

**Cambridge Technicals
Applied Science**

Unit 2: Laboratory Techniques

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

Mark Scheme for January 2019

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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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Annotations available in RM Assessor

Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	Ignore

Abbreviations, annotations and conventions used in the detailed Mark Scheme (to include abbreviations and subject-specific conventions).

Annotation	Meaning
/	alternative and acceptable answers for the same marking point
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
()	Words which are not essential to gain credit
—	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

Subject-specific Marking Instructions

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question		Answer	Marks	Guidance	
1	(a)	<p>Any three from: Cells of multicellular organism / originally collected from one source ✓ Cells have the same genome/genes ✓ Removed and grown outside the body ✓ In specially-designed containers/suitable surface/agar ✓ Under precise conditions ✓</p>	3	<p>ALLOW from a single named source</p> <p>ALLOW any correctly named condition</p>	
	(b)	(i)	<p>Any two from: Prepare growth medium (in unsterile conditions) ✓ Transfer to (screw-capped) bottle/named type of bottle ✓ (Sterilise in) autoclave ✓</p>	2	Answers must be in this order
		(ii)	<p>Any three from: Insert cotton wool into end (of Pasteur pipette) ✓ Wrap pipettes in (aluminium) foil ✓ (Sterilise in) autoclave ✓ Retain in (aluminium) foil prior to use ✓</p>	3	Answers must be in this order
		(iii)	Heat(-sterilise) / (Sterilise in)autoclave	1	
	(c)	<p>Any three from: Work in sterile/culture hood / leave hood running ✓ Position of hood/free from draughts/no through-traffic ✓ Avoid cluttered work area ✓ Spray/wipe surfaces with (70%) ethanol / wipe hands with ethanol ✓ Maintain good hygiene/wash hands regularly ✓</p>	3	ALLOW controlled airflow/Lit Bunsen burner for updraft of air	













Question		Answer	Marks	Guidance
	(d)	<p>Any four from:</p> <p>Dip an inoculum loop (in alcohol and) flame ✓</p> <p>Remove (bacteria) culture bottle lid and pass the neck of the bottle through a flame ✓</p> <p>Collect a sample of bacteria on the inoculum loop ✓</p> <p>Re-flame the neck of the culture bottle ✓</p> <p>Replace the bottle lid ✓</p> <p>Lift lid of the agar dish ✓</p> <p>Streak the inoculum loop across surface of agar ✓</p> <p>Avoid damaging the surface of the agar ✓</p> <p>Turn agar plate to repeat streaking at a different angle ✓</p> <p>Replace agar dish lid ✓</p> <p>Re-flame the inoculum loop ✓</p> <p>Seal edge of agar dish lid to base ✓</p> <p>Store the inoculated agar dish upside down ✓</p> <p>Label the base of the agar dish ✓</p>	4	<p>The steps should be in a logical order.</p> <p>Streak bacteria across surface of agar is insufficient for mark</p> <p>ALLOW close lid for 1 mark if neither bottle or dish lid mentioned</p>
		Total	16	

Question			Answer	Marks	Guidance
2	(a)	(i)	Hand lens/magnifying glass ✓	1	DO NOT ALLOW reference to any type of microscope
		(ii)	Light/optical (microscope) ✓	1	
		(iii)	<p>FIRST CHECK ANSWER ON ANSWER LINE If answer = 421 (µm) award 3 marks</p> <p>Scale bar representing 100 µm measures 28 mm and Length X = 118 mm on micrograph ✓</p> <p>∴ Length X = $\left(\frac{118}{28} \times 100\right)$ (µm) ✓ = 421 (µm) ✓</p>	3	<p>ECF from incorrect measurements</p> <p>ALLOW measurements = 28 ± 1 mm = 118 ± 1 mm</p>
		(iv)	<p>FIRST CHECK ANSWER ON ANSWER LINE If answer = (x) 280 award 3 marks</p> <p>Measurement Length of scale bar X = 28 (mm on page) Actual length of scale bar = 100 (µm)</p> <p>Conversion 28 (mm) = 28 000 (µm) ✓</p> <p>OR 100 (µm) = 0.1 (mm) ✓ ∴ magnification = 28000 ÷ 100 ✓ = (x) 280 ✓</p> <p>OR 28 ÷ 0.1 ✓ = (x) 280 ✓</p>	3	<p>ALLOW measurement of scale bar = 28 ± 1 mm ECF from incorrect measurements in Q2aiii</p> <p>ALLOW calculation form tardigrade length</p> <p>118 x 1000</p> <p><u>118000</u> 421</p> <p>= (x) 280</p>

