

Cambridge Technicals Applied Science

Unit 2: Laboratory techniques

Level 3 Cambridge Technical in Applied Science
05847 – 05849, 05874 & 05879

Mark Scheme for June 2022

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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MARKING INSTRUCTIONS

PREPARATION FOR MARKING

TRADITIONAL

Before the Standardisation meeting you must mark at least 10 scripts from several centres. For this preliminary marking you should use **pencil** and follow the **mark scheme**. Bring these **marked scripts** to the meeting.

MARKING


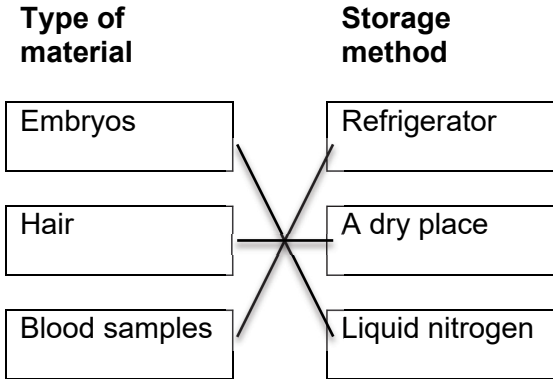
1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the traditional 40% Batch 1 and 100% Batch 2 deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.
4. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or by email.
5. Work crossed out:
 - a. where a candidate crosses out an answer and provides an alternative response, the crossed out response is not marked and gains no marks
 - b. if a candidate crosses out an answer to a whole question and makes no second attempt, and if the inclusion of the answer does not cause a rubric infringement, the assessor should attempt to mark the crossed out answer and award marks appropriately.
6. Always check the pages (and additional lined pages if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add an annotation to confirm that the work has been seen.
7. There is a NR (No Response) option. Award NR (No Response)
 - if there is nothing written at all in the answer space
 - OR if there is a comment which does not in anyway relate to the question (e.g. 'can't do', 'don't know')
 - OR if there is a mark (e.g. a dash, a question mark) which isn't an attempt at the questionNote: Award 0 marks - for an attempt that earns no credit (including copying out the question)
8. Assistant Examiners will email a brief report on the performance of candidates to your Team Leader (Supervisor) by the end of the marking period. Your report should contain notes on particular strength displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

9. Annotations

Annotation	Meaning
ORA	Or reverse argument
ECF	Error carried forward
OWTTE	Or words to that effect

10. Subject-specific marking instructions

Question		Answer	Marks	Guidance	
1	(a)	Take care of their own health and safety and that of others.	✓	2	
		Be paid more than the minimum wage.			
		Co-operate with their employer on health and safety issues.	✓		
		Not work more than 8 hours.			
		Take a rest break during the working day.			
	(b)	1. Hazards 2. Harmed 3. Risks 4. Record 5. Review ✓✓	2	4 or 5 correct = 2 2 or 3 correct = 1 1 correct = 0	
	(c)	The needle ✓ Viruses (in the blood) ✓	2	ALLOW HIV/pathogen/named pathogen IGNORE risks	
	(d)	Wearing gloves ✓	1	ALLOW cover any cuts (with plasters/bandages) IGNORE PPE	
	(e)	In a sharps box/bin ✓	1		

Question		Answer	Marks	Guidance
(f)	(i)		1	
(f)	(ii)	The idea of patient confidentiality ✓	1	IGNORE safety of patient
(f)	(iii)	If the tubes are labelled the contents and labels cannot be mixed up / lids could potentially be swapped between tubes ✓	1	ALLOW idea of lid could get lost
(g)		To prevent contamination of others / contamination of sample/loss of blood ✓	1	avoid cross contamination is insufficient
(h)		<p>Type of material</p> <p>Embryos</p> <p>Hair</p> <p>Blood samples</p> <p>Storage method</p> <p>Refrigerator</p> <p>A dry place</p> <p>Liquid nitrogen</p> 	3	
		Total	15	

