



## **Cambridge Technicals**

### **Laboratory Skills**

Unit 1: Science fundamentals

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

## **Mark Scheme for January 2018**

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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)	20 <input type="checkbox"/> 20 <input type="checkbox"/>	2	
	(b)	same number of protons / element <b>AND</b> different numbers of neutrons <input type="checkbox"/>	1	<b>ALLOW</b> mass/nucleon number / relative atomic mass = neutron number
	(c)	(extra) neutrons <input type="checkbox"/>  outside of the valley of stability <input type="checkbox"/>  (strong) nuclear force / nucleon-nucleon interaction <input type="checkbox"/>  strong nuclear force greater than repulsion <input type="checkbox"/>	4	<b>ALLOW</b> statement to effect that Ca-40 and Ca-51 have same number of protons but different mass as AW neutrons <b>ALLOW</b> statement to effect linking mp1 to instability of Ca-51 <b>IGNORE</b> strong force, unqualified <b>ALLOW</b> strong nuclear force not strong enough to hold the nucleus together /AW.M <b>ALLOW</b> weak (nuclear) force causes beta decay (to make the nucleus more stable)
	(d)	<b>FIRST CHECK THE ANSWER ON THE ANSWER LINE</b> <b>If answer = <math>2 \times 10^{-10}</math> m award 3 marks</b>  on Fig. 1.1 vertical line at 20 and horizontal line to y-axis <input type="checkbox"/>  $2 \times 10^{-10}$ <input type="checkbox"/>  m <input type="checkbox"/>	3	<b>ALLOW</b> $200 \times 10^{-12}$ / $194 \times 10^{-12}$ m OR $2 \times 10^{-8}$ cm OR $2 \times 10^{-7}$ mm OR $2 \times 10^{-1}$ nm = 3 marks  <b>ALLOW</b> 0.2 nm = 1 mark
	(e) (i)	2 <input type="checkbox"/>	1	
	(ii)	$\text{PO}_4^{3-}$ <input type="checkbox"/>	1	
	(iii)	covalent <b>between</b> phosphorous and oxygen <input type="checkbox"/>  ionic <b>between</b> calcium and phosphate/phosphorous and oxygen group <input type="checkbox"/>	2	<b>ALLOW</b> covalent in the phosphate ion <b>ALLOW</b> symbols  <b>ALLOW</b> for one mark max. - ionic between metal and non-metal <b>OR</b> covalent between non-metals
<b>Total</b>			<b>14</b>	

Question		Answer	Marks	Guidance
2	(a) (i)	<p>Any four from:            increased light intensity linked to greater biomass            (= <b>overall</b> observation) <input type="checkbox"/></p> <p><b>initial increase</b> in rate of biomass production (0.48 to 0.74) <input type="checkbox"/>            as light intensity changes from 0 – 30 <math>\mu\text{mol m}^{-2} \text{s}^{-1}</math> <input type="checkbox"/></p> <p><b>decrease</b> in rate of biomass production (0.74 to 0.73) <input type="checkbox"/>            as light intensity changes 30 – 60 <math>\mu\text{mol m}^{-2} \text{s}^{-1}</math> <input type="checkbox"/></p> <p><b>increase</b> in rate of biomass production (0.74 to 0.84) <input type="checkbox"/>            as light intensity changes 30/60 – 120 <math>\mu\text{mol m}^{-2} \text{s}^{-1}</math> <input type="checkbox"/></p> <p><b>peak</b> at biomass of 0.85 <input type="checkbox"/>            at light intensity 120/145 <math>\mu\text{mol m}^{-2} \text{s}^{-1}</math> <input type="checkbox"/></p> <p><b>final decrease</b> in rate of biomass production (0.85 to 0.82) <input type="checkbox"/>            as light intensity changes 120 - 200 <math>\mu\text{mol m}^{-2} \text{s}^{-1}</math> <input type="checkbox"/></p>	4	<p><b>ALLOW</b> biomass differs/changes with increased light intensity</p> <p><b>ALLOW</b> any value between 120 to 145 <math>\mu\text{mol m}^{-2} \text{s}^{-1}</math></p>
	(ii)	<p>Any four from:            physical state <input type="checkbox"/>            temperature <input type="checkbox"/>            pressure <input type="checkbox"/>            solvents <input type="checkbox"/>            catalysts/enzymes <input type="checkbox"/>            surface area <input type="checkbox"/>            electromagnetic radiation <input type="checkbox"/>            concentration (of reactants) <input type="checkbox"/></p>	4	<p><b>REJECT</b> light intensity</p> <p><b>ALLOW</b> heat = temperature</p> <p><b>ALLOW</b> stirring/agitation</p>
	(b) (i)	<p>oxidation/redox <input type="checkbox"/>            2H removed <input type="checkbox"/>            (to form) C=O/double bond/illustration of this <input type="checkbox"/></p>	3	<p><b>ALLOW</b> highlight of double bond on Fig. 2.2, as illustration</p>

