OCR
Oxford Cambridge and RSA

Cambridge Technicals
Applied Science

Unit 1: Science Fundamentals

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

Mark Scheme for January 2021

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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.

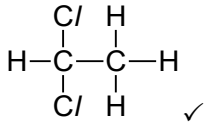
Annotations available in RM Assessor

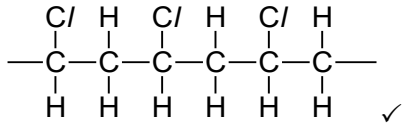
Annotation	Meaning
	Correct response
	Incorrect response
	Omission mark
	Benefit of doubt given
	Contradiction
	Rounding error
	Error in number of significant figures
	Error carried forward
	Level 1
	Level 2
	Level 3
	Benefit of doubt not given
	Noted but no credit given
	Ignore

Question			Answer	Marks	Guidance
1	(a)	(i)	V 2,7 **AND** 9 ✓ W 24 ✓ X 14 ✓ Y 2,8,7 ✓	4	1 mark for each correct row
		(ii)	V and Y ✓	1	**ALLOW** reverse order
		(iii)	W = Mg **AND** Y = C*l* ✓	1	**IGNORE** +/- charges or numerical values
		(iv)	MgCl_2✓	1	**DO NOT ALLOW** MgC*l* or *Cl*$_2$Mg **ALLOW** only correct case
		(v)	The type of bonding between **W** and **Y** is **ionic** ✓ In the compound that is formed, **W** is a **positive** ion and **Y** is a **negative** ion ✓	2	1 mark for each correctly completed sentence. **ALLOW** correct order only
	(b)	(i)	$^{28}_{14}Si$ **OR** $^{14}_{28}Si$ correct element symbol (Si) ✓ correct mass number above, proton number below ✓	2	**IGNORE** 28.1
		(ii)	**Comparison** **Y** has stronger attractive forces / stronger (strong) nuclear force ✓ **Y** has greater repulsive forces / more repulsion ✓ **Explanation for stability** In both nuclei, the strong nuclear force/attractive force is **greater than** the repulsive force **OR** the binding energy per nucleon is sufficient to keep the nucleus together ✓	3	**ORA** for V **ALLOW** stronger attraction **ALLOW** electromagnetic forces **IGNORE** references to electron shells
			Total	**14**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>2</td><td>(a)</td><td>(i)</td><td>
<table>
<tr><th>Formula</th><th>Free radical</th></tr>
<tr><td>CF_3Cl</td><td></td></tr>
<tr><td>CF_3</td><td>✓</td></tr>
<tr><td>Cl</td><td>✓</td></tr>
<tr><td>O_3</td><td></td></tr>
<tr><td>ClO</td><td>✓</td></tr>
<tr><td>O_2</td><td></td></tr>
</table>
✓✓✓</td><td>3</td><td>1 mark for each correct tick.</td></tr>
<tr><td></td><td>(a)</td><td>(ii)</td><td>Increasing the amount / intensity of radiation will increase the rate of reaction ✓

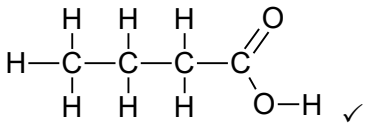
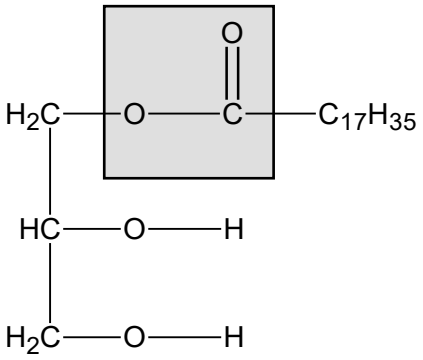
(Ultraviolet / UV / electromagnetic radiation) gives energy ✓</td><td>2</td><td>OWTTE
ALLOW speed = rate