Question		Answer	Marks	Guidance												
2	(a)	<table border="1"> <tr> <td>Generic chemistry</td> <td></td> </tr> <tr> <td>Gas chromatography</td> <td>✓</td> </tr> <tr> <td>Geographical climate</td> <td></td> </tr> <tr> <td>Glacial constituent</td> <td></td> </tr> </table>	Generic chemistry		Gas chromatography	✓	Geographical climate		Glacial constituent		1					
Generic chemistry																
Gas chromatography	✓															
Geographical climate																
Glacial constituent																
	(b) (i)	The old snow spectrum has more peaks ✓	1	ORA ALLOW more retention times 'more higher peaks'/'more frequent peaks' is ok for the mark but 'higher peaks' is not												
	(ii)	<table border="1"> <thead> <tr> <th>Retention time (s)</th> <th>Fresh and old snow</th> <th>Additional pollutant</th> </tr> </thead> <tbody> <tr> <td>300</td> <td>✓</td> <td></td> </tr> <tr> <td>800</td> <td>✓</td> <td></td> </tr> <tr> <td>1500</td> <td></td> <td>✓</td> </tr> </tbody> </table>	Retention time (s)	Fresh and old snow	Additional pollutant	300	✓		800	✓		1500		✓	3	
Retention time (s)	Fresh and old snow	Additional pollutant														
300	✓															
800	✓															
1500		✓														
	(iii)	Peak at 1210s identified with a letter N ✓	1													
	(iv)	Standards✓ Area✓ Calibration✓	3	ALLOW responses only in the correct order.												
	(c) (i)	Numbers in boxes from left to right 2, 4, 1, 3 ✓✓✓✓	4	ALLOW responses only in the correct order. 1 mark for each correct box.												
	(ii)	C✓	1													

Question		Answer	Marks	Guidance
	(iii)	Any one from: ✓ Determine the molar mass from mass of heaviest fragment Use the M_r of (other) fragments to determine its structure Compare spectrum with database spectra	1	OWTTE
		Total	15	

Question			Answer	Marks	Guidance	
3	(a)	(i)	Positive ✓	1		
		(ii)	(Pale) Green OR Apple green ✓	1		
		(iii)	Lithium Magnesium Sodium Potassium Copper (II) ✓	1		
(b)	(i)	It is a very cheap way to determine the quantity of an element in a sample.			2	
		It is a very reliable method of determining the quantity of an element in a sample.		✓		
		It can detect very small amounts of cations.		✓		
		It can detect anions as well as cations.				
		(ii)	In the following sequence C A D B	4		
(c)	(i)	Interpolation clearly shown on graph ✓ 0.9 (mg dm ⁻³) ✓		2	ecf for incorrect interpolation using 0.6 on the x axis to get 0.4	
		(ii)	FIRST CHECK ANSWER ON ANSWER LINE If answer = 4.5 x 10⁻² (mg) award 2 marks Mass in 50 cm ³ = 0.9 x 10 ⁻³ x 50 mg ✓ = 4.5 x 10 ⁻² (mg) ✓	2	ALLOW ecf from value in (c)(i).	

Question		Answer	Marks	Guidance
	(iii)	FIRST CHECK ANSWER ON ANSWER LINE If answer is 30 mg in 1kg so it is contaminated award 2 marks 4.5 x10 ⁻² mg in 1.5 g soil ✓ 30 mg in 1kg so it is contaminated ✓	2	ALLOW ecf from value in (c)(ii). soil sample is contaminated alone is not worth a mark
		Total	15	

