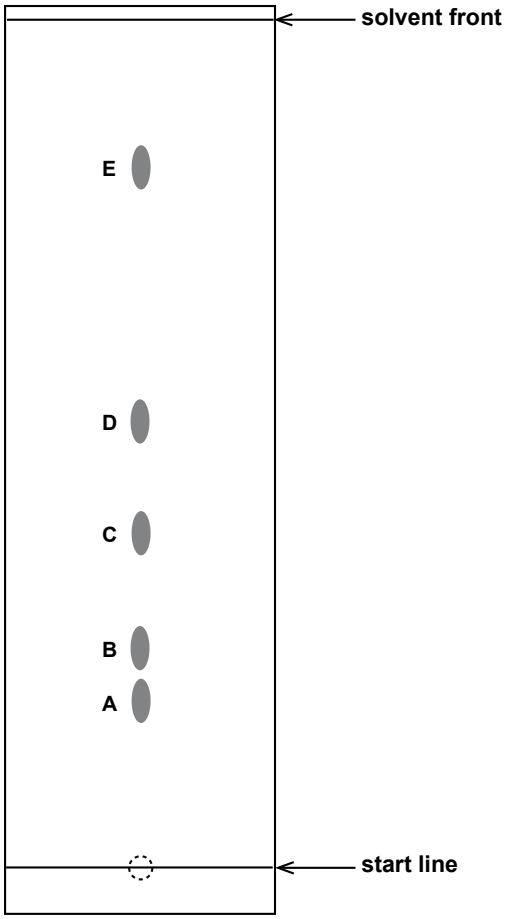


Fig. 2.1

To identify the spots, Olivia consults R_f values from a published scientific paper.

The published R_f values are shown in the table below (**Table 2.1**):

Class of lipid	R_f value
Free fatty acids	0.54
Diglycerides (diacylglycerols)	0.42
Monoglycerides (monoacylglycerols)	0.20
Triglycerides (Triacylglycerols)	0.85

Table 2.1

Questions 2(d)

(i) Use **Fig. 2.1** to complete the table below (**Table 2.2**).

	Distance moved (mm)
Spot A	30
Spot B	39
Spot C	57
Spot D	76
Spot E	118
Solvent front	134

Table 2.2

[1]

(ii) Use the values in **Table 2.1** and **Table 2.2** to complete the table below.

The identification of one of the spots is unknown.

Spot	R_f value	Suggested identification of class of lipid
A	0.22	monoglycerides
B	0.29	unknown
C	0.42	diglycerides
D	0.57	free fatty acids
E	0.88	triglycerides

[2]

(iii) Suggest and describe an alternative method for identifying the spots.

Any two from:
Use a series of standards (A-F);
Individual lipids;
Compare distance travelled by spots

[2]

Mark scheme guidance

Question 2(a)(i):

A solid or liquid supported on a solid.

Reject plate.

Question 2(a)(iii):

Allow reverse arguments for either.

Must be a comparison.

Question 2(b):

All correct = 1 mark.

Question 2(d)(i):

All correct = 1 mark.

Allow measurements up to – **7mm** of value given in answer table (due to the shape of the trace).

Question 2(d)(ii):

All R_f values correct (+/- 0.01) = 1 mark.

Allow ecf.

All identifications correct = 1 mark.

Question 2(d)(iii):

Reject answers related to gas chromatography.

Ignore published R_f values.

Examiner comments

Question 2(a)(i) – It was nice to see that most candidates gained this mark.

Question 2(a)(ii) – Many candidates just gave TLC plate as an answer and this was insufficient to gain a mark.

Question 2(a)(iii) – To gain full marks candidates must give advantages and a disadvantage. Many did not give both. Many were awarded a mark for paper chromatography being cheaper but few were able to give advantages of TLC.

Question 2(b) – It was nice to see that most candidates gained this mark. Those who did not get the mark had usually left the answer blank.

Question 2(c) – Many candidates did not read the question or did not understand the question and so suggested dyes, specifically ninhydrin. Those who gained a mark did so for ultraviolet light but did not go on to say that you would see fluorescence.

Question 2(d)(i) – Many got this mark. Those who did not, had misunderstood the terminology and had done things such as add up all the distances to get the solvent front.

Question 2(d)(ii) – There was an error carried forward for this question from question 2di so if candidates had filled in the table they could still get the first mark here even if their numbers for 2di were wrong. Those who did not get the second mark did not understand that it was not possible to state what B was and usually wrote monoglyceride again. Candidates need to understand that no result or being unable to interpret a result is part of the process of working in a laboratory.

Question 2(d)(iii) – This was not well answered because candidates suggested using published values which is in the question, or found it difficult to explain. Answers such as "identify the colour and distance" were common but not creditworthy as it was not clear what colour or distance was being identified.

Question 3(a) and (b)

3 Matt is analysing a number of malt vinegar samples for their ethanoic acid concentration.

He titrates the samples against sodium hydroxide solution.

(a) Ethanoic acid is a weak acid. Matt decides to use an acid-base titration for his analyses.

Name the indicator to be used when titrating ethanoic acid.

Explain why.

Phenolphthalein;
Reaction is weak acid-strong base;
Phenolphthalein changes colour at equivalence point.

.....

.....

.....

.....

[3]

(b) Matt monitors a titration using a pH meter.

He takes a series of readings while adding standardised 0.2 mol dm^{-3} sodium hydroxide solution to 50 cm^3 of a 10% solution of the vinegar.

His titration curve is shown in **Fig. 3.1**.