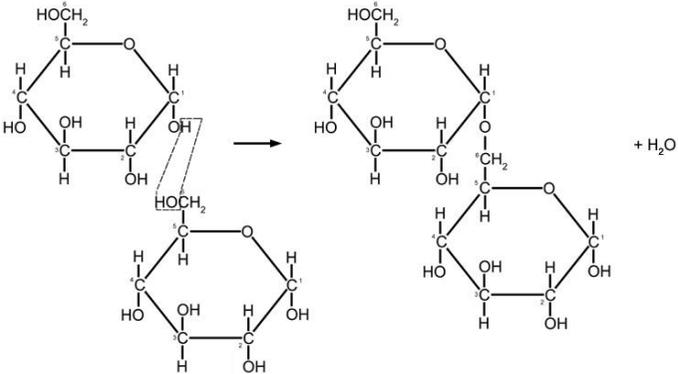
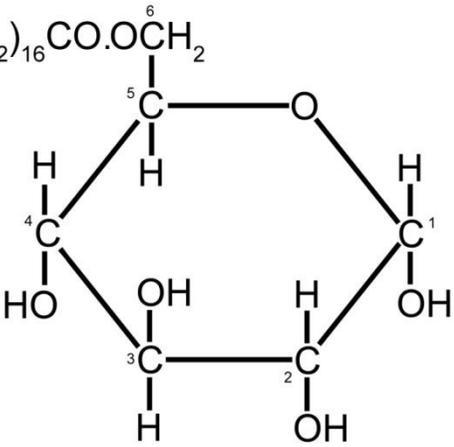
Question	Answer	Marks	Guidance
(ii)	<p>two correct reactants <input type="checkbox"/></p> <p>correct bond (shown in product) <input type="checkbox"/></p> <p>water molecule released <input type="checkbox"/></p> $  \begin{array}{c}  \text{CH}_3 \qquad \text{CH}_3 \qquad \text{CH}_3 \\    \qquad \quad   \qquad \quad   \\  \text{HO}-\text{C}-\text{C}-\text{OH} \quad \text{HO}-\text{C}-\text{C}-\text{OH} \quad \text{HO}-\text{C}-\text{C}-\text{OH} \\    \qquad \quad    \qquad \quad   \qquad \quad    \qquad \quad   \qquad \quad    \\  \text{H} \qquad \quad \text{O} \qquad \quad \text{H} \qquad \quad \text{O} \qquad \quad \text{H} \qquad \quad \text{O}  \end{array}  $ <p style="text-align: center;">↓</p> $  \begin{array}{c}  \text{CH}_3 \qquad \text{CH}_3 \qquad \text{CH}_3 \\    \qquad \quad   \qquad \quad   \\  \text{HO}-\text{C}-\text{C}-\text{O}-\text{C}-\text{C}-\text{O}-\text{C}-\text{C}-\text{OH} + 2\text{H}_2\text{O} \\    \qquad \quad    \qquad \quad   \qquad \quad    \qquad \quad   \qquad \quad    \\  \text{H} \qquad \quad \text{O} \qquad \quad \text{H} \qquad \quad \text{O} \qquad \quad \text{H} \qquad \quad \text{O}  \end{array}  $	3	<p><b>NOTE</b> – the models shown in the expected answer indicate the reaction for <b>three</b> lactic acid molecules BUT the response only requires <b>two</b> lactic acid molecules with the release of <b>one</b> water molecule.</p>
	<b>Total</b>	<b>14</b>	