Question		Answer	Marks	Guidance								
4	(a)	Great(er)/high(er) magnification/resolution ✓	1									
	(b)	Any two from Can view living organisms ✓ Can see more of the layer at any one time/wider field of view / 3D image ✓	2	ALLOW can see colours ALLOW Cheap ALLOW Quick to use ALLOW Little training needed ALLOW portable								
	(c)	Any one from needs to be dead to see internal structures ✓ The specimen may be disfigured during preparation to be viewed under the microscope ✓	1	IGNORE resolution/magnification ALLOW needs light source								
	(d)	Used <i>in situ</i> / underwater / easy to transport ✓	1	ALLOW Little training/ease of use/ quicker/no sample preparation/live sample								
	(e)	<table border="1" data-bbox="448 981 784 1268"> <tbody> <tr> <td>Scanning</td> <td>✓</td> </tr> <tr> <td>Sonorous</td> <td></td> </tr> <tr> <td>Tangential</td> <td></td> </tr> <tr> <td>Transmission</td> <td>✓</td> </tr> </tbody> </table>	Scanning	✓	Sonorous		Tangential		Transmission	✓	2	
Scanning	✓											
Sonorous												
Tangential												
Transmission	✓											

Question	Answer	Marks	Guidance
(f)	<p>FIRST CHECK ANSWER ON ANSWER LINE If answer = 1.8×10^{-6} (m) award 2 marks</p> <p>$\frac{18}{4} = 4.5$</p> <p>$4.5 \times 400 = 1800\text{nm} \checkmark$</p> <p>$1.8 \times 10^{-6} \text{ (m)} \checkmark$</p>	2	<p>ALLOW 1800×10^{-10} Please double-check this alternative response.</p> <p>Horizontal I think it is 18 mm therefore 4.5×400 or $18 \times 100 = 1800\text{nm}$ 1.8×10^{-6} range 17-19</p> <p>vertical</p> <p>22mm 5.5×400 or $22 \times 100 = 2200\text{nm}$ $2.2 \times 10^{-6} \text{ (m)}$ range 21-23</p> <p>ALLOW answers not to standard form</p>
(g)	<p>FIRST CHECK ANSWER ON ANSWER LINE If answer = 3.75 (x greater) award 2 marks</p> <p>$\frac{\text{width of EM bryozoan}}{\text{width of LM brozoan}}$ or $\frac{18}{4} \checkmark$</p> <p>= 4.5 (x greater) \checkmark</p>	2	<p>ecf measurements from 5f horizontal range 3-4 and 17-19</p> <p>vertical range 5-7 and 21-23</p> <p>allow horizontal $\frac{22}{6} = 3.67 \text{ (x greater)}$</p>

Question		Answer	Marks	Guidance
	(h)	FIRST CHECK ANSWER ON ANSWER LINE If answer = 7.5×10^{-3} (nm) award 4 marks Total magnification = $10 \times 40 = 400$ ✓ Size of object = $3/400$ ✓ = 0.0075 ✓ = 7.5×10^{-3} (nm) ✓	4	ECF from MP1
		Total	15	

Question			Answer	Marks	Guidance
5	(a)	(i)	$n \text{ NaOH} = (250 \times 0.2)/1000 = 0.05 \checkmark$ mass NaOH needed = $40 \times 0.05 = 2\text{g} \checkmark$ Dissolve weighed mass (2g) of NaOH in distilled water \checkmark Make up to 250 cm^3 in a volumetric flask \checkmark	4	OR any other valid method for first 2 marks. eg. Mass NaOH to make 250 cm^3 of 1 mol dm^{-3} solution = 10g Mass needed to make 250 cm^3 of a 0.2 mol dm^{-3} solution = $10 \times 0.2 = 2\text{g}$
	(a)	(ii)	<p>[Level 3] Candidate shows a high level of understanding by giving a detailed method with some features of accuracy. <i>(5 - 6 marks)</i></p> <p>[Level 2] Candidate shows an understanding giving a detailed method that would complete the titration successfully. <i>(3 - 4 marks)</i></p> <p>[Level 1] Candidate shows a basic understanding by giving an outline method that would mostly complete the titration. <i>(1 - 2 marks)</i></p> <p>[Level 0] Candidate response includes fewer than two valid points or provides a method that would be completely unsuccessful. <i>(0 marks)</i></p>	6	Indicative points might include: Accuracy <ul style="list-style-type: none"> Burette readings recorded to the nearest 0.05 cm^3 Concordant titres (within 0.1 cm^3) used to find the mean titre Solution in burette added dropwise near end point Swirling of solution in conical flask Use of white tile Detailed Method <ul style="list-style-type: none"> Pipette to measure out one of the solutions Use of conical flask Addition of indicator Use of burette for the other solution Endpoint is when indicator changes colour Record volume added at endpoint Repeat readings Outline method <ul style="list-style-type: none"> Known volume in flask or beaker of one solution Addition of other solution Use of indicator Note volume of other solution Credit a labelled diagram