IGNORE heat
IGNORE references to collision rate</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Substitution ✓</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>  ✓ OR $CHCl_2CH_3$</td><td>1</td><td>MUST show
• One carbon with three single bonds to hydrogen
single bonded to
• One carbon with two single bonds to chlorine and one single bond to hydrogen</td></tr>
</table>

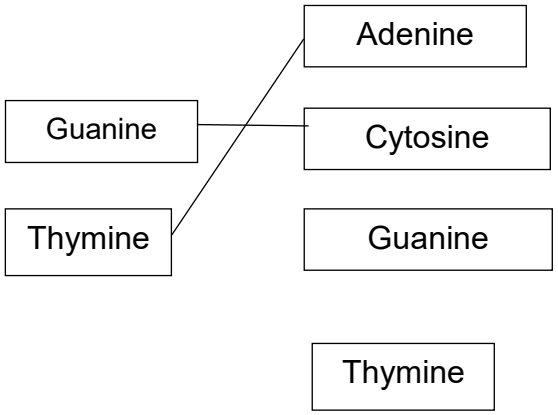
Question			Answer	Marks	Guidance
		(iii)	$CH_2C/CH_2C/$ has **no double bond** ✓ $CHC/=CH_2$ does **not** have two different atoms / groups on both carbons **OR** only one carbon has two different atoms✓	2	**ALLOW** C=C
	(c)	(i)	$C_2H_3C/$ ✓	1	
		(ii)	 ✓	1	**IGNORE** brackets and n **ALLOW** only diagrams showing single bonds at end of chain to next subunit **ALLOW** diagram in reverse order / inverted
		(iii)	**Difference in monomers**: **EITHER**: polylactate monomer has –OH **and** –COOH groups **OR** PVC monomer has a C=C / double bond ✓ **Differences in polymerisation reaction**: **EITHER:** Polylactate monomers: react by condensation (rather than addition) ✓ lose a water molecule / H_2O when combining ✓ **OR** PVC monomers react by addition ✓ Do not lose a water molecule ✓	3	**ALLOW** polylactate monomer has two functional groups **IGNORE** unqualified references to oxygen unless as part of functional groups.
			Total	**14**	

Question			Answer	Marks	Guidance
3	(a)	(i)	Endoplasmic reticulum / ER ✓	1	**IGNORE** smooth / rough / ribosome **DO NOT ALLOW** endoplasmic membrane
		(ii)	ribosomes ✓ protein ✓ lipid **AND** carbohydrate ✓	3	 **ALLOW** *visa versa*
	(b)	(i)	Ca^{2+} ✓	1	
		(ii)	**Link** (osteoporosis) is caused by a lack of / deficiency of mineral / calcium ion / Ca^{2+} / the ion ✓ **Effect** **Any two from:** bone density decreases / bones become more porous / have more gaps ✓ bones become more fragile / more brittle / more likely to fracture / break ✓ bones cannot fully support / protect/move the body effectively ✓	3	Mark **ACROSS** the link and effect sections **ALLOW** (bones become) weaker / softer

Question			Answer	Marks	Guidance
	(c)	**(i)**	(80 × 4 = 320) Spinach ✓	1	
		(ii)	**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 270 (mg) award 2 marks** 50 g of almonds contains 150 mg if magnesium ✓ 420 (mg) – 150 (mg) = 270 (mg) ✓	2	
	(d)		co-factors ✓	1	**IGNORE** to act as catalysts
			Total	**12**	

Question			Answer	Marks	Guidance
4	(a)		 ✓	1	C=O **MUST** be shown **ALLOW** –OH **ALLOW** inverted or reversed diagram
	(b)		$CH_3COOH + NaOH \rightarrow$ **CH_3COONa + H_2O** ✓✓	2	One mark for each correct formula **ALLOW** correct responses in reverse order **IGNORE** 'water' **DO NOT ALLOW** $2H_2O$
	(c)		Alcohol ✓	1	
	(d)	(i)	 **Ester link** / functional group correctly drawn ✓ Rest of molecule correct ✓	2	**ALLOW** ester link and chain on any carbon atom of the glycerol molecule
	(d)	(ii)	**Three** fatty acids / carboxylic acids / ester links ✓	1	
	(d)	(iii)	Energy ✓	1	**ALLOW** heat **DO NOT ALLOW** energy created / produced