Question		Answer	Marks	Guidance
3	(a)	<p><b>[Level 3]</b> Candidate shows a high level of understanding and gives a good description of the structure of different types of epithelial tissue and how this is related to their function. <i>(5 – 6 marks)</i></p> <p><b>[Level 2]</b> Candidate shows an understanding of the structure of some different functions of epithelial tissue and how this is related to their basic function. <i>(3 – 4 marks)</i></p> <p><b>[Level 1]</b> Candidate shows a basic understanding of the structure of epithelial tissues and how this is related to their basic function, but with little or no explanation. <i>(1 – 2 marks)</i></p> <p><b>[Level 0]</b> Candidate includes <b>fewer than two</b> valid points. <i>(0 marks)</i></p>	6	<p><b>valid points:</b></p> <p><b>basic structure</b></p> <ul style="list-style-type: none"> <li>• Tissues are collections of similar/identical cells sharing a common function</li> <li>• Epithelia are tissues that cover flat surfaces in the body</li> <li>• Any correctly named example of epithelial tissue e.g. ciliated, alveolus, skin, (micro)villi and line cavities</li> <li>• Cells of epithelia, are bound together / form sheets</li> <li>• Supported by basement membrane/basal lamina</li> </ul> <p><b>different functions</b></p> <ul style="list-style-type: none"> <li>• Can become specialised, e.g. as sensory receptors;</li> <li>• Replicate to replace damaged/dead cells/striated epithelium to resist wear and tear;</li> <li>• Aid in transport/absorption, e.g. intestinal epithelium;</li> <li>• Female reproductive organs/respiratory system lined with ciliated epithelium to remove foreign bodies</li> <li>• Goblet cells in some epithelia secrete mucus for lubrication/protection.</li> <li>• Epithelial cells slough off so dead cells are replaced e.g. skin surface, digestive tract</li> </ul> <p><b>detailed features</b></p> <ul style="list-style-type: none"> <li>• Several types of interaction exist between adjacent cells (tight junctions, adherens, desmosomes, gap junctions)</li> <li>• Tight junctions delineate and enable polarisation of cells</li> <li>• Capillary bed below (basal lamina) and capillaries are not found within the tissue</li> <li>• Can be innervated by neurons</li> <li>• Nucleus in each cell is found towards basal surface</li> </ul>



Question		Answer	Marks	Guidance
		transcription/involved in gene expression/regulation <input type="checkbox"/>		
	(c)	<b>cancerous cells</b>  <i>any two from:</i> large nuclei <input type="checkbox"/> (some) cells contain two/extra nuclei <input type="checkbox"/> cells are less folded / more spread out / regular-shaped <input type="checkbox"/> (may be) dividing <input type="checkbox"/>	2	<b>ALLOW</b> visa versa for normal/non-cancerous cells  <b>ASSUME</b> that response refers to normal cells if not qualified  <b>IGNORE</b> less dense cells
		<b>Total</b>	<b>17</b>	