Question		Answer	Marks	Guidance
	(b) (i)	Any two from: ✓✓ Quick(er) /high(er) throughput of samples Reduced labour costs 24 hour working Small(er) volume of solutions used	2	IGNORE accuracy
	(ii)	(Too) expensive OR Only a few titrations are done in a teaching laboratory ✓	1	IGNORE difficult to use/need training
	(iii)	In the following order: Electrode ✓ Small ✓	2	
		Total	15	

Question			Answer	Marks	Guidance								
6	(a)	(i)	<table border="1"> <tr> <td>Autoclaving</td> <td>✓</td> </tr> <tr> <td>Dry heating</td> <td></td> </tr> <tr> <td>Filtration</td> <td></td> </tr> <tr> <td>Flaming</td> <td></td> </tr> </table>	Autoclaving	✓	Dry heating		Filtration		Flaming		1	
Autoclaving	✓												
Dry heating													
Filtration													
Flaming													
		(ii)	Kill the bacteria present in the agar ✓ so only bacteria inoculated onto the plate grow ✓	2	IGNORE prevent contamination								
		(iii)	Line starts at contamination ✓ Line ends at destroy the plates by autoclaving ✓	2									
	(b)	(i)	<p>Difference Fig 6.3 has more colonies than 6.2 ✓ Explanation Water sample in Fig 6.3 had more bacteria/coliforms present ✓</p> <p>Difference Fig 6.3 has more morphologies/types of colony than Fig 6.2 ✓ Explanation Water sample in Fig 6.3 has more species/types of bacteria/coliforms present than Fig 6.2 ✓</p>	4	<p>ALLOW responses in either order but the explanation must correspond with the difference stated.</p> <p>ORA</p> <p>ORA</p>								

Question		Answer	Marks	Guidance								
	(ii)	<table border="1"> <tr> <td>The river water is not safe to swim in.</td> <td></td> </tr> <tr> <td>The river water upstream of the farm is not contaminated with faeces.</td> <td></td> </tr> <tr> <td>The farm is the source of the pollution.</td> <td></td> </tr> <tr> <td>The river water is more polluted downstream of the farm than upstream.</td> <td>✓</td> </tr> </table>	The river water is not safe to swim in.		The river water upstream of the farm is not contaminated with faeces.		The farm is the source of the pollution.		The river water is more polluted downstream of the farm than upstream.	✓	1	
The river water is not safe to swim in.												
The river water upstream of the farm is not contaminated with faeces.												
The farm is the source of the pollution.												
The river water is more polluted downstream of the farm than upstream.	✓											
	(iii)	<p>FIRST CHECK ANSWER ON ANSWER LINE If answer = 82 award 2 marks</p> <p>(Number of colonies on plate =) 41 ✓ (41 colonies = 41 coliforms per 50 cm³ 41 x 2 =) 82 (coliforms per 100 cm³) ✓</p>	2	ALLOW +/- 2 number of colonies ALLOW ecf for second mark.								
	(c)	<p>Line starts at 'Autoclave the plates and dispose of them' ✓ Line ends at 'To prevent people coming in contact with pathogens' ✓</p>	2									
	(d)	<p>Any one from: ✓</p> <p>cell and tissue culture preparation of medical test kits pharmaceutical production microbiology medical and surgical procedures</p>	1	ALLOW other types of practical work that clearly require aseptic technique.								
		Total	15									

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

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Facsimile: 01223 552627

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