Question			Answer	Marks	Guidance
		(iv)	Myelin sheath / insulating layer around, axon / nerve cell / nerve ✓ Increases the rate of nerve transmission ✓	2	**IGNORE** references to synapses **ALLOW** Enables nerve / electrical impulse to travel quickly **ALLOW** enables rapid transmission
		(v)	Insulation / protective layer (around organs) / energy store ✓	1	**ALLOW** correct references to cell (surface) membrane **ALLOW** keeps the body warm **ALLOW** glucose / sugar production / gluconeogenesis
	(e)	(i)	**Deduction/reason** Temperature 1 is higher ✓ The (T1) gradient is steeper **OR** levels off sooner ✓	2	**ALLOW** reverse argument for temperature 2 **ALLOW** more product in less time **ALLOW** correct comparison of quantity of product at a given time **IGNORE** unqualified references to amount of product
		(ii)	(Increase in temperature) increases the rate of reaction ✓ More frequent collisions between particles **OR** more molecules have energy greater than the activation energy ✓	2	 **ALLOW** correct reference to kinetic energy
			Total	**15**	

Question			Answer	Marks	Guidance
5	(a)		double ✓ porous ✓ eukaryotic ✓	3	Reponses **MUST** be in correct sentence.
	(b)		Mitochondrion / chloroplast / lysosome / Golgi apparatus/body / endoplasmic reticulum ✓	1	**IGNORE** the type of endoplasmic reticulum **IGNORE** cell / plasma membrane **DO NOT ALLOW** nucleus, ribosome **ALLOW** vacuole/vesicle
	(c)	(i)	Sugar – Phosphate – Sugar ✓	1	
	(c)	(ii)	**Base 1** **Base 2**  ✓✓	2	One mark for each correct line.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>(c)</td><td>(iii)</td><td>
<table>
<tr><th>Feature</th><th>DNA</th><th>RNA</th></tr>
<tr><td>Type of sugar found</td><td>deoxyribose ✓</td><td>ribose ✓</td></tr>
<tr><td>Four bases found</td><td>thymine
adenine
guanine
cytosine✓</td><td>uracil
adenine
guanine
cytosine✓</td></tr>
</table>
</td><td>4</td><td>ALLOW has an extra OH = ribose (for RNA)

ALLOW use of initials A, C, G, T and U in the correct box</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>11</td><td></td></tr>
</table>

Question			Answer	Marks	Guidance
6			**[Level 3]** Candidate shows a high level of understanding of the structure of bronze **AND** of haemocyanin and how the structure of bronze **AND** haemocyanin affects its use, properties or function. ***(5 – 6 marks)***	6	Valid points: **Bronze** **Structure (arrangement of particles)** - (Alloy / mixture of) copper and tin **atoms** - More copper atoms than tin atoms - Atoms are not in regular layers - Atoms are arranged at random - Tightly packed - Tin atoms are larger than copper atoms **Property/function/use** - Presence of tin makes the bronze more **dense** - Atoms/layers, cannot slide (easily) / move over each other / pinned - Makes the bronze harder / more rigid / stronger - Makes the bronze more durable / difficult to bend out of shape **Haemocyanin** **Structure (arrangement of particles)** - Copper(II) **ions** are in haemocyanin - Large organic molecule / macromolecule / protein - Copper is the prosthetic group - Copper(II) ions are bonded to nitrogen atoms - Two copper ions bond to one oxygen molecule - Covalent bonds between copper ions and oxygen **Property/function/use** - Oxygen molecules enter the invertebrate - Copper has an affinity for oxygen molecules - Haemocyanin is transported around the invertebrate (in the haemolymph) - Oxygen is released to the cells for use in respiration
			[Level 2] Candidate shows some detailed understanding of the structure of bronze **AND** of haemocyanin and how the structure of bronze **AND** haemocyanin affects the use, properties or function. ***(3 – 4 marks)***		
			[Level 1] Candidate shows a basic understanding of the structure of **EITHER/OR** bronze and of haemocyanin and how the structure of bronze **OR** haemocyanin affects its use, properties or function. ***(1 – 2 marks)***		
			[Level 0] Candidate includes fewer than two valid points. ***(0 marks)***		
			Total	**6**	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>7</td><td>(a)</td><td>(i)</td><td>Harder materials have smaller indentations for same force / ORA ✓

