



Cambridge Technicals IT

Unit 2: Laboratory Techniques

Level 3 Cambridge Technical in Science for Technicians

Mark Scheme for June 2017

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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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Question			Answer	Marks	Guidance
1	(a)	(i)	<p>Hazard: Pathogenic/disease causing / microorganisms/bacteria;</p> <p>Risk: infection (of laboratory worker);</p> <p>Control measure: aseptic technique/swabbing bench/good hygiene/washing hands after work;</p>	3	<p>Ignore food poisoning for risk</p> <p>Allow disinfectant/disinfecting</p> <p>Ignore gloves</p> <p>Ignore dispose of carefully</p> <p>mark independently</p>
		(ii)	<p>Hazard: Enzymes;</p> <p>Risk: Allergic reaction/ sensitising/ irritation/dermatitis;</p> <p>Control measure: Avoid contact with skin/exposure to washing powder/avoid breathing dust;</p>	3	<p>Do not allow answers related to bacteria</p> <p>Allow degradation of body tissue = risk</p> <p>Allow wear gloves = control</p> <p>Ignore dispose of carefully</p>
		(iii)	<p>Hazard: X-rays/ionizing radiation/irradiation;</p> <p>Risk: Damage to DNA/ carcinogenic/ teratogenic/ cell death/mutation;</p> <p>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;</p>	3	<p>Allow cells killed/cells become cancerous/cancer/radiation poisoning</p> <p>Allow wear protective clothing</p> <p>Allow radiographer stands outside room/behind screen</p> <p>Ignore dispose of carefully</p>

Question		Answer	Marks	Guidance
	(b)	<p><i>Any three from:</i></p> <p>Accepted measurement system in place;</p> <p>Evaluation of measurement system/assessment of uncertainty/comparison with standard measurement system;</p> <p>Use of accepted equipment;</p> <p>Traceability of reference solutions/buffer solutions (for calibration);</p> <p>Internal laboratory monitoring programme of measurement system/reference materials;</p> <p>Lab establishes unbroken chain of comparison with standards;</p>	3	Allow calibrate with known pH solutions
	(c)	<p>Enclose in biohazard/autoclaving bag/container;</p> <p>Sterilise/autoclave (at 121 °C for 15 minutes);</p> <p>Dispose of according to laboratory guidelines/in general waste.</p>	3	only allow MP3 for in general waste if either MP 1 or 2 already awarded
		Total	15	

Question			Answer	Marks	Guidance
2	(a)	(i)	the paper	1	A solid or liquid supported on a solid Reject plate
		(ii)	<i>Any two from:</i> Silica gel; Alumina/aluminium oxide; Cellulose;	2	
		(iii)	Answers related to advantages of TLC/ advantages of paper chromatography. <i>Any three from:</i> 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. <i>Any one from:</i> (Neither) give positive identification; (Usually used as) qualitative technique/(usually) not quantitative;	4	Allow reverse arguments for either Must be a comparison
	(b)		Hexane = 90 (cm ³)	1	All correct = 1 mark.
	(c)		Fluorescence; (Under) ultraviolet light.	2	

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(d)	(i)	<table border="1"> <thead> <tr> <th></th> <th>Distance moved (mm)</th> </tr> </thead> <tbody> <tr> <td>Spot A</td> <td>30</td> </tr> <tr> <td>Spot B</td> <td>39</td> </tr> <tr> <td>Spot C</td> <td>57</td> </tr> <tr> <td>Spot D</td> <td>76</td> </tr> <tr> <td>Spot E</td> <td>118</td> </tr> <tr> <td>Solvent front</td> <td>134</td> </tr> </tbody> </table>		Distance moved (mm)	Spot A	30	Spot B	39	Spot C	57	Spot D	76	Spot E	118	Solvent front	134	1	<p>All correct = 1 mark.</p> <p>Allow measurements up to – 7mm of value given in answer table (due to the shape of the trace).</p>				
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	(iii)	<p>Any two from:</p> <p>Use a series of standards (A-F);</p> <p>Individual lipids;</p> <p>Compare distance travelled by spots;</p>	2	<p>Reject answers related to gas chromatography.</p> <p>Ignore published R_f values</p>																		
Total			15																			