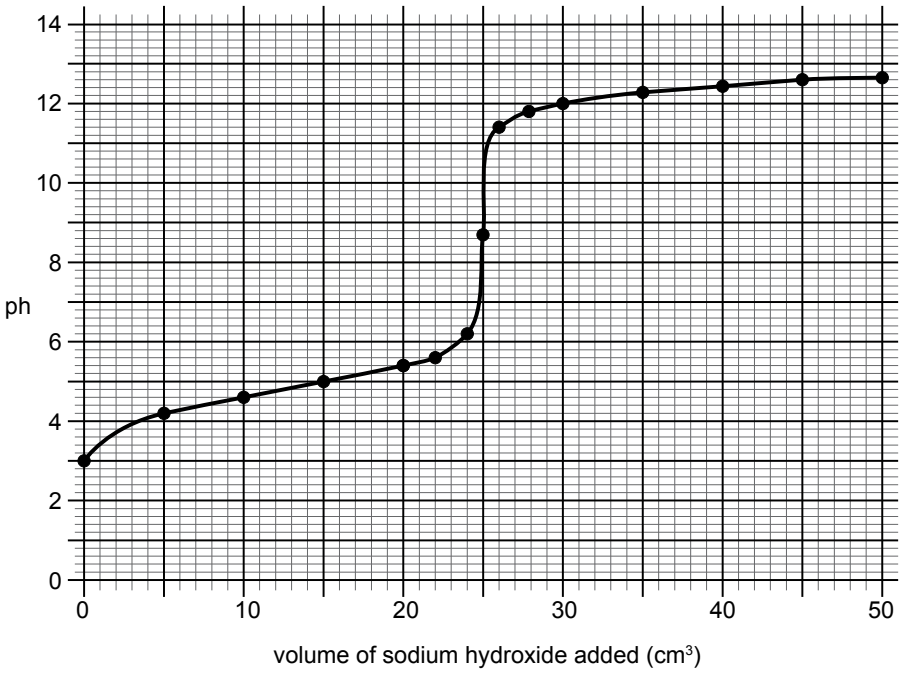


Fig. 3.1

Question 3(b)

Use **Fig.3.1** to complete the sentences.

Before any sodium hydroxide solution is added, the solution in the conical flask is described as a . weak acid ..... .

After the initial increase in pH and some more sodium hydroxide is added, the curve flattens out.

The solution at this flatter part of the curve is called a . buffer solution ..... .

After a total of 25 cm^3 of sodium hydroxide has been added, the. equivalence point ..... is reached.

The solution is then described as a . weak alkali ..... .

The conical flask now contains a mixture of . sodium ethanoate ..... and . water ..... .

As more sodium hydroxide is added, the solution then becomes a strong alkali ..... .

[6]

Question 3(c)

(c) Matt uses an autotitrator for the analyses.

Explain how an autotitrator works and why this method is preferred rather than using an indicator.

Valid points:
Technique:
- Titrant addition/add reagent
- In specific/small volumes
- Increment size is determined by the nature of the titration
- Reaction monitored using pH electrode/potentiometer/constantly measures pH
- Titration of unknowns will measure volume of the titrant
- At the (predetermined) inflection point of curve/equivalence point/end point
- Defined by pH/concentration-dependent potential
- Concentration of unknown calculated

Why technique is preferred:
- Process is automated
- Faster once calibrated
- Not affected by coloured analytes

.....

.....

.....

.....

[6]

Mark scheme guidance

Question 3(a):

ECF from first mark point.

Question 3(b):

Mark using the **sequence** provided in the answer column.

Question 3(c):

Compensatory mark: award no human error/idea it is not subjective if no other mark awarded.

Level 0 (0 marks)

Candidate includes no valid points.

Level 1 (1 – 2 marks)

Candidate shows a basic understanding of how autotitrators work AND/OR why this method is preferred to using an indicator, with little or no explanation.

Level 2 (3 – 4 marks

Candidate shows an understanding of how autotitrators work AND why this method is preferred to using an indicator.

Level 3 (5 – 6 marks)

Candidate shows a high level of understanding and gives a good description of how autotitrators work AND why this method is preferred to using an indicator.

Examiner comments

Question 3(a) – This was answered badly. Candidates do not seem to have basic chemistry knowledge. Many missed out on the third mark point because they used end point rather than equivalence point. Many did not know the indicator and many stated got the type of reaction wrong. A lot of weak answers such as, "when it reacts you can see a clear colour change" were seen.

Question 3(b) – This was also badly answered with few candidates getting more than 1 mark. Candidates did not specify the strength of the acid and the alkali; they used neutral rather than buffer solution; they used end point rather than equivalence point; many gave vinegar or ethanoic acid rather than sodium ethanoate.

Question 3(c) – This was a levels based question. Candidates could get marks using the indicative content although other creditworthy statements would have been credited. These were not seen. The most common creditworthy statement was that the "autotitrator gave the results automatically". Few candidates were able to give more detail. Many discussed lack of human error which was awarded a compensatory mark but candidates did not know how the autotitrator worked. Many stated it was faster than other methods but this was not credited as they did not show an understanding that it was only faster once it was calibrated.

Exemplar Candidate Work

Question 3(b) – low level answer

3 Matt is analysing a number of malt vinegar samples for their ethanoic acid concentration.
He titrates the samples against sodium hydroxide solution.

(a) Ethanoic acid is a weak acid. Matt decides to use an acid-base titration for his analyses.
Name the indicator to be used when titrating ethanoic acid.
Explain why.

Phenylphthalein as it is used with weak acids, unlike methyl orange which is used for strong acids. Phenylphthalein is used because it will not interfere with the acid-base reaction, and will allow the reaction to complete successfully. Methyl orange may react with ethanoic acid. [3]

(b) Matt monitors a titration using a pH meter.
He takes a series of readings while adding standardised 0.2 mol dm^{-3} sodium hydroxide solution to 50 cm^3 of a 10% solution of the vinegar.
His titration curve is shown in **Fig. 3.1**.