Any two from:
Force is applied ✓
(Force produces an) indentation in the material ✓
Bigger force produces bigger indentation ✓✓</td><td>3</td><td>OWTTE

ALLOW impression / going through = indentation

ALLOW pressure = force

ALLOW 2 marks for final mp</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>diamond is the hardest material known / is (very) hard ✓
OR
diamond cannot be deformed by any material ✓</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td><table><tr><th>Metal alloy</th><th>Ratio</th></tr><tr><td>Aluminium alloy</td><td>115</td></tr><tr><td>Stainless steel</td><td>63.1</td></tr><tr><td>Titanium alloy</td><td>260</td></tr><tr><td>Low carbon steel</td><td>46.4</td></tr></table>✓✓</td><td>2</td><td>All four correct = 1 mark
ALLOW 4 correct calculator values = 1 mark max
All to 3 sf = 1 mark
ALLOW
<table><tr><th>Metal alloy</th><th>Ratio</th></tr><tr><td>Aluminium alloy</td><td>115 :1</td></tr><tr><td>Stainless steel</td><td>63.1 :1</td></tr><tr><td>Titanium alloy</td><td>260 :1</td></tr><tr><td>Low carbon steel</td><td>46.4 :1</td></tr></table></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Titanium
AND Highest strength to weight ratio ✓</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Any two from:
Cost ✓
Corrosion resistance / non rusting✓
Abundance of metal ✓</td><td>2</td><td>ALLOW sensible factors e.g. stiffness, malleability, toughness, brittleness, plasticity, elasticity, machinability, form of raw materials
ALLOW heat resistance / resistance to rain

IGNORE weight / strength</td></tr>
<tr><td colspan="3"></td><td>Total</td><td>9</td><td></td></tr>
</table>

Question			Answer	Marks	Guidance
8	(a)		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 10 (Ω) award 2 marks** resistance = potential difference ÷ current / 5 ÷ 0.5 ✓ (*R*x =) 10 (Ω) ✓	2	 **ALLOW** R=V/I
	(b)		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 47.5 (Ω) award 2 marks** (*R*t =) 5 ÷ 0.087 = (57.5 Ω) ✓ (*R*y = *R*t – *R*x =) 47.5 Ω ✓	2	**ALLOW** 47.47 = 2 marks **ALLOW** ecf using *R*x from **(a)**
	(c)		**FIRST CHECK ANSWER ON ANSWER LINE** **If answer = 8.3 (Ω) award 2 marks** **1/10 + 1/47.5** (= 1/Rt) ✓ (Rt =) 8.3 Ω ✓	2	**ALLOW** 8.26(4628……) Ω = 2 marks **ALLOW** ecf from **(a) and/or (b)** but Max=1
	(d)		(Current due to *R*x and *R*y = 5.0 V ÷ 8.3 Ω =) 0.60 A ✓ (Additional current due to lamp = 0.75 – 0.60) 0.15 A ✓ **0.15 A x 60 s** = 9.0 C ✓	3	**ALLOW** ecf from **(c)** but Max=2 **ALLOW** answers in range 8.4 to 9.0 due to rounding
			Total	**9**	

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