OCR
Oxford Cambridge and RSA

Cambridge Technicals

Laboratory Skills

Unit **2:** Laboratory Techniques

Level 3 Cambridge Technical Certificate/Diploma in Laboratory Skills
05847 – 05849 05874 – 05879

Mark Scheme for January 2018

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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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.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Annotations available in RM Assessor

Annotation	**Meaning**
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	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**.

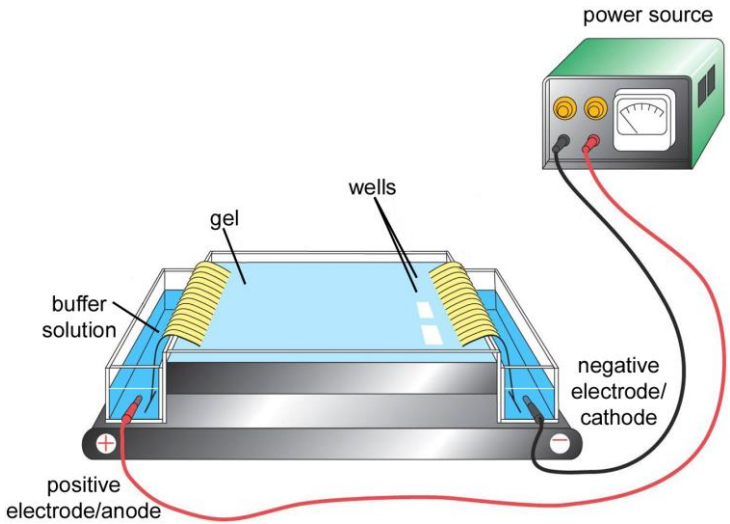
Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Marks	Guidance
1	(a)		*Any two from:* Isolate affected patients; Hospital staff wear gloves; Hospital staff wear masks; Hospital staff wash hands (when caring for patient/when on ward/regularly); Hospital environment cleaned thoroughly/with disinfectant/kept clean; Transfer of patients between wards kept to a minimum;	2	Ignore anti bacterial
	(b)	(i)	*Any two from:* Carry out Risk Assessment; Wear gloves /wear mask/avoid contact with blood; Follow standard procedures strictly; Caution when handling (hypodermic) needles/use sterilised needles; Answers related to keeping the camel restrained;	2	
		(ii)	*Any two from:* Staff trained in necessary procedures; Wear gloves /wear mask/ avoid contact with blood; Follow (organisational) guidance / adhere to (organisational) regulations; Use good laboratory practice/no eating / no drinking / no smoking; Avoid splashes/work in biological safety cabinet if splashes likely to occur; Decontaminate work surfaces after work/sterilise/autoclave wastes;	2	

Question			Answer	Marks	Guidance
	(c)	(i)	*Any two from:* Refer to recorded procedures used in 1992, or wtte; Refer to scientists' findings from 1992; Collected / sampled and treated in identical way; Appropriate and detailed labelling of sample; Avoid any processing (in 1992) likely to affect subsequent analysis;	2	**ALLOW** specific example of treating in same way
		(ii)	**Storage** *Any two from:* Separate components of blood / separate cells, plasma, serum; Freeze components of blood / store at -80 °C; Store in regulation locations / separate from other samples; **Explanation** To reduce microbial degradation / degradation of blood by microorganisms / to maintain presence of virus/to prevent cross contamination;	3	One mark is awarded for the explanation.
	(d)	(i)	(DNA analysis) must be carried out in an accredited laboratory to ensure traceability of analysis / equipment used in analysis / that same procedures are followed (to ensure consistency of analysis), or wtte;	1	**ALLOW** appropriate facilities not available in country of origin/other labs are more specialised or have better equipment.