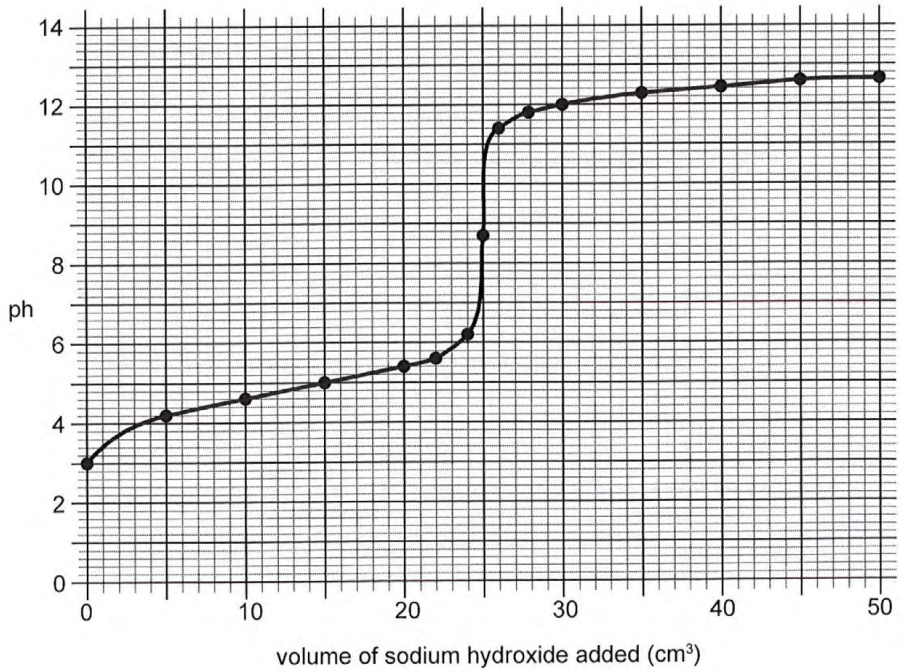


Fig. 3.1

Use **Fig.3.1** to complete the sentences.

Before any sodium hydroxide solution is added, the solution in the conical flask is described as a ....acid.... .

After the initial increase in pH and some more sodium hydroxide is added, the curve flattens out. neutral solution. ~~buffer solution~~.

The solution at this flatter part of the curve is called a ....~~neutral solution~~.... .

After a total of 25 cm^3 of sodium hydroxide has been added,

the....endpoint.... is reached.

The solution is then described as a ....~~neutral solution~~ weak alkali.... .

The conical flask now contains a mixture of ....ethanoic acid....

and ....sodium hydroxide.... .

As more sodium hydroxide is added, the solution then becomes a

....alkali.... .

[6]

Commentary

This answer is low level because the candidate did not give full answers for the missing sections of each sentence as well as being confused over key terms and concepts.

For example the first answer should be 'weak acid'. 'acid' alone is insufficient. 3b is based on the overarching context of Q3. It is important that the candidate reads all the information in the stem carefully and uses that to inform their answer. The candidate also needs to use their knowledge of acid-base titrations and the titration curves produced to answer the questions. Some of this is recall of key chemistry knowledge. There is also an element of interpreting the titration curve.

Candidates need to learn to interpret and correctly label titration curves.

This candidate interpreted the flatter part of the curve as being neutral. This is a common misconception. The correct answer is 'buffer solution' Low level candidates cannot correctly interpret the curve and do not understand what is happening in the solution during the flatter part of the curve.

Another common misconception is the confusion between end point and equivalence point. Many candidates gave the incorrect answer for the third sentence. This is a confusing concept and it is likely that lower level candidates will not get this right.

The candidate has understood that the solution is now a weak alkali however they have misunderstood either the question for the fifth sentence, or misunderstood the science. The candidate knows that sodium hydroxide has been added to ethanoic acid but does not show an understanding that these have reacted to form new products.

A medium level candidate would at least attempt to give the products. It would be expected that a high level candidate would correctly identify the products. Both products must be correct for this mark.

This candidate does not show an understanding of the importance of the strength of the acids and alkalis involved in the titration. Again, they do not give a full answer to the final sentence, missing the word 'strong'.

A high level candidate would give complete answers for each missing section and understand that more than one word may be needed. They would recognise that once the reactants are mixed, new substances are formed and give the correct products, They would also know the difference between end point and equivalence points. They would be able to interpret the graph correctly, stating that the flat part of the curve is a buffer solution.

Question 4(a)(i)

4 Anitka is a forensic palynologist.

She is examining pollen grains collected from the clothes of a suspected drugs dealer.

(a) An image of two of the pollen grains found is shown in **Fig. 4.1**.

[For copyright purposes this image cannot be reproduced here; the image used within the question can be viewed in the original question paper.]

Fig. 4.1

(i) What type of microscope was used to produce this image?

Light (microscope)

[1]

Question 4(a)(ii)

(ii) Anitka is measuring the diameter of one of the pollen grains.

She uses a stage micrometer to complete this task.

[For copyright purposes this image cannot be reproduced here; the image used within the question can be viewed in the original question paper.]

Fig 4.2

Calculate the diameter of the pollen grain shown in **Fig 4.2**.

Show your working.

100 µm on stage micrometer corresponds with 65 divisions on graticule.
Therefore, 1 division
= 100/65 = 1.5 µm;

Width of pollen grain = 28 divisions;

Therefore, width of pollen grain = (28 × 1.5) µm
= 42 µm

diameter of pollen grain = ... µm

[3]

Questions 4(a)(iii) and (iv)

(iii) Describe the stages in the calibration of the eyepiece graticule.

Any three from:
Eyepiece graticule is placed in the eyepiece of microscope;
Stage micrometer placed on stage of microscope;
Appropriate objective selected;
Eyepiece graticule rotated to appropriate orientation;
Graticule and micrometer lined up so that a suitable distance on the micrometer corresponds with divisions, beginning with whole division on the graticule scale;
Reading made from scale on graticule against dimension/100 µm, on micrometer

..... [3]

(iv) Draw a scale bar alongside the pollen grain in **Fig. 4.3**.

Use your calculated measurement for the diameter of the pollen grain in part **(a)(ii)** to complete this task.

[For copyright purposes this image cannot be reproduced here; the image used within the question can be viewed in the original question paper.]

Fig. 4.3

Show your working.

Width of pollen grain (from light micrograph/calculation) is 42 µm and width of pollen grain from light micrograph is 14 mm/42 µm is represented by 14 mm on micrograph;
Choice of suitable length of scale bar, e.g. equivalent to 50 µm/100 µm;
Correct calculation of length of this scale bar

(represented by $\frac{50}{42} \times 14$ mm

Or $\frac{100}{42} \times 14$ mm etc)

Accurately drawn and labelled scale bar

[4]

Question 4(b)

(b) Anitka then uses a different type of microscope to view some of the pollen grains.

One of her images is shown in **Fig. 4.4**.

