

**Cambridge Technicals
Applied Science**

Unit 1: Science Fundamentals

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

Mark Scheme for January 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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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

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:

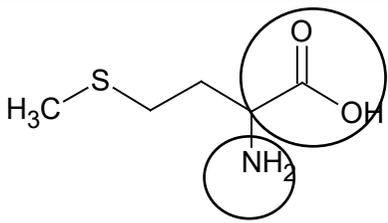
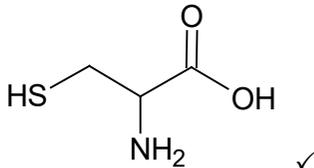
- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

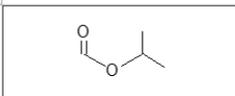
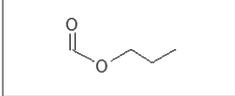
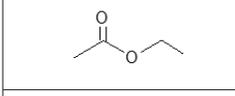
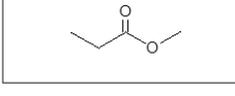
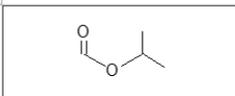
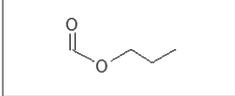
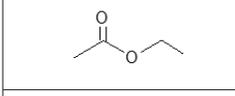
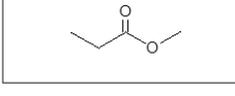
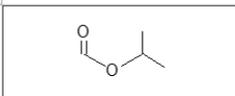
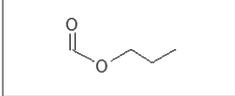
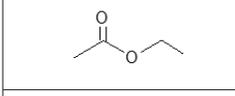
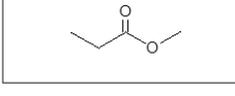
You should ensure that you have copies of these materials.

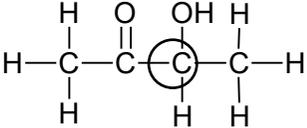
You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New 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)	(i)	(Two or more types/forms of the same element which have the) same number of protons / atomic number ✓ (But) different number of neutrons / mass number ✓	2	IGNORE reference to electrons ALLOW same number of nucleons ALLOW more / less = different
		(ii)	Y has more than one isotope / has isotopes ✓ The relative atomic mass is an average / a mean of all of the isotopes / (the isotopic masses) ✓	2	IGNORE Y is an isotope
		(iii)	7 ✓	1	IGNORE 6.9
		(iv)	W has 1 AND X has 4 ✓	1	
		(v)	copper ✓	1	ALLOW Cu
	(b)		X and Y ✓ W or Z and Y ✓	2	ALLOW responses in any order per line
	(c)	(i)	rings drawn around the dots at 3, 11 and 19 ✓	1	
		(ii)	Any two from: Boron Phosphorus Sulfur ✓✓	2	ALLOW sulphur
		(iii)	Increase in number of protons (from 11 to 18) ✓ Greater (force of) attraction / pull between the nucleus / protons and the (outer shell) electrons ✓	2	ALLOW vice versa if 18-11 IGNORE reference to atomic number IGNORE nuclear force unless qualified
		(iv)	an extra electron shell is added / more shells ✓	1	IGNORE more electrons
Total				15	

Question		Answer	Marks	Guidance
2	(a) (i)	carbon <input type="checkbox"/> nitrogen <input type="checkbox"/> oxygen <input checked="" type="checkbox"/> phosphorus <input type="checkbox"/> ✓	1	
	(ii)	Any two from: Electrons are gained from hydrogen ✓ Electrons are lost from oxygen ✓ (Sulfate ions) lost oxygen ✓ (Sulfur has) gained hydrogen ✓	2	
	(b) (i)	 ✓	1	ALLOW
	(ii)	 ✓	1	DO NOT ALLOW S-H ALLOW H-S
	(c)	Thymine ✓ (Uracil has) a similar structure ✓ (Similar shape / correct position / type of functional groups) so can pair / bond with adenine ✓	3	ALLOW only if an appropriate comparison is made between uracil and thymine (eg C=O and N-H bonds) ALLOW incorrect number / type / position of functional groups to pair with cysteine or guanine
Total			8	