Question			Answer	Marks	Guidance
		(ii)	*Any two from:* According to regulations; Have a hazard warning label / GHS hazard pictogram; Approved packaging / triple layer packaging (leak-proof primary container containing absorbent material, leak-proof secondary container, outer, rigid packaging); Temperature control as required; With appropriate documentation / paperwork / includes details of sender and recipient; Includes description of contents; By specialist carrier;	2	**ALLOW** references to 'biohazard' labelling.
		(iii)	representative;	1	>1 tick = 0 marks
			Total	**15**	

Question			Answer	Marks	Guidance
2	(a)		Determine/approximate the amount present; Check the quality of DNA present/check that DNA has not been degraded;	2	
	(b)		*Any two from:* Primers added (to copy specific DNA sequence); Nucleotides added; Polymerase added; DNA/mixture heated and cooled in cycles; DNA helix separates; adds complementary nucleotides adjacent to / on locating primer; Cycle repeated many times / specified number (to produce many copies);	2	Maximum 1 mark if RNA mentioned

Question			Answer	Marks	Guidance
	(c)	(i)	*Any four from:* Add buffer to chamber; Place the gel in the (electrophoretic) chamber; With wells closest to negative electrode/cathode; Load wells of (agarose) gel with (DNA) sample(s); And tracking dye; Place the lid on the chamber; Connect electrodes to power supply/turn on/run current through; Allow to run for requisite period of time/until separation achieved/dye crosses gel; **Example drawing**  	4	**ALLOW** differences in learners' sequencing of procedure. Learners may describe a procedure where the gel is run in the vertical plane; the principles are the same. **ALLOW** 2 marks max. for clear and correct use of a drawing.

Question			Answer	Marks	Guidance
		(ii)	*Any three from:* Electric field applied (to gel with DNA fragments); Gel has pores; DNA is negatively-charged; (DNA fragments) move towards positive electrode / anode; Fragments separated according to size / speed at which fragments move is inversely proportional to length/larger fragments can't pass through gel easily;	3	
	(d)		**FIRST CHECK THE ANSWER LINE** **If answer = 666 award 3 marks** Mass genome = 6pg = 0.006ng; Mass of DNA sample = 400ng ÷100µl = 4ng μl^{-1}; 4 ÷ 0.0006 = 666.66 so ….. (number of complete genomes in sample =) 666;	3	
	(e)		(Paper/thin-layer/gas/high-performance liquid) chromatography;	1	
			Total	**15**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>3</td><td>(a)</td><td>(i)</td><td>Any four from:
(Platinum) wire (loop) cleaned in flame;
Dipped into concentrated hydrochloric acid;
Dipped in powdered alga/Spirulina;
Placed in non-luminous/blue Bunsen flame;
Flame colour observed;</td><td>4</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td><table><tr><th>cation</th><th>colour in a flame</th></tr><tr><td>calcium</td><td>brick-red</td></tr><tr><td>potassium</td><td>lilac</td></tr><tr><td>sodium</td><td>yellow</td></tr></table></td><td>3</td><td>AWARD one mark for each correct row.

ALLOW acceptable, alternative descriptions of flame colours.</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Any two from:
Not all the elements in Spirulina give flame colours;
Not suitable for analysing more than one element/cation at once;
Intensity of sodium flame masks others;
Concentration of element/cation too low;</td><td>2</td><td></td></tr>
</table>

Question			Answer	Marks	Guidance
	(b)		**[Level 3]** Candidate shows a high level of understanding of the principles of ICP-AES and explains the advantages of using this technique. ***(5 – 6 marks)*** **[Level 2]** Candidate shows an understanding of the principles of ICP-AES, with knowledge of some advantages of this technique. ***(3 – 4 marks)*** **[Level 1]** Candidate shows a basic understanding of the principles of ICP-AES and with little or no explanation. ***(1 – 2 marks)*** **[Level 0]** Candidate includes **fewer than two** valid points. ***(0 marks)***	6	**Valid points:** **Principles of ICP-AES** • Sample dissolved/liquid sample nebulised • Plasma source/argon plasma at 7000 K – 10 000 K used to dissociate/split sample into constituent atoms/ions • Excites electrons to higher energy levels • On return to ground state, emit photons of wavelength characteristic of element • Light recorded on optical spectrometer • Intensity is proportional to concentration of element in sample • Light emitted compared with calibrated standard to give quantitative analysis of sample **Improved analysis** • Very low limits of detection • Multi-element analysis/Many elements can be analysed using this technique • Wide analytical range • High speed/sample throughput • Can be left unattended/no flammable gases involved
			Total	**15**	