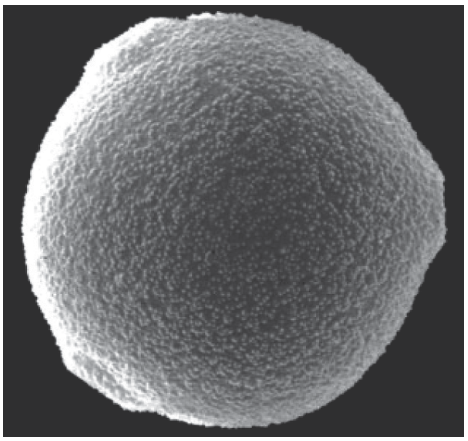


Fig 4.4

(i) What type of microscope did Anitka use to produce this image?

Scanning electron (microscope)/EM **[1]**

(ii) Suggest **three** advantages of using this type of microscope to produce an image of the pollen grain.

1 *Any three from:*
Increased depth of field/3D image;
2 Reveals surface detail;
Reveals (triporate) shape of pollen grain;
3 Improved/increased/greater resolution

[3]

Mark scheme guidance

Question 4(a)(ii):

Allow 43 µm

Make allowances for differences in judgement based on the boundary of pollen grain.

ECF

Question 4(a)(iv):

Accept ecf using answer from (a)(ii).

Question 4(b)(i):

Allow SEM.

Question 4(b)(ii):

Ignore references to higher magnification.

Ignore cleaner image.

Examiner comments

Question 4(a)(i) – Most candidates gained this mark and as "microscope" was in the question just writing "light" was sufficient.

Question 4(a)(ii) – Candidates struggled with this question. This is skill required by the specification and it would be a good idea for Centres to practice this skill with candidates. Many measured the 100, the 65 and the 28 but then did not know what to do with those numbers. Some hedged their bets by taking 28 away from 65 but also dividing 100 by 65. Many candidates did not use the 65 at all and multipled the 28 by 1 over a 100.

Question 4(a)(iii) – This was another example where candidates did not have basic knowledge. Their answers were very vague e.g. "get the microscope set up with a eye piece graticule and compare that to a known measurement e.g. metric using a ruler you can see how many mms it is from their x or / by 1000 for which unit you want it in" Although this candidate knows it is a comparison and remember words such as "graticule" they have a lack of understanding and so gain no marks. When marks were awarded it was mostly for candidates who stated where the eyepeice graticule would be placed; that the eyepiece graticule needs to be rotated and the graticule and micrometer need to be lined up.

Question 4(a)(iv) – Candidates struggled with this question. Most drew a line with no real scale or units. It was unclear why the length of the scale bar had been chosen. They did not use the correct numbers. Candidates could still get full marks here if they had 4aii wrong as long as they used their answer for this question.

Question 4(b)(i) – Most candidates gained this mark. It was important that the word scanning was present but not the word microscope.

Question 4(b)(ii) – This question was answered well with most candidates able to get at least one mark. Many gained the mark for "higher resolution". Misunderstandings and answers that were not in depth enough included "you can see the outside of the grain"; "you get to see great detail"; "more accurate". Good candidates commented on being able to see detail in 3D, or see more surface detail.

Exemplar Candidate Work

Question 4(a)(ii) – low level answer

(ii) Anitka is measuring the diameter of one of the pollen grains.
She uses a stage micrometer to complete this task.

[For copyright purposes this image cannot be reproduced here; the image used within the question can be viewed in the original question paper.]

Fig 4.2

Calculate the diameter of the pollen grain shown in **Fig 4.2**.

Show your working.

100 ÷ 65 = 1·538461

10 - 7.5 = 100 µm

10 - 3.75 = 50 µm

10 - 18.75 = 25

diameter of pollen grain = 40 µm

[3]

65 = 100 µm

15·584615
15·384615
+ 9·230765
39·999999 = 40

1·538461 x 10
1·538461 x 10
1·55846 x 6

Commentary

This candidate has correctly calculated that 100 µm on the stage micrometer corresponds with 65 divisions on graticule. The correct unit is given on the answer line and so they do not have to give it again. They have shown their working which is good practice, as marks can be awarded even if the final answer is incorrect.

In order to improve their answer they should work out the width of the pollen grain measured by the graticule. This is 58 – 30 = 28 divisions.

They then should multiply this answer by 1.5 to get the final answer.

Exemplar Candidate Work

Question 4(a)(ii) – high level answer

(ii) Anitka is measuring the diameter of one of the pollen grains.
She uses a stage micrometer to complete this task.

[For copyright purposes this image cannot be reproduced here; the image used within the question can be viewed in the original question paper.]

Fig 4.2

Calculate the diameter of the pollen grain shown in **Fig 4.2**.

Show your working.

65 units = 100 µm
28 units = x

X : 100 = 28 : 65
2800 : 65 = 43.07692 µm

diameter of pollen grain = 43.07 µm

[3]

Commentary

This candidate has used a different method to answer the question. However, it is a valid method and so still creditworthy.

They have worked out that 65 units = 100 µm. They have used an algebraic method to calculate the answer.

The final answer is allowed in the mark scheme which states 43 µm. Even though this candidate has not rounded their answer to 43 they have rounded to 2 decimal places. The question does not ask for an answer to a specified number of decimal places or significant figure. Even if they had not rounded their answer they would still been correct.

Although both answers shown here used the pollen width of 28 divisions, the examiner could have allowed for a small range of answers based on different interpretations of the boundary of the pollen grain. +/- half a division in the calculation would have been acceptable.

Questions 5(a) and (b)(i)

5 Atiq is a technician at a water company.

He is testing for lead ions in water samples from water pipes in an old house.

(a) Atiq completes a quick test on a water sample from the house using sodium hydroxide solution.

(i) Describe what happens in the test if lead ions are present.

White precipitate (of lead hydroxide) formed;
Precipitate is soluble in excess sodium hydroxide solution;
Gives a clear, colourless solution

[3]

(ii) Write chemical equations for the reactions between lead ions and sodium hydroxide solution.

Reaction of lead
$Pb^{2+} + 2OH^- \Rightarrow Pb(OH)_2$;
With excess hydroxide
$Pb(OH)_2 + 2OH^- [Pb(OH)_4]^{2-}$

[2]

(iii) Which other cation behaves in a similar way when sodium hydroxide solution is added?

Aluminium

[1]

(b) Atiq analyses the water samples for cations using an inductively coupled plasma-atomic emission spectroscopy (ICP-AES).