Question		Answer	Marks	Guidance	
	(b)	(i)	Scanning electron microscope/SEM ✓	1	DO NOT ALLOW electron microscope (unqualified)
		(ii)	<p>Advantage: Shows effect of dehydration on surface structure of tardigrade in detail, OWTTE ✓</p> <p>Disadvantage: Gives no information on how dehydration affects internal structure OWTTE(of the tardigrade) ✓</p>	2	
		(iii)	<p>Any four from: Normal tardigrade elongated / dehydrated tardigrade globular/rounded in shape ✓ Sizes of normal ($\approx 310 \mu\text{m}$) and dehydrated ($\approx 100 \mu\text{m}$) tardigrades ✓ Relative sizes / normal approx. three times the length of dehydrated tardigrade ✓ Contracted segments in dehydrated tardigrade ✓ Retracted legs/claws in dehydrated tardigrade ✓ Retracted mouthparts in dehydrated tardigrade ✓</p>	4	<p>ALLOW approximations of size and relative size.</p> <p>DO NOT ALLOW loses its legs/claws/head ALLOW retracted head</p>
			Total	15	

Question			Answer	Marks	Guidance
3	(a)	(i)	<p>[Level 3] Candidate gives a detailed description of procedures at employee level AND can explain clearly why these measures are in place. <i>(5 – 6 marks)</i></p> <p>[Level 2] Candidate gives a good description of procedures at employee level AND can explain why these measures are in place. <i>(3 – 4 marks)</i></p> <p>[Level 1] Candidate shows a basic understanding of health and safety procedures AND is able to explain why some of the health and safety procedures are carried out. <i>(1 – 2 marks)</i></p> <p>[Level 0] Candidate includes fewer than two valid points. <i>(0 marks)</i></p>	6	<p>Valid points: Employees' health and safety procedures</p> <ul style="list-style-type: none"> • Assess biosafety levels • Work within safety cabinet or other designated area • Keep work area uncluttered/clear of unnecessary equipment • Wear gloves and other PPE, e.g. eye protection and labcoat/apron • Perform operations in such a manner as to minimise splashing, spraying, spattering, and generation of droplets • Prohibit mouth pipetting of blood • Prohibit eating, smoking, drinking, applying cosmetics or lip balm • Cover cuts, grazes and broken skin on exposed skin with waterproof dressings • Avoid using sharps and glassware • In the event of accident/punctured skin, the wound should be gently encouraged to bleed while washing with running water/do not scrub a wound, and dress wound. • Follow designated standard procedures • Clean and disinfect bench surfaces and any equipment immediately on completing a work session • Put into action a satisfactory disinfection policy, e.g. hypochlorite, phenolic disinfectant, for dealing with spillages • Reference to storage/disposal procedures • Reference to decontamination procedures • Spillage and disinfectants should be mopped up with disposable paper towels, discarded into a clinical waste bag and the area disinfected again. <p>Explanations</p> <ul style="list-style-type: none"> • Avoid entry of pathogen into body through mouth • Avoid entry of pathogen into body through eyes or respiratory system • Avoid entry of pathogen into body through damaged skin

Question			Answer	Marks	Guidance
					<ul style="list-style-type: none"> • Avoid transfer of pathogen to work surfaces/other surfaces/retention of pathogen on work surfaces, where they may be transferred to others • Avoid transfer of pathogen to others
		(ii)	Answer relating to any chemical agent ✓	1	

Question		Answer	Marks	Guidance										
	(b)	(i)	4											
		<table border="1"> <thead> <tr> <th>Pictogram</th> <th>Hazard</th> </tr> </thead> <tbody> <tr> <td></td> <td>Oxidising</td> </tr> <tr> <td></td> <td>Toxic to the aquatic environment</td> </tr> <tr> <td></td> <td>Health hazard</td> </tr> <tr> <td></td> <td>Gas under pressure</td> </tr> </tbody> </table>	Pictogram	Hazard		Oxidising		Toxic to the aquatic environment		Health hazard		Gas under pressure		
Pictogram	Hazard													
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	Gas under pressure													
		✓✓✓✓												

Question		Answer	Marks	Guidance
	(ii)	<p>Any four from:</p> <p>Chemical / agent / activity / physical object that <u>may be / likely to be hazardous</u> ✓</p> <p>(Definition of the) hazard ✓</p> <p>(Associated) risk ✓</p> <p>Measures to minimise risk ✓</p> <p>Emergency procedures ✓</p> <p>Review of risk assessment ✓</p> <p>Date of risk assessment ✓</p> <p>Name of person undertaking risk assessment ✓</p>	4	<p>ALLOW safety procedures for one mark if minimise risk and emergency procedures are not mentioned.</p>
		Total	15	