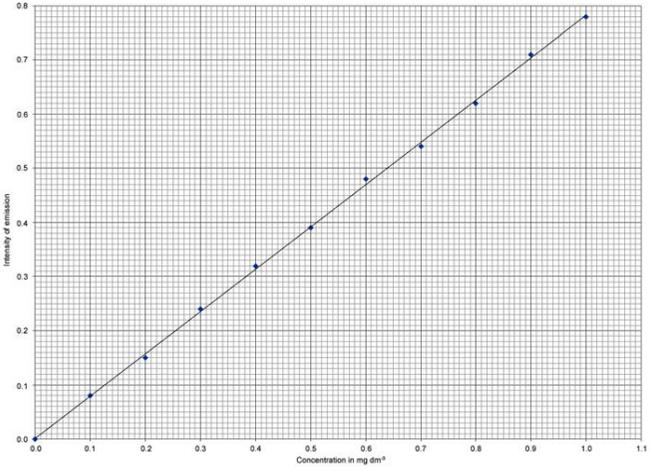
Question		Answer	Marks	Guidance
3	(a)	Phenolphthalein; Reaction is weak acid-strong base; Phenolphthalein changes colour at equivalence point.	3	ECF from first mark point.
	(b)	weak acid; buffer solution; equivalence point; weak alkali; sodium ethanoate and water; strong alkali;	6	Mark using the sequence provided in the answer column.
	(c)	<p>[Level 0] Candidate includes no valid points. (0 marks)</p> <p>[Level 1] 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. (1 – 2 marks)</p> <p>[Level 2] Candidate shows an understanding of how autotitrators work AND why this method is preferred to using an indicator. (3 - 4 marks)</p> <p>[Level 3] 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. (5 – 6 marks)</p>	6	<p>Valid points:</p> <p>Technique:</p> <ul style="list-style-type: none"> • 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 <u>pH/concentration-dependent potential</u> • Concentration of unknown calculated <p>Why technique is preferred:</p> <ul style="list-style-type: none"> • Process is automated • Faster once calibrated • Not affected by coloured analytes

Question			Answer	Marks	Guidance
					Compensatory mark: award no human error/idea it is not subjective if no other mark awarded
			Total	15	

Question			Answer	Marks	Guidance
4	(a)	(i)	Light (microscope)	1	
		(ii)	<p>100 μm on stage micrometer corresponds with 65 divisions on graticule. Therefore, 1 division $\equiv 100/65 = 1.5 \mu\text{m}$;</p> <p>Width of pollen grain = 28 divisions;</p> <p>Therefore, width of pollen grain = $(28 \times 1.5) \mu\text{m} = 42 \mu\text{m}$;</p>	3	<p>Allow 43 μm</p> <p>Make allowances for differences in judgement based on the boundary of pollen grain.</p> <p>ECF</p>
		(iii)	<p><i>Any three from:</i></p> <p>Eyepiece graticule is placed in the eyepiece of microscope;</p> <p>Stage micrometer placed on stage of microscope</p> <p>Appropriate objective selected;</p> <p>Eyepiece graticule rotated to appropriate orientation;</p> <p>Graticule and micrometer lined up so that a suitable distance on the micrometer corresponds with divisions, beginning with whole division on the graticule scale;</p> <p>Reading made from scale on graticule against dimension/ 100 μm, on micrometer;</p>	3	