(i) Suggest why Atiq choses ICP-AES for the analyses.

Quantitative technique;
Measures concentration to very low levels;
All/almost all elements can be analysed at same time/no interference

[3]

Questions 5(b)(ii) and (iii)

(ii) Atiq prepares a series of standard solutions from a stock solution.

The stock solution is bought from a standard supplier, and not prepared in the water company laboratory.

Suggest **two** reasons why.

Any two from:

1. Concentration has defined degree (or wtte) of accuracy; .....
2. Ensures that standards are the same degree of accuracy each time; Adds traceability to analyses .....

[2]

(iii) The standard solutions are used to produce a calibration graph.

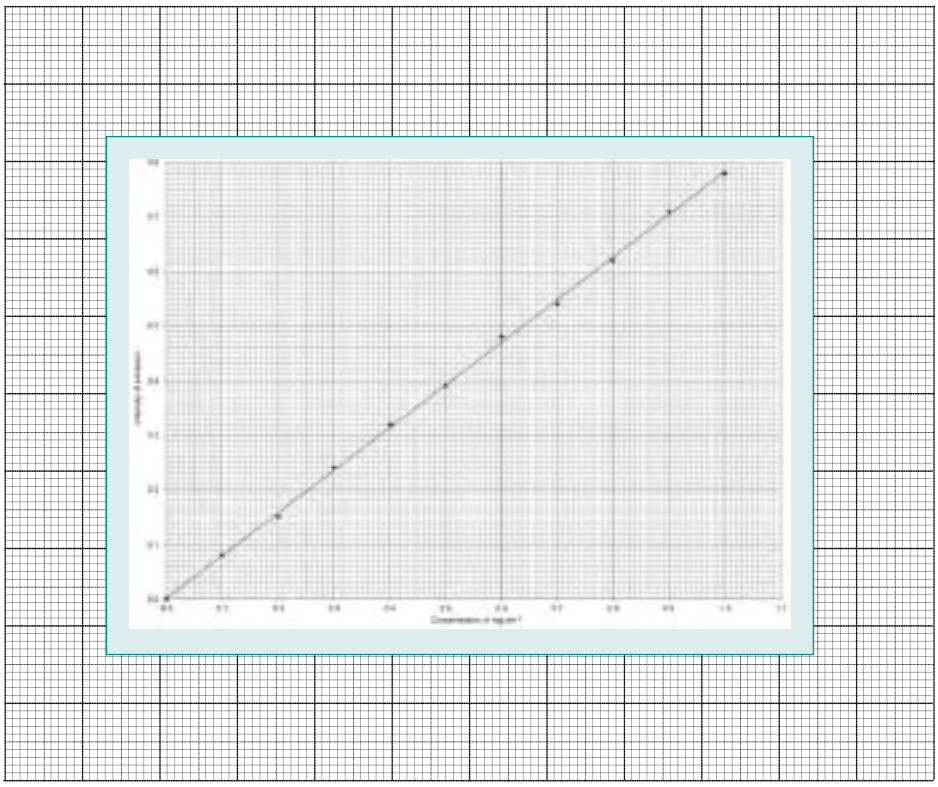
The data collected for the calibration plot are shown in **Table 5.1**.

Concentration of lead(II) (mg dm^{-3})	Intensity of emission
0.00	0.00
0.10	0.08
0.20	0.15
0.30	0.24
0.40	0.32
0.50	0.39
0.60	0.48
0.70	0.54
0.80	0.62
0.90	0.71
1.00	0.78

Table 5.1

On the graph paper on the opposite page draw a graph to show the calibration plot produced by the data in **Table 5.1**.

Question 5(b)(iii)



[4]

Correct axes and units;
Points plotted correctly;
Appropriate line of best fit

Mark scheme guidance

Question 5(a)(iii):

Allow Al^{3+}.

Question 5(b)(ii):

Ignore answers related simply to accuracy.

Allow reliable for same degree of accuracy each time.

Question 5(b)(iii):

For the plotting of points: correct to +/- ½ one small square.

10 or 11 points plotted correctly = 2 marks.

4 to 9 points plotted correctly = 1 mark.

3 or fewer points plotted correctly = 0 marks.

Maximum 3 marks for plots if axes reversed.

Examiner comments

Question 5(a)(i) – Again this question showed that candidates did not have basic knowledge. Good candidates got the first two mark points but did not always state it gave a clear, colourless solution. Some candidates misunderstood the question and discussed having to replace the pipes.

Question 5(a)(ii) – Very few candidates gained marks here. Centres should practice writing and balancing appropriate equations from the specification.

Question 5(a)(iii) – Again very few candidates knew this and this answer was often left blank. Some candidates attempted to answer and knew they had to suggest a metal ion. Metals such as tin or iron were suggested.