Question			Answer	Marks	Guidance
4	(a)	(i)	<p>✓✓✓✓</p>	4	One mark for each correctly linked box
		(ii)	<p>X – (HPLC) solvents ✓ Y – sample ✓</p>	2	ALLOW mobile phase
	(b)		<p>FIRST CHECK ANSWER ON ANSWER LINE If answer = 6.65/6.7 award 4 marks</p> <p>Retention time of drug W – 15.3 (min) ✓</p> <p>$t_0 = 2$ ✓</p> <p>Substitution into formula: $k = \frac{(15.3 - 2.0)}{2.0} = \frac{13.3}{2}$ ✓ = 6.65/6.7 ✓</p>	4	<p>ECF from incorrect t_R or t_0</p> <p>Maximum 3 marks for incorrect units</p>

Question		Answer	Marks	Guidance	
	(c)	(i)	Discovery RP-Amide 16 ✓	1	
		(ii)	Has largest selectivity factor / α ✓	1	
	(d)		Drugs and contaminants are / must be heat-labile / OWTTE ✓	1	
	(e)	(i)	HPLC-mass spectrometry ✓	1	
		(ii)	Thin-layer chromatography (TLC) ✓	1	
			Total	15	

Question		Answer	Marks	Guidance
5	(a)	<p>FIRST CHECK ANSWER ON ANSWER LINE If answer = 10.21(g) award 4 marks</p> <p>0.1 x 204.22 ✓ = 20.42 (g) ✓ ∴ 500 cm³ of solution contains 20.42 ÷ 2 ✓ = 10.21 (g) ✓</p>	4	ECF for the second and/or third marking point.
	(b)	<p>[Level 3] Candidate shows a high level of understanding and gives a good description of how to standardise sodium hydroxide solution using potassium hydrogen phthalate. (5 – 6 marks)</p> <p>[Level 2] Candidate shows an understanding of how to standardise sodium hydroxide solution using potassium hydrogen phthalate. (3 – 4 marks)</p> <p>[Level 1] Candidate shows a basic understanding of how to standardise sodium hydroxide solution using potassium hydrogen phthalate, with little or no explanation. (1 – 2 marks)</p> <p>[Level 0] Candidate includes fewer than two valid points. (0 marks)</p>	6	<p>Valid points: preparation</p> <ul style="list-style-type: none"> • Rinse burette with deionised/distilled water • Rinse burette with standardised sodium hydroxide solution <p>technique</p> <ul style="list-style-type: none"> • Fill burette with standardised sodium hydroxide solution • Allow to drain so that reading is 0.00 cm³/record volume reading • Rinse (250 cm³) conical flask with deionised/distilled water • Pipette 25 cm³/known volume of potassium hydrogen phthalate into the conical flask • Using one-mark pipette • Add two drops of <u>phenolphthalein</u> (indicator) • Titrate against sodium hydroxide/release sodium hydroxide from burette • Run in until swirls of pink appear • Titrate slowly/drop by drop • Until <u>very pale</u> pink colour appears • Take accurate reading • Repeat until <u>concordant</u> (owtte) results obtained

Question		Answer	Marks	Guidance
	(c)	FIRST CHECK ANSWER ON ANSWER LINE If answer = 1.51 (g dm⁻³) award 5 marks $c = \frac{4.2 \times 10^{-4}}{0.025} \checkmark$ $= 0.0168 \text{ (mol dm}^{-3}\text{)} \checkmark$ $= 0.0168 \times 90.1 \text{ (g dm}^{-3}\text{)} \checkmark$ $= 1.51 \text{ (g dm}^{-3}\text{)} \checkmark$ 2 decimal places \checkmark	5	ECF at any one stage. ALLOW $90.1 \times 4.2 \times 10^{-4}$ for 1 mark
		Total	15	

Question			Answer	Marks	Guidance
6	(a)	(i)	Test: Flame test ✓ Result: Brick-red (colour) ✓	2	
		(ii)	Test: Add nitric acid or hydrochloric acid AND then add limewater ✓ Result: (Carbon dioxide/gas produced) turns (limewater) milky ✓	2	ALLOW Add strong acid
		(iii)	Test: Flame test ✓ Result: Yellow/orange/yellow-orange (colour) ✓	2	
		(iv)	Test: Add silver nitrate solution ✓ Result: White precipitate is produced / precipitate darkens on exposure to light ✓	2	
	(b)			3	One mark for each correct line

Question		Answer	Marks	Guidance
	(c)	<p>Ion chromatography</p> <p>Atomic Emission Spectroscopy (AES)</p> <p>Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES)</p> <p>Energy supplied...</p> <p>Chemical analysis ...</p> <p>Separates ions</p>	3	One mark for each correct line
		Total	14	

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