

**Cambridge Technicals
Applied Science**

Unit 1: Science Fundamentals

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

Mark Scheme for January 2019

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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
BOD	Benefit of doubt given
CON	Contradiction
RE	Rounding error
SF	Error in number of significant figures
ECF	Error carried forward
L1	Level 1
L2	Level 2
L3	Level 3
NBOD	Benefit of doubt not given
SEEN	Noted but no credit given
I	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)	7✓	1	
	(b)	covalent ✓ shared electrons ✓	2	
	(c)	(i)	2	IGNORE strong nuclear and nuclear forces
		(nuclei contain) protons ✓ (protons) repel / repulsion ✓		
		(ii)	1	
	(d)	(i)	1	
		(ii)	2	DO NOT ALLOW weight = mass IGNORE mean/mode
		isotope ✓ (weighted) <u>average</u> mass / nucleon number ✓		
	(e)	(i)	3	
		(ii)	1	

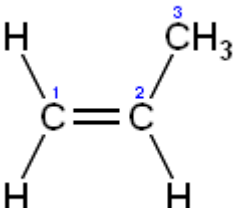
Question		Answer	Marks	Guidance
(f)	(i)	atomic radius decreases ✓	1	ALLOW gets less/smaller
	(ii)	(outer) electrons are in same shell / (outer) electrons experience similar or same shielding / same number of shells / same energy level ✓ greater nuclear attraction on (outer) electrons or shells / (Outer) electrons or shells are attracted more strongly to the nucleus ✓	2	
(g)		<p style="text-align: right;">✓ ✓ ✓</p>	3	
		Total	19	

Question		Answer	Marks	Guidance					
2	(a)	faster ✓ kinetic ✓ increases ✓	3						
	(b)	(i) catalyst ✓	1						
		(ii) Any four from: both curves/reactants start at same point / energy level ✓ both curves increase as the reaction progresses ✓ activation energy /peak is lower with enzyme / enzymes lower the activation energy ✓ peaks coincide ✓ both curves then decline ✓ energy level of the products (for both curves) the same ✓ product energy is less than reactant energy ✓	4	IGNORE explanations ORA DO NOT ALLOW products formed more quickly with enzyme					
		(iii) Any two from: number/concentration of reactants used up ✓ number/concentration of products generated ✓ measure the energy level of the reactants/products ✓	2	ALLOW named reactant or product ONLY if with qualified reaction e.g. respiration/photosynthesis					
	(c)	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td>2</td></tr> <tr><td>4</td></tr> <tr><td>1</td></tr> <tr><td>5</td></tr> <tr><td>3</td></tr> </table> <p style="text-align: right;">✓ ✓ ✓ ✓</p>	2	4	1	5	3	4	One mark for each correct number in the sequence.
2									
4									
1									
5									
3									
		Total	14						

Question			Answer	Marks	Guidance
3	(a)	(i)	packaging/processing of material/proteins/lipids ✓	1	DO NOT ALLOW <i>production</i> of material/proteins/lipid
		(ii)	site of (aerobic) respiration/oxidation of acetyl CoA / release energy / production of ATP ✓	1	IGNORE powerhouse of cell DO NOT ALLOW creates energy / anaerobic respiration
	(b)		Any one from: only parts of some organelles/structures are visible ✓ chloroplast must have a circular/cup shape ✓ different parts of the chloroplast are sectioned ✓	1	OWTTE ALLOW any correct description for non-linear structure
	(c)		Any two from: feature - thylakoids/grana ✓ function (any one from) trap/absorb light ✓ light reactions of photosynthesis ✓ contain chlorophylls ✓ photolysis of water ✓ production of NADPH ₂ / reduced NADP ✓ production of ATP ✓ OR feature - stroma/ground substance/matrix ✓ function (any one from) contains enzymes ✓ site of Calvin cycle / light-independent reactions ✓ OR feature – outer (double)-membrane/envelope ✓ function (any one from) freely permeable to carbon dioxide / oxygen / glucose ✓ allows light transmission ✓ acts as barrier to restrict reactions within the chloroplast/organelle / OWTTE ✓	2	One mark for the correct feature and the second mark for its related function.