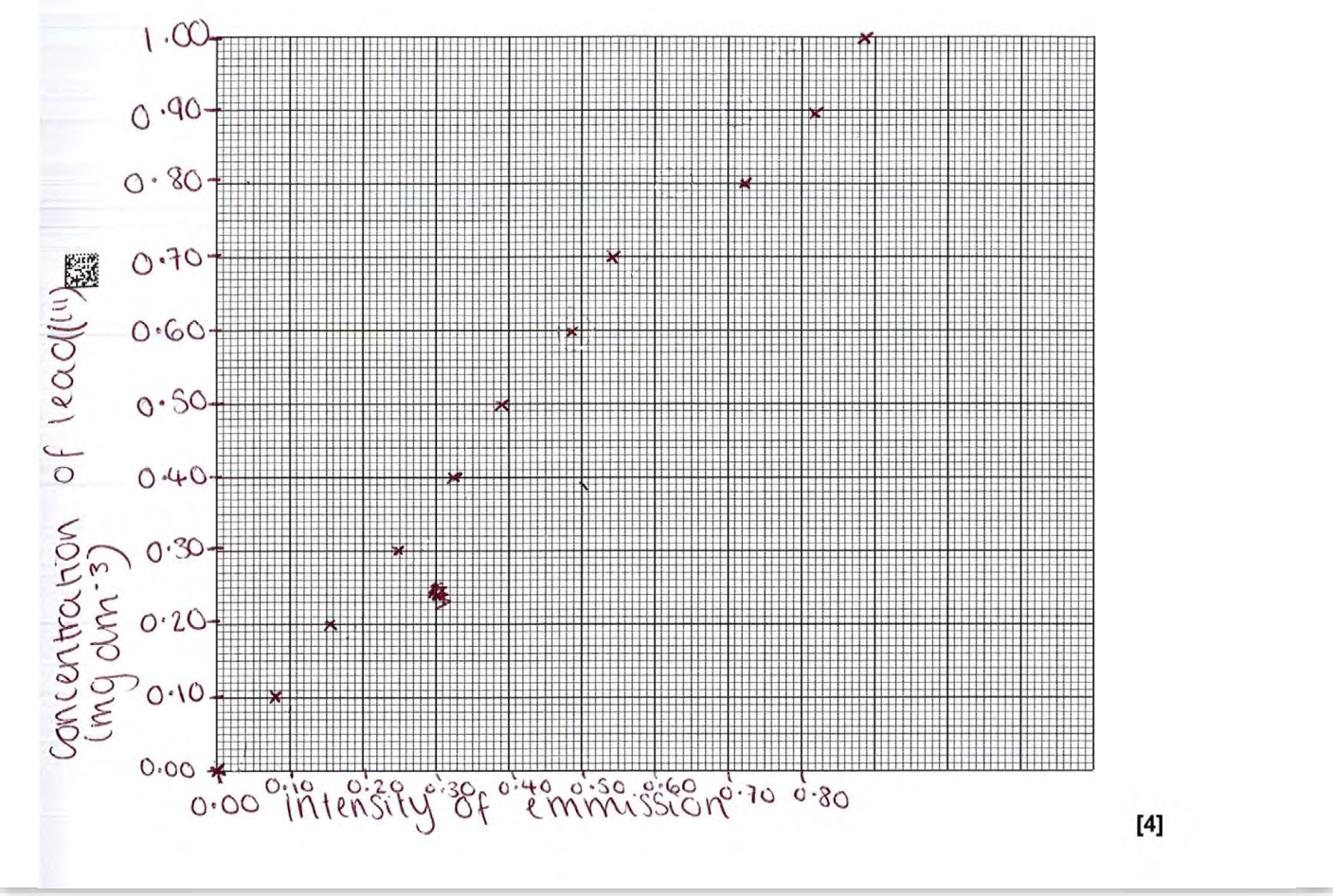
Question 5(b)(i) – This is another question about choices of procedures. Candidates struggled to answer this because they did not know the procedure. Vague answers about accuracy or ease were often seen. E.g. "for accuracy". This would not be enough to gain the mark. It is important that candidates know all the procedures in the specification.

Question 5(b)(ii) – Again candidates gave vague answers that did not quite meet the required level of understanding needed. E.g. "no risks of contamination of standard solutions". The mark scheme is looking for concentration having defined degree of accuracy or standards are same degree of accuracy each time. Comments on adding traceability would also have been credited.

Question 5(b)(iii) – Candidates did well on this question and most were able to get 3 or 4 marks. Marks were lost where the axis was the wrong way round or the line of best fit was missing, too thick or inappropriate. A mark was also lost if the correct unit wasn't given on the x-axis. Candidates should use a sharp pencil and a ruler when drawing a straight line on a graph.

Exemplar Candidate Work

Question 5(b)(iii) – low level answer



Commentary

The first mark is for correctly labelling axes and units. This candidate used the headings and units from the given table; however, they put the headings on the wrong axes.

There are two marks available for plotting the points from the table. 10 or 11 correctly plotted points would gain both marks. 4 to 9 correctly plotted points would gain 1 mark.

These marks are available even if the axes are labelled incorrectly. They would not be penalised for this again.

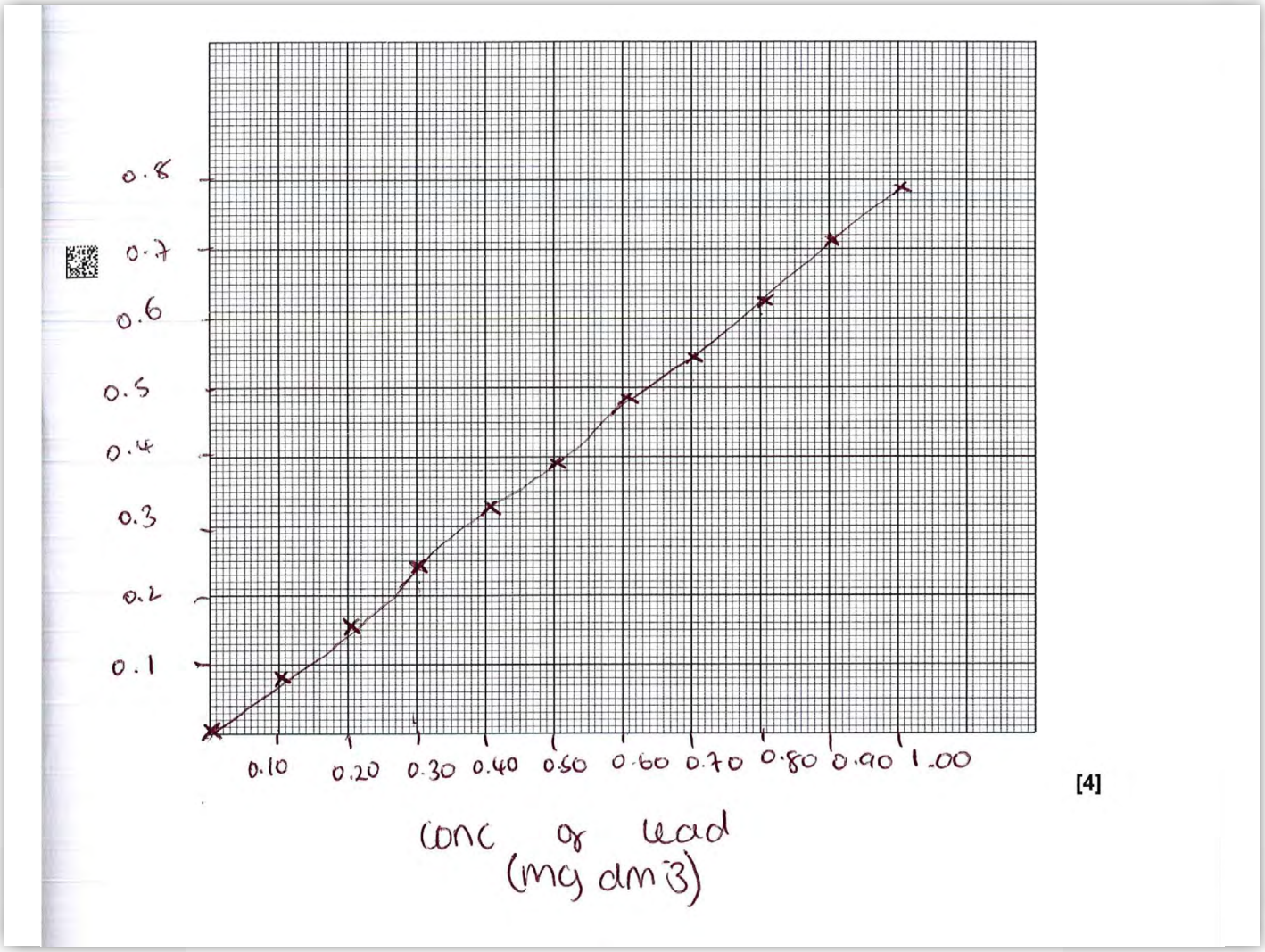
This candidate has 4 incorrect plots at concentration 0.6, 0.8, 0.9 and 1.0 $mgdm^{-3}$. This is because the plots at 0.6, 0.8, 0.9 and 1.0 $mgdm^{-3}$ are out by more than +/- ½ small square. This means only seven plots are correct.