Question			Answer	Marks	Guidance								
3	(a)	(i)	CH_2O <input type="checkbox"/> $\text{C}_3\text{H}_4\text{O}_2$ <input checked="" type="checkbox"/> $\text{C}_3\text{H}_6\text{O}_3$ <input type="checkbox"/> $\text{C}_6\text{H}_8\text{O}_4$ <input type="checkbox"/>	1									
		(ii)	$\begin{array}{c} \text{H} \quad \text{O} \\ \quad \\ \text{H}-\text{O}-\text{C}-\text{C}-\text{O}-\text{H} \\ \\ \text{H}-\text{C}-\text{H} \\ \\ \text{H} \end{array}$	1									
	(b)	(i)	<table border="1"> <tbody> <tr> <td></td> <td></td> </tr> <tr> <td></td> <td></td> </tr> <tr> <td></td> <td>✓</td> </tr> <tr> <td></td> <td></td> </tr> </tbody> </table>						✓			1	
													
													
	✓												
													
		(ii)	<p>Carboxylic acid</p> <p>HCOOH CH_3COOH $\text{CH}_3\text{CH}_2\text{COOH}$</p> <p>Alcohol</p> <p>$\text{CH}_3\text{OH}$ $\text{CH}_3\text{CH}_2\text{OH}$ $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$</p>	2									

Question	Answer	Marks	Guidance
(iii)	Optical / stereoisomerism ✓ Chiral centre / asymmetric carbon / carbon attached to four different groups ✓ (Exists as) two non-superimposable molecules / molecules which are mirror images ✓	3	ALLOW identification of chiral carbon  <p>The diagram shows the structural formula of 2-butanol. It consists of a four-carbon chain. The first carbon is bonded to three hydrogens. The second carbon is bonded to a hydrogen, a hydroxyl group (OH), and a methyl group. The third carbon is bonded to two hydrogens. The fourth carbon is bonded to three hydrogens. The central carbon (C2) is circled to indicate it is the chiral center.</p>
Total		8	

Question		Answer	Marks	Guidance															
4	(a)	X = ovary ✓ Y = testis ✓	2	ALLOW plural. ALLOW testicle DO NOT ALLOW common terms															
	(b)	Any two from: Watery matrix / gel like / environment / region ✓ Bulk of the cell ✓ Site of cell reactions ✓ Location / protection of cell organelles ✓ Cell cytoskeleton ✓ Cell shape / support ✓	2	IGNORE aerobic respiration															
	(c)	Any three from: Site of (aerobic) respiration ✓ Provides / releases energy / produce ATP ✓ (Sperm cells) need lots of energy / ATP ✓ Allows the cell to move / swim (quickly) ✓ Fertilisation of egg / release of acrosome ✓	3	IGNORE produces energy ALLOW to reach egg cell DO NOT ALLOW to reach ovary															
	(d) (i)	Double membrane ✓	1																
	(ii)	<table border="1"> <thead> <tr> <th>Feature</th> <th>Eukaryotic</th> <th>Prokaryotic</th> </tr> </thead> <tbody> <tr> <td>(DNA in a nucleus)</td> <td>(✓)</td> <td></td> </tr> <tr> <td>membrane-bound organelles</td> <td>✓</td> <td></td> </tr> <tr> <td>cell surface membrane</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>mesosome</td> <td></td> <td>✓</td> </tr> </tbody> </table> <p style="text-align: right;">✓ ✓</p>	Feature	Eukaryotic	Prokaryotic	(DNA in a nucleus)	(✓)		membrane-bound organelles	✓		cell surface membrane	✓	✓	mesosome		✓	2	3 correct rows = 2 marks 1 or 2 correct rows = 1 mark
Feature	Eukaryotic	Prokaryotic																	
(DNA in a nucleus)	(✓)																		
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cell surface membrane	✓	✓																	
mesosome		✓																	

Question	Answer	Marks	Guidance
(e)	<p>Release of the egg cell Any two from: day 14 ✓</p> <p>oestrogen at maximum / highest level / peak ✓ progesterone (relatively) low ✓</p> <p>Thickness of the uterus lining Any two from: days 1 to 14 ✓</p> <p>increases as the amount of progesterone / oestrogen increases ✓</p> <p>days 14 – 21 / after ovulation</p> <p>increases, as the amount of progesterone increases / amount of oestrogen fluctuates</p> <p>day 21-23 ✓</p> <p>at a maximum when the amount of progesterone is at a maximum ✓</p> <p>decreases as the amount of, progesterone decreases / oestrogen increases ✓</p> <p>after day 21-23 ✓</p> <p>decreases and the amount of progesterone decrease ✓</p>	4	<p>IGNORE high level unqualified</p> <p>IGNORE higher level</p> <p>ALLOW day mark only if linked to correct statement</p> <p>ALLOW day mark only if linked to correct statement</p> <p>ALLOW day mark only if linked to correct statement</p> <p>ALLOW day mark only if linked to correct statement</p> <p>ALLOW correct reference to oestrogen increase and decrease</p>
Total		14	