Question		Answer	Marks	Guidance																		
	(d)	lysosome ✓	1																			
	(e) (i)	<p>Any one from: prokaryotic cells much smaller/size differential quantified ✓ prokaryotic cells do not appear to have the organelles / correctly-named organelles visible in the eukaryotic cells ✓</p>	1	IGNORE general references to cell shape/clarity																		
	(ii)	<p>Any two from: plasma membrane ✓ cytoplasm ✓ DNA ✓ ribosomes present ✓</p>	2	ALLOW some eukaryotes (all prokaryotes) have a cell wall																		
	(iii)	<p>Any two from:</p> <table border="1"> <thead> <tr> <th>feature</th> <th>prokaryotic</th> <th>eukaryotic</th> </tr> </thead> <tbody> <tr> <td>nucleus</td> <td>absent</td> <td>present ✓</td> </tr> <tr> <td>DNA</td> <td>cytoplasm</td> <td>nucleus/mitochondrion ✓</td> </tr> <tr> <td>mitochondria</td> <td>absent</td> <td>present ✓</td> </tr> <tr> <td>chromatin</td> <td>absent</td> <td>present ✓</td> </tr> <tr> <td>ribosomes</td> <td>small</td> <td>large (and small)</td> </tr> </tbody> </table>	feature	prokaryotic	eukaryotic	nucleus	absent	present ✓	DNA	cytoplasm	nucleus/mitochondrion ✓	mitochondria	absent	present ✓	chromatin	absent	present ✓	ribosomes	small	large (and small)	2	<p>ALLOW any other correctly-named distinguishing feature</p> <p>ONLY need one correct reference for each feature</p> <p>ALLOW correct reference to the size of each ribosome type – 70S/20nm (prokaryotic) vs 80S/25-30nm (eukaryotic)</p>
feature	prokaryotic	eukaryotic																				
nucleus	absent	present ✓																				
DNA	cytoplasm	nucleus/mitochondrion ✓																				
mitochondria	absent	present ✓																				
chromatin	absent	present ✓																				
ribosomes	small	large (and small)																				
		Total	11																			

Question			Answer	Marks	Guidance
4	(a)	(i)	Nucleotides ✓	1	
		(ii)	Adenine ✓ Thymine ✓	2	
		(iii)	<p style="text-align: center;">Type of compound Description</p> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Alkane</div> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Organic compounds containing the C=O group.</div> </div> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Alkene</div> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Organic compounds containing the COOH group.</div> </div> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Aldehyde</div> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Organic compounds containing the OH group.</div> </div> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Carboxylic acid</div> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Saturated hydrocarbons containing single C-C and C-H bonds.</div> </div> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Alcohol</div> <div style="border: 1px solid black; padding: 5px; width: 150px; text-align: center;">Unsaturated hydrocarbons containing a C=C double bond.</div> </div> <p style="text-align: right; margin-top: 10px;">✓ ✓ ✓ ✓ ✓</p>	5	One mark for each correct line.

Question	Answer	Marks	Guidance
(b)	Double bond (between C ¹ and C ²) ✓ Correct number of carbon and hydrogen atoms ✓ OR Correct structure ✓✓ 	2	ALLOW correct molecular formula C ₃ H ₆ = 1 mark max. ALLOW CH ₃ at different rotation/corners
(c)	Any five from: chromatin unwinds (separates from histones) to expose DNA ✓ DNA carries the coded message/sequence of bases for protein synthesis ✓ DNA is held in the (switchgrass) cell nucleus ✓ DNA forms a template (called mRNA) ✓ via process called transcription ✓ mRNA leaves the nucleus (via nuclear pore) ✓ mRNA codes for protein synthesis at ribosome ✓ tRNA brings amino acids to ribosome ✓ amino acids form the protein/polypeptide chain ✓ peptide bonds form between adjacent amino acids ✓ via process called translation ✓	5	OWTTE IGNORE references to the process of genetic modification
	Total	15	

Question		Answer	Marks	Guidance						
5	(a)	<p>Any one from: (Mn component of) oxidases ✓ (Mn component of) enzymes involved in structural components (of bone, cartilage) ✓ biosynthesis of choline / important for normal liver function/growth/repair ✓</p>	1	ALLOW any other correct structural component						
	(b)	(i)	Liver ✓	1						
		(ii)	Pigs OR cattle ✓	1	<p>ALLOW Pigs – based on lowest average conc. within an organ ALLOW Cattle – based on lowest average conc. within animal</p>					
	(c)	<table border="1"> <thead> <tr> <th>Manganese compound</th> <th>Oxidation state</th> </tr> </thead> <tbody> <tr> <td>(Mn₂O₃)</td> <td>+3</td> </tr> <tr> <td>(MnO₂)</td> <td>+4</td> </tr> </tbody> </table>	Manganese compound	Oxidation state	(Mn ₂ O ₃)	+3	(MnO ₂)	+4	2	One mark for each correct row
Manganese compound	Oxidation state									
(Mn ₂ O ₃)	+3									
(MnO ₂)	+4									
	(d)	Electrons are lost ✓	1							