Question		Answer	Marks	Guidance
	(iv)	<p>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;</p> <p>Choice of suitable length of scale bar, e.g. equivalent to 50 μm/ 100 μm;</p> <p>Correct calculation of length of this scale bar (represented by $\frac{50}{42} \times 14 \text{ mm}$ Or $\frac{100}{42} \times 14 \text{ mm}$, etc.);</p> <p><u>Accurately</u> drawn and <u>labelled</u> scale bar;</p>	4	Accept ecf using answer from (a) (ii).
(b)	(i)	<u>Scanning</u> electron (microscope)/EM	1	Allow SEM
	(ii)	<p><i>Any three from:</i></p> <p>Increased depth of field/3D image;</p> <p>Reveals surface detail;</p> <p>Reveals (triporate) shape of pollen grain;</p> <p>Improved/increased/greater resolution;</p>	3	<p>Ignore references to higher magnification.</p> <p>Ignore cleaner image</p>
Total			15	

Question			Answer	Marks	Guidance
5	(a)	(i)	White precipitate (of lead hydroxide) formed; Precipitate is soluble in excess sodium hydroxide solution; Gives a clear, colourless solution;	3	
		(ii)	Reaction of lead $\text{Pb}^{2+} + 2\text{OH}^{-} \rightarrow \text{Pb}(\text{OH})_2;$ With excess hydroxide $\text{Pb}(\text{OH})_2 + 2\text{OH}^{-} \rightarrow [\text{Pb}(\text{OH})_4]^{2-};$	2	
		(iii)	Aluminium;	1	Allow Al^{3+}
	(b)	(i)	Quantitative technique; Measures concentration to very low levels; All/almost all elements can be analysed at same time/no interference;	3	
		(ii)	<i>Any two from:</i> Concentration <u>has defined degree</u> (or wtte) of accuracy; Ensures that standards are the same degree of accuracy <u>each time</u> ; Adds traceability to analyses;	2	Ignore answers related simply to accuracy. Allow reliable for same degree of accuracy each time
		(iii)	Correct axes and units; Points plotted correctly; Appropriate line of best fit;	1 2 1	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.

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	 <table border="1"><caption>Data points from the graph</caption><thead><tr><th>Concentration in mg dm⁻³</th><th>Intensity of emission</th></tr></thead><tbody><tr><td>0.0</td><td>0.0</td></tr><tr><td>0.1</td><td>0.08</td></tr><tr><td>0.2</td><td>0.15</td></tr><tr><td>0.3</td><td>0.23</td></tr><tr><td>0.4</td><td>0.31</td></tr><tr><td>0.5</td><td>0.39</td></tr><tr><td>0.6</td><td>0.47</td></tr><tr><td>0.7</td><td>0.55</td></tr><tr><td>0.8</td><td>0.63</td></tr><tr><td>0.9</td><td>0.71</td></tr><tr><td>1.0</td><td>0.79</td></tr></tbody></table>	Concentration in mg dm ⁻³	Intensity of emission	0.0	0.0	0.1	0.08	0.2	0.15	0.3	0.23	0.4	0.31	0.5	0.39	0.6	0.47	0.7	0.55	0.8	0.63	0.9	0.71	1.0	0.79		
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6	(a)	(i)	<p><i>Any two from:</i></p> <p>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);</p>	2	Allow pathogens are harmful
		(ii)	<p><i>Any two from:</i></p> <p>Sterile working area; Good personal hygiene; Sterile media and reagents; Sterile handling/glassware/equipment;</p>	2	Allow disinfection of working area
	(b)	(i)	<p><i>Any four from:</i></p> <p>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;</p>	4	
		(ii)	<p><i>Any three from:</i></p> <p>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;</p>	3	<p>Accept answers relating to affecting manufacturer warranties.</p> <p>Ignore alter results unqualified</p>

Question		Answer	Marks	Guidance
(c)	(i)	<i>Any two from:</i> Wrap in aluminium foil; Sterilise in autoclave; Keep wrapped until required;	2	
	(ii)	(For media made up unsterile) Sterilise in autoclave;	1	
	(iii)	(Swabbed/wiped) with (70%) ethanol/autoclave;	1	
		Total	15	

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