Question			Answer	Marks	Guidance
4	(a)	(i)	$HC_6H_7O_6$ (+ NaOH) → ($NaC_6H_7O_6$ +) H_2O	2	1 mark for the missing reactant 1 mark for missing product
		(ii)	**Indicator** Thymol blue; **Justification** End point/equivalence point lies within colour range of thymol blue;	1 1	If indicator is incorrect no marks awarded
	(b)	(i)	*Any two from:* Make up solution of sodium hydroxide solution at approximate concentration required; Standardise; With potassium hydrogen phthalate of known concentration;	2	**ALLOW** standardisation with hydrochloric acid.
		(ii)	graduated pipette;	1	>1 tick = 0 marks
	(c)	(i)	Volumes: 24.00 23.65; 23.70; 23.60 Average: 23.65;	1	All answers must be correct for one mark. **DO NOT ALLOW** average volume based on the inclusion of rough titration.

Question			Answer	Marks	Guidance
		(ii)	**FIRST CHECK THE ANSWER LINE** **If answer = 0.005782 (moles), award 3 marks** Conversion of 23.65 cm^3 to 0.02365 dm^3; Substitution into formula and calculation: $c = 0.2445 \times 0.02365$; = 0.005782 (moles);	3	**ALLOW** ecf stemming from an incorrect average value shown in the table at 4(c)(i).
		(iii)	**FIRST CHECK THE ANSWER LINE** **If answer = 203.67 (mg cm^{-3}), award 3 marks** *Any three from:* 1 mole vitamin C ≡ 1 mole NaOH; ∴0.005782 moles of vitamin C (in conical flask); 0.005782 moles of vitamin C = (0.005782 × 176.12) g = 1.0183 g; = 1.0183 mg (in 5 cm^3) = 1.0183 ÷ 5 mg (in 1 cm^3) = 203.67 (mg cm^{-3});	3	**ALLOW ecf from 4cii**
			Total	**14**	

Question			Answer	Marks	Guidance
5	(a)	(i)	**FIRST CHECK THE ANSWER LINE** **If answer = 100 (nm), award 3 marks** Width of soot particle = 12 mm on micrograph; = 12 000 000 nm (magnification = × 120 000) ∴ actual size = $\left(\frac{12\ 000\ 000}{120\ 000}\right)$ nm ; = 100 (nm); **OR** (working in millimetres) (Width of soot particle = 12 mm on micrograph) (magnification = × 120 000) ∴ actual size = $\left(\frac{12}{120\ 000}\right)$ nm ; = 0.0001 mm; = 100 (nm);	3	**Allow** measurement between 12 and13mm
		(ii)	Any two from Better resolution (than light microscopy or scanning electron microscopy); Higher magnification possible (than light microscopy or scanning electron microscopy); No requirement to see surface of structures (as provided by scanning electron microscopy);	2	Comparison of magnification needed.