Question			Answer	Marks	Guidance
4	(a)	(i)	aldehyde <input type="checkbox"/>	1	<b>ALLOW</b> phonetic spellings
		(ii)	16 <input type="checkbox"/> Any <b>one</b> from: (four) asymmetric/chiral carbon atoms <input type="checkbox"/> number of isomers = $2^n$ (where n = number of asymmetric C atoms) <input type="checkbox"/>	2	<b>MARK</b> explanation independent of isomer number  <b>ALLOW</b> an illustration of the chiral carbon atoms on Fig.4.1 e.g circles, ticks or arrows
		(iii)	any two correct isomers <input type="checkbox"/> <input type="checkbox"/>	2	<b>NOTE</b> - the two isomers need to show any rotation around C atoms 2-5.
		(iv)	32 <input type="checkbox"/> Any <b>one</b> from: <b>additional</b> asymmetric C atom/chiral centre <input type="checkbox"/> on C atom 1 <input type="checkbox"/>	2	<b>ALLOW</b> 'C atom 1 is chiral too' <b>ALLOW</b> an illustration of the chiral property of C atom 1 on Fig. 4.2 eg. circle, tick or arrow
	(b)	(i)		4	1 mark for reactants / correct alignment <input type="checkbox"/> 1 mark for products <input type="checkbox"/> 1 mark for showing how glycosidic linkage is formed / H and OH highlighted on carbons 1 and 4 <input type="checkbox"/> 1 mark for release of water <input type="checkbox"/>

Question		Answer	Marks	Guidance
	(ii)		4	1 mark for reactants / correct alignment <input type="checkbox"/> 1 mark for products <input type="checkbox"/> 1 mark for showing how glycosidic linkage is formed / H and OH highlighted on carbons 1 and 6 <input type="checkbox"/> 1 mark for release of water <input type="checkbox"/>
	(iii)	glycogen <input type="checkbox"/>	1	<b>ALLOW</b> phonetic spelling
	(c)	$\text{CH}_3(\text{CH}_2)_{16}\text{CO.OCH}_2$ 	1	<b>NOTE</b> - care should be taken over correct alternative representations of ester link.
		<b>Total</b>	<b>17</b>	

Question			Answer	Marks	Guidance
5	(a)	(i)	nitrate <input type="checkbox"/>	1	<b>ALLOW</b> NO <sub>3</sub> <sup>-</sup>
		(ii)	component of DNA <input type="checkbox"/> used in protein synthesis <input type="checkbox"/>	2	
		(iii)	<b>increases</b> for nitrogen/potassium/magnesium <input type="checkbox"/> <b>stays the same</b> /does not change for phosphorus,/calcium/iron/copper/manganese <input type="checkbox"/>	1 1	<b>ALLOW</b> 'trace elements' = iron, copper, and manganese
		(iv)	nitrogen AND potassium <input type="checkbox"/> requirement increases most / correct ref. to values (during fruit production) <input type="checkbox"/>	2	<b>ALLOW</b> both increase by 80 ppm <b>ALLOW</b> answers relating to a correct, specific role during fruit development e.g. nitrogen for protein synthesis, cell growth/division or potassium for lycopene formation, transportation of sugars, flower number
		(v)	<i>Any two from:</i> needed for photosynthesis <input type="checkbox"/> photosynthesis is essential for plant growth <input type="checkbox"/> involved in photosystem II/PSII/photolysis (of water) <input type="checkbox"/> acts as a cofactor of various enzymes <input type="checkbox"/> in (multiple steps) in the synthesis of fatty acids/ acylglycerols/ glycerides <input type="checkbox"/>	2	<b>ignore</b> answers related to deficiencies. <b>allow</b> oxygen production or photosynthetic electron transport = photosynthesis  <b>ALLOW</b> water splitting = photolysis
	(b)	(i)	$2\text{NH}_4^+ + 4\text{O}_2 \rightarrow 2\text{NO}_2^- + 4\text{H}_2\text{O}$ <input type="checkbox"/> $2\text{NO}_2^- + \text{O}_2 \rightarrow 2\text{NO}_3^-$ <input type="checkbox"/>	2	1 mark for each reaction correctly balanced;
		(ii)	<i>Any one from:</i> <b>greatest/highest</b> lettuce mass at 5 kg m <sup>-3</sup> <input type="checkbox"/> fish density from 2 to 5 kg m <sup>-3</sup> <b>increases</b> lettuce growth/dry mass <input type="checkbox"/> fish density from 5.0 to 8.0 kg m <sup>-3</sup> <b>decreases</b> lettuce growth/dry mass <input type="checkbox"/>  <i>Any one from:</i> numerical description of 6.3 – 7.1 g <input type="checkbox"/> numerical description of 7.1 – 5.65 g <input type="checkbox"/>	2	<b>ALLOW</b> one mark max. for direct reference to graph coordinates  <b>ALLOW</b> mark for numerical description <b>ONLY</b> if linked correctly to the first marking point <b>IGNORE</b> references to limiting factors
			<b>Total</b>	<b>13</b>	