The candidate needed to use the table carefully in order to plot correctly.

The final mark is for an appropriate line of best fit. This line is marked as appropriate to the points plotted. This candidate needed to draw an appropriate line.

Exemplar Candidate Work

Question 5(b)(iii) – medium level answer



Commentary

This candidate has not labelled the axes correctly.

The headings and units to be used are given in the table and these should be written exactly as given in the table. This candidate has not labelled the y-axis and the (II) is missing from lead (II). Both axes need to be labelled for the mark.

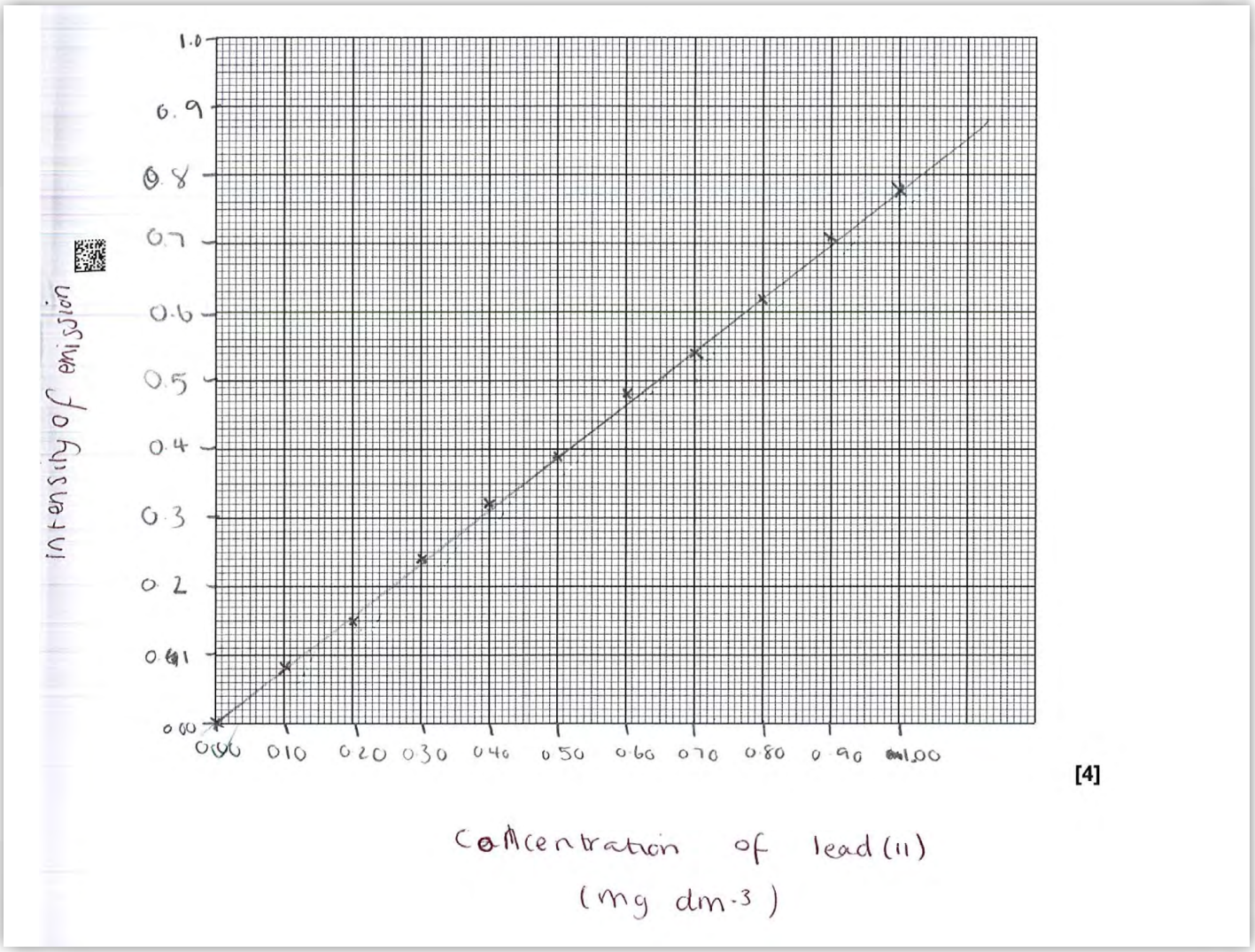
The candidate has not plotted the point at concentration 0.40 mgdm^{-3} correctly, however the other plots are within +/- ½ small square of the correct point and so 10 are plotted correctly. This candidate should be careful in future as most of the points were plotted as ½ small square distance from the correct point and so only just gained marks.