Question		Answer	Marks	Guidance												
5	(a)	(i) Polysaccharide ✓	1													
		(ii) Glycosidic ✓	1													
		(iii) Condensation ✓ Polymerisation ✓	2													
		(iv) <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>Carbohydrate</p> <div style="border: 1px solid black; padding: 5px; width: 80px; margin: 10px auto;">Cellulose</div> <div style="border: 1px solid black; padding: 5px; width: 80px; margin: 10px auto;">Starch</div> </div> <div style="text-align: center;"> <p>Function in plant cell</p> <div style="border: 1px solid black; padding: 5px; width: 120px; margin: 10px auto;">Source of energy</div> <div style="border: 1px solid black; padding: 5px; width: 120px; margin: 10px auto;">Structure of cell wall</div> <div style="border: 1px solid black; padding: 5px; width: 120px; margin: 10px auto;">Synthesis of protein</div> <div style="border: 1px solid black; padding: 5px; width: 120px; margin: 10px auto;">Insulation of nerve cells</div> <div style="border: 1px solid black; padding: 5px; width: 120px; margin: 10px auto;">Absorption of light</div> </div> </div> <p style="text-align: right;">✓✓</p>	2													
	(b)	(i) <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="padding: 5px;">Mixture</th> <th style="padding: 5px;">Starch with water</th> <th style="padding: 5px;">Sugar with water</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">Colloid</td> <td style="padding: 5px;">✓</td> <td style="padding: 5px;"></td> </tr> <tr> <td style="padding: 5px;">Suspension</td> <td style="padding: 5px;"></td> <td style="padding: 5px;"></td> </tr> <tr> <td style="padding: 5px;">Solution</td> <td style="padding: 5px;"></td> <td style="padding: 5px;">✓</td> </tr> </tbody> </table> <p style="text-align: right;">✓✓</p>	Mixture	Starch with water	Sugar with water	Colloid	✓		Suspension			Solution		✓	2	MARK via columns
Mixture	Starch with water	Sugar with water														
Colloid	✓															
Suspension																
Solution		✓														
		(ii) pH = 7 ✓	1	ALLOW any value between 6.9 and 7.1												
		(iii) enzyme/amylase (active site) denatures / changes shape ✓ starch (molecule) / substrate can no longer fit (into the active site) ✓	2	ALLOW correct use of <u>labelled</u> diagrams.												

Question	Answer	Marks	Guidance
(iv)	Sugar units / alcohols in starch are all arranged in the same way AND/OR sugar units / alcohols in cellulose alternate in arrangement ✓ C-O-C link in starch points down AND/OR in cellulose C-O-C link alternates between pointing up and down ✓ starch will bind (in active site of) amylase / cellulose will not bind (in active site) of amylase ✓	3	ALLOW flipped = alternate ALLOW flipped = alternate
Total		14	