Question		Answer	Marks	Guidance
6	(a)	<p><b>similar properties</b></p> <p><i>Any two from:</i></p> <ul style="list-style-type: none"> <li>• strength (tensile) <input type="checkbox"/></li> <li>• elasticity <input type="checkbox"/></li> <li>• flexibility <input type="checkbox"/></li> <li>• chemical resistance <input type="checkbox"/></li> <li>• durability / resistance to tearing/breaking <input type="checkbox"/></li> </ul> <p><b>different properties</b></p> <p><i>Any two from:</i></p> <ul style="list-style-type: none"> <li>• friction/grip with sports shoe/slipping (on top surface) ✓</li> <li>• noise reduction (on bottom surface) ✓</li> <li>• water(sweat) resistant/no absorbency (on top surface) ✓</li> <li>• impact resistance (on top surface) ✓</li> <li>• discharge of static electricity (on top surface) <input type="checkbox"/></li> </ul>	2	<p><b>IGNORE</b> references to <i>wear resistance</i> (already in question stem)</p> <p><b>IGNORE</b> stretches</p> <p><b>IGNORE</b> reference to static charge / electricity</p>
		<p>addition of plasticizers <input type="checkbox"/></p> <p>cross-linking <input type="checkbox"/></p>	2	<p><b>ALLOW</b> reverse argument</p>
<b>Total</b>			<b>6</b>	

Question			Answer	Marks	Guidance
7	(a)	(i)	<b>FIRST CHECK ANSWER ON ANSWER LINE</b> If answer = 250 (V) award 2 marks □□  (V =) $E/Q$ or energy/charge or $10/0.04$ □ 250 (V) □	2	
		(ii)	<b>FIRST CHECK ANSWER ON ANSWER LINE</b> If answer = 2(A) award 2 marks □□  (I =) $Q/t$ or charge ÷ time or $0.04/0.02$ □ 2 (A) □	2	
		(iii)	<b>FIRST CHECK ANSWER ON ANSWER LINE</b> If answer = 500 (W) award 2 marks □□  (P =) $VI$ or voltage x current or $250 \times 2$ □ 500 (W) □  <b>OR</b> (P =) $E/t$ or energy ÷ time or $10/0.02$ (1) □ 500 (W) □	2	<b>ALLOW</b> ecf for using voltage calculated in (a)(i) <b>ALLOW</b> ecf for using current calculated in (a)(ii)
			<b>Total</b>	<b>6</b>	

Question	Answer	Marks	Guidance
8	(11 $\Omega$ =) R1 in series with R2 and R3 in parallel <input type="checkbox"/> (13.75 $\Omega$ =) R2 in series with R1 and R3 in parallel <input type="checkbox"/> (18.3 $\Omega$ =) cannot be produced by any arrangement (of these 3 resistors) <input type="checkbox"/>	3	<b>ALLOW</b> correctly drawn circuit diagrams  <b>ALLOW</b> arrangement of the three resistors gives 18.39/18.4
	<b>Total</b>	<b>3</b>	

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