The line is inappropriate as these plots should have a straight line through them. The line is not straight. This candidate should have used a ruler to draw the line.

Wobbly lines, multiple lines, thick lines or dot to dot lines will not be awarded marks.

Exemplar Candidate Work

Question 5(b)(iii) – high level answer



[4]

Commentary

This candidate used the headings from the table to correctly label the axes with headings and units.

All the points are plotted correctly.

The line is drawn with a ruler, goes through or near all points including 0,0. Where the line does not go through all the points it should have as equal a number of points on each side of the line as possible and all points should be as close to the line as possible. This line is a good example of this practice.

Question 6(a)

6 Jason is a hospital technician.

He is culturing samples taken from a patient.

The samples are suspected of containing the pathogenic bacterium, *Staphylococcus aureus*.

(a) Throughout the procedure, Jason uses aseptic technique.

(i) Explain why aseptic technique is necessary under these conditions.

Any two from:
Prevent contamination of culture;
Erroneous results would be obtained/erroneous conclusions drawn;
Prevent contamination of the environment with the bacterium;
For safety (as culture may contain pathogenic bacteria)

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

(ii) State **two** measures required to work aseptically.

1 .....

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

Any two from:
Sterile working area;
Good personal hygiene;
Sterile media and reagents;
Sterile handling/glassware/equipment

Question 6(b)

(b) Jason uses a controlled airflow cabinet (**Fig. 6.1**) when preparing bacterial cultures.

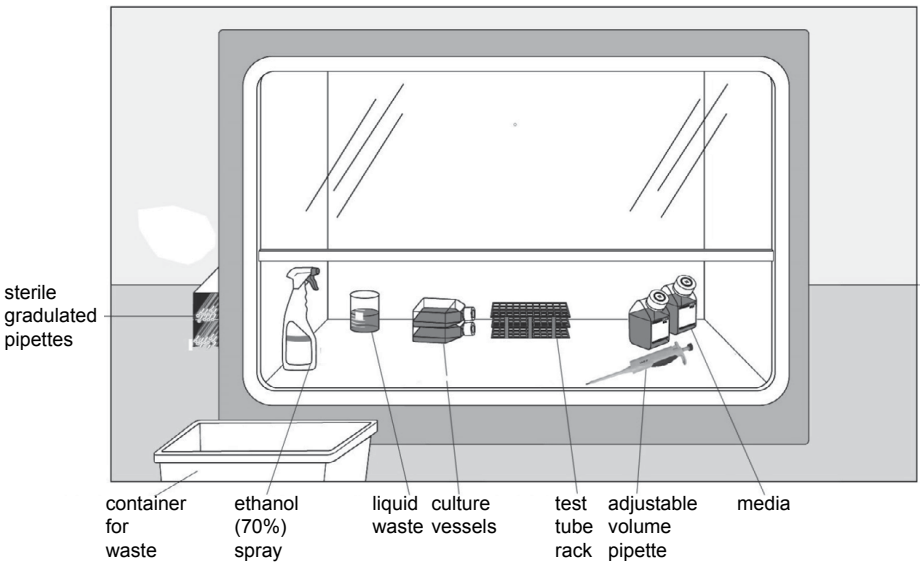


Fig. 6.1

(i) Explain the function of the controlled airflow cabinet (**Fig.6.1**).

Any four from:
Provides aseptic environment for culture work;
Contains infectious splashes/aerosols;
Protect culture from contamination;
(Inward) airflow protects user;
Exhaust air is filtered to protect user/laboratory workers

[4]

(ii) Bunsen burners are often used to sterilise microbiological equipment.

Give **three** reasons why the use of Bunsen burners is **not** recommended in controlled airflow cabinets.

1 .
2 .
3 .

Any three from:
Disrupts airflow/creates turbulence (compromising protection of culture and user);
Causes heat build-up/affects metabolism of microorganisms;
Damage (HEPA) air filter;
Potential cause of fire

[3]

Question 6(c)

(c) Describe how the following are sterilised before use.

(i) Graduated pipettes

Any two from:
Wrap in aluminium foil;
Sterilise in autoclave;
Keep wrapped until required

[2]

(ii) Culture media

(For media made up unsterile)
Sterilise in autoclave

[1]

(iii) Test tube rack

(Swabbed/wiped) with (70%) ethanol/autoclave

[1]

Mark scheme guidance

Question 6(a)(i):

Allow pathogens are harmful.

Question 6(a)(ii):

Allow disinfection of working area.

Question 6(b)(ii):

Accept answers relating to affecting manufacturer warranties.

Ignore alter results unqualified.

Examiner comments

Question 6(a)(i) – Candidates got most marks for understanding that the process prevented contamination of the culture and of the environment. In general this was quite well answered. Very few discussed erroneous results.

Question 6(a)(ii) – Candidates lost marks here due to poor terminology. "Clean work area" is not sufficient to gain the sterile work area mark. Some candidates just wrote "sterilised" but did not state what was sterilised and so did not gain a mark. General comments on PPE such as wear gloves were not creditworthy.

Question 6(b)(i) – Again candidates gained marks for understanding this was to stop contamination. Candidates struggled to explain in enough depth and so did not get marks. E.g. "the airflow cabinet is to make sure that the air in the cabinet is always flowing so no harmful bacteria are floating around" did not quite meet any mark point.

Question 6(b)(ii) – Candidates often gained marks here for the idea that there was risk of a fire. The better learners also recognised that the heat would cause turbulence and may affect the metabolism of the microorganisms. Ideas such as "create a convection current" were credited. Candidates need to make sure if there are 3 mark points then they give 3 different responses. So "there could be flammable objects and it can catch fire" would only be worth one mark.

Question 6(c)(i) – There were a lot of not creditworthy answers that mentioned cleaning, rinsing or washing e.g. "wash with sodium hydroxide solution". "sterilise by washing" was not creditworthy as the method (autoclave) needed to be given. Many candidates thought using a Bunsen burner was appropriate but this gained no marks.

Question 6(c)(ii) – Many candidates answered this question in exactly the same way as they answered 6ci. Sterilise in autoclave was the only creditworthy response.

Question 6(c)(iii) – Use of alcohol was accepted. If candidates wrote "wash with alcohol" this did gain the mark.

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