Question		Answer	Marks	Guidance												
6	(a)	Alloy ✓	1													
	(b)	(i) Reaction would speed up ✓ Nickel would not be used up at the end of the reaction ✓	2	IGNORE references to activation energy												
		(ii) Description Decreases / slower rate of reaction ✓ Explanation More space between the gas particles ✓ Less frequent collisions ✓	3	MARK responses across the description and explanation areas ALLOW larger volume for the gas particles to move. IGNORE references to surface area												
	(c)	(i) <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">The biosynthesis of choline for normal liver function</td> <td style="text-align: center; padding: 2px;">✓</td> </tr> <tr> <td style="padding: 2px;">The formation of bone matrix and cartilage structure</td> <td style="text-align: center; padding: 2px;">✓</td> </tr> <tr> <td style="padding: 2px;">The formation of myofibrils for muscle contraction</td> <td style="text-align: center; padding: 2px;"></td> </tr> <tr> <td style="padding: 2px;">The maintenance of a constant environment in cells</td> <td style="text-align: center; padding: 2px;"></td> </tr> <tr> <td style="padding: 2px;">The transport of carbon dioxide molecules</td> <td style="text-align: center; padding: 2px;"></td> </tr> <tr> <td style="padding: 2px;">The operation of some protein-based transport systems</td> <td style="text-align: center; padding: 2px;">✓</td> </tr> </table> <p style="text-align: right; margin-top: 5px;">✓✓✓</p>	The biosynthesis of choline for normal liver function	✓	The formation of bone matrix and cartilage structure	✓	The formation of myofibrils for muscle contraction		The maintenance of a constant environment in cells		The transport of carbon dioxide molecules		The operation of some protein-based transport systems	✓	3	
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The operation of some protein-based transport systems	✓															
		(ii) Chloroplast ✓	1													
		(iii) Hydrolase ✓ Oxidation ✓ Hydrogen ✓	3	ALLOW response only in the correct order.												
	(d)	(Platinum(II) is a component of the drug) Cisplatin ✓ Used in cancer treatment ✓ Interferes with DNA replication / mitosis / cell division ✓	3	ALLOW other valid medical uses of platinum = 1 max												
Total			16													

Question	Answer	Marks	Guidance
7	<p>[Level 3] Candidate gives a detailed comparison of steel and nylon via graph AND impact of temperature on properties [for steel AND nylon] (5 – 6 marks)</p> <p>[Level 2] Candidate gives limited comparison of steel and nylon via graph AND impact of temperature on properties [for EITHER steel OR nylon] (3 – 4 marks)</p> <p>[Level 1] Candidate gives limited comparison of steel and nylon via graph AND/OR impact of temperature on properties [for EITHER steel OR nylon] (1 – 2 marks)</p> <p>[Level 0] Candidate includes fewer than two valid points with an unstructured answer. (0 marks)</p>	6	<p>Valid points</p> <p>Comparison</p> <ul style="list-style-type: none"> • Energy to break steel <ul style="list-style-type: none"> - goes down between -150 and -100 °C - before going up again - big jump between -50 and 50 °C - approximately constant above 50 °C • Energy to break nylon <ul style="list-style-type: none"> - gradually increases between -150 and 50 °C - increases more rapidly beyond 50 °C • General <ul style="list-style-type: none"> - more energy required to break steel than nylon <p>Properties</p> <ul style="list-style-type: none"> • Strength <ul style="list-style-type: none"> - steel stronger (at all temperatures) ORA for nylon - steel strength approximately constant after 50°C, but nylon strength increases after 50°C - large increase in steel strength between -75°C and 20°C • Brittleness <ul style="list-style-type: none"> - steel becomes more brittle as temperature decreases - nylon becomes more brittle as temperature decreases - steel become less brittle below -100°C • Ductility

Question			Answer	Marks	Guidance
					<ul style="list-style-type: none">- steel becomes more ductile as temperature increases (beyond -50°C)- nylon becomes more ductile as temperature increases (beyond -50°C)- change of ductility per unit temperature for steel is greater than nylon as temperature increase from -50°C to 50°C <p>ALLOW force = energy IGNORE references to melting point, plasticity and elasticity or arrangement of atoms</p>
Total				6	

Question			Answer	Marks	Guidance
8	(a)	(i)	(pd at 0A =) 3.95 (mV) ✓	1	
		(ii)	(3.95 – 2.55 =) 1.4 (mV) ✓	1	ALLOW ecf using response to (a)(i)
		(iii)	FIRST CHECK ANSWER ON ANSWER LINE If answer for r = 200 (mΩ) award 2 marks 1.4 ÷ 0.007 ✓ 200 (mΩ) ✓	2	ALLOW ecf for response to (a)(ii)
	(b)	(i)	FIRST CHECK ANSWER ON ANSWER LINE If answer for power = 0.0296 (W) award 2 marks 3.7 x 0.008 ✓ 0.0296 W ✓	2	
		(ii)	FIRST CHECK ANSWER ON ANSWER LINE If answer for power = 1408 (days) award 3 marks (1 kWh = 1000 x 60 x 60 =) 3,600,000 J ✓ 3.6 MJ ÷ 0.0296 ✓ = 121621621.6 seconds = 1408 (days) ✓	3	ALLOW ecf using response to (b)(i)
Total				9	

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 **Cambridge
Assessment**