Question			Answer	Marks	Guidance
	(b)	**(i)**	Length of particle represented by 62.5 mm on micrograph; Choice of suitable length of scale bar, e.g. equivalent to **50** µm; Correct calculation of length of this scale bar (represented by $\left(\frac{50}{125} \times 62.5\right)\ mm$ = 25 mm; Accurately drawn and labelled scale bar;	4	**If scale bar = 25 mm in length, and labelled, 50 µm (or suitable alternative), award max.2 marks if working is not shown.** **If scale bar drawn =62.5 mm in length and labelled 125 µm award max 1 mark if working is not shown** **ALLOW** measurement = 27.5 ± 1 mm **Accept** measurement = 62.5 ± 1 mm.
		(ii)	Light (microscopy); Use of incident light;	2	
	(c)		*Any two from:* Staining aids identification of different types of cells; Technique reveals internal structure showing dust particles; No magnification higher than that obtained by LM required; Resolution by LM is adequate	2	
	(d)		**FIRST CHECK THE ANSWER** **If answer = 0.37 (µm), award 2 marks** Substitution into formula: $\varepsilon = 0.61 \times \frac{\lambda}{N.A} = 0.61 \times \frac{0.55}{0.90} = 0.37\ \mu m$; = 0.37 (µm);	2	Allow upto four decimal places
			Total	**15**	

Question			Answer	Marks	Guidance
6	(a)		**[Level 3]** Candidate shows a high level of understanding and gives a good description of necessary components of aseptic technique to isolate the bacterium and check for the purity of the colonies in the culture produced. ***(5 – 6 marks)*** **[Level 2]** Candidate shows an understanding of how to use aseptic technique to isolate the bacterium. ***(3 – 4 marks)*** **[Level 1]** Candidate shows a basic understanding of how to use aseptic technique to isolate the bacterium and with little or no detail in the description. ***(1 – 2 marks)*** **[Level 0]** Candidate includes **fewer than two** valid points. ***(0 marks)***	6	**Valid points:** **Taking sample of bacteria from bottle and plating** • Prepare suitable medium for growth of bacterium/ *Ideonella sakaiensis* • Plausible suggestion for growth medium, e.g. sterile sheet/film of PET in Petri dish/ use scientific literature to find suitable medium suitable/ use a range of media with different metabolic substrates • Sterilise work surface • Sterilise medium • Pour sterile agar plates • Sterilise inoculating loop • Use inoculating loop to remove sample from bottle • Streak Petri dish/ agar plate in appropriate manner to obtain single, isolate colonies • Seal culture appropriately • Incubate at appropriate temperature/ at temperature of environment where bacterium found DO NOT ALLOW specified temperature **Isolation of bacterium/*Ideonella sakaiensis*** • Sterilise inoculating loop • Pick up loopful of bacterium • From one of single/isolated ‘dominant’ colonies • Streak Petri dish

Question			Answer	Marks	Guidance
					• With fresh, sterile PET/ agar plate • Seal culture appropriately • Incubate at appropriate temperature/ at temperature of environment where bacterium found **Checking for purity of colonies** • Suitable method, e.g. check colony morphology/ examine microscopically (with oil immersion)
	(b)	**(i)**	*Any two from:* Prevent contamination of culture; Prevent contamination of environment; Prevent contamination/illness of operator;	2	Allow 1 mark maximum for unqualified contamination
		(ii)	*Any two examples from:* Cell/tissue culture / growth of plant explants; Blood samples; Production of pharmaceuticals; Medical/surgical procedures;	2	
	(c)		*Any two from:* Follow standard procedures for disposal; Wrapped in aluminium foil/placed in autoclaving bag; Autoclaved; Disposed of by appropriate agency / procedure in organisation; Keep/maintain disposal records;	2	**IGNORE** responses indicating that the PET bottle is burned.
	(d)	**(i)**	50;	1	**DO NOT CREDIT** unless it is to TWO significant figures.
		(ii)	**FIRST CHECK THE ANSWER** **If answer = 200 000 mm^{-3}, award 3 marks** **If answer is 200 000 but unit is incorrect award 2 marks**	3	**ALLOW** one mark for correct units, even with the incorrect concentration.

Question			Answer	Marks	Guidance
			Volume of cell = 0.05 mm × 0.05 mm × 0.10 mm = 0.00025 mm^3; (Mean cell count = 50 cells in 0.00025 mm^3) ∴ concentration = $\left(\frac{50}{0.00025}\right)$ $cells\ mm^{-3}$ = 200 000 mm^{-3};		**ECF** from di
			Total	**16**	

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