Question		Answer	Marks	Guidance
	(e)	<p>[Level 3] Candidate shows a high level of understanding of the data, describing trends for all regions of the body AND draws conclusions from the data. <i>(5 – 6 marks)</i></p> <p>[Level 2] Candidate shows an understanding of the data, using some data, describing general trends AND draws conclusions from the data. <i>(3 – 4 marks)</i></p> <p>[Level 1] Candidate describes basic trends OR makes limited conclusions from the data. <i>(1 – 2 marks)</i></p> <p>[Level 0] Candidate includes fewer than two valid points. <i>(0 marks)</i></p>	6	<p>Valid points:</p> <p>Description of data trends</p> <ul style="list-style-type: none"> • (prion proteins containing) Mn found in all three organs and the blood. • more Mn in brain stem, spinal cord and blood of BSE cattle (than in non-BSE). • less Mn in brain cortex of BSE cattle (than in non-BSE) • greatest conc. of Mn in brain stem. • lowest conc. of Mn in brain cortex. • > x2 amount of Mn in brain stem of BSE vs non-BSE. • correct reference to data values for one or more parts. • correct reference to % change in Mn for any region of body or between different regions. • relatively low levels of Mn in blood for both groups of cattle. <p>Conclusions</p> <ul style="list-style-type: none"> ○ high Mn may be cause of BSE. ○ link between Mn levels and the development of BSE for brain stem, spinal cord and blood. ○ BSE generally associated more with the brain stem than other nervous tissues/organs ○ low levels of Mn in blood but high levels in organs may indicate that the blood transports the Mn but Mn builds up within the organs.

Question		Answer	Marks	Guidance												
	(f)	<p>Lowest risk of arthritis with manganese intake of 2.09 – 3.00 ✓</p> <p>Highest risk of arthritis with manganese intake of >3.00 ✓</p> <p>Mid-risk of arthritis with manganese intake of <2.09 ✓</p> <p>intake from food has no effect (on rheumatoid arthritis) ✓</p>	1	<p>OWTTE</p> <p>ALLOW any realistic interpretation of data in Table 5.4 including correct reference/assumption of diet</p>												
	(g)	<table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center; width: 50%;">Function</th> <th style="width: 10%;"></th> <th style="text-align: center; width: 40%;">Ion</th> </tr> </thead> <tbody> <tr> <td style="border: 1px solid black; padding: 5px; text-align: center;">Carriage of oxygen in haemoglobin and myoglobin.</td> <td style="text-align: center; vertical-align: middle;">/</td> <td style="border: 1px solid black; padding: 5px; text-align: center;">Calcium</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px; text-align: center;">Component of the enzyme, hydrolase.</td> <td style="text-align: center; vertical-align: middle;">/</td> <td style="border: 1px solid black; padding: 5px; text-align: center;">Iron</td> </tr> <tr> <td style="border: 1px solid black; padding: 5px; text-align: center;">Needed for the formation of bone matrix.</td> <td style="text-align: center; vertical-align: middle;">/</td> <td style="border: 1px solid black; padding: 5px; text-align: center;">Nickel</td> </tr> </tbody> </table>	Function		Ion	Carriage of oxygen in haemoglobin and myoglobin.	/	Calcium	Component of the enzyme, hydrolase.	/	Iron	Needed for the formation of bone matrix.	/	Nickel	2	<p>3 correct lines = 2 marks</p> <p>1 or 2 correct lines = 1 mark</p>
Function		Ion														
Carriage of oxygen in haemoglobin and myoglobin.	/	Calcium														
Component of the enzyme, hydrolase.	/	Iron														
Needed for the formation of bone matrix.	/	Nickel														
		Total	15													

Question		Answer			Marks	Guidance
6	(a)	Feature	Form 1	Form 2	2	OWTTE ALLOW any realistic comparison based on the two forms in Fig. 6.1
		overall form	amorphous/non-crystalline	regular lattice/crystalline ✓		
		chain length	different / long and short	same / all long ✓		
		branched	yes	no ✓		
		packing	loose	close ✓		
	(b)	Feature	Form 1	Form 2	3	OWTTE ALLOW a clear, correct statement for EITHER Form 1 or Form 2 for each feature
		tensile strength	weaker	stronger ✓		
		hardness	softer	harder ✓		
		melting point	lower	higher ✓		
	(c)	Feature	Form 1	Form 2	3	OWTTE ALLOW a clear, correct statement for EITHER Form 1 or Form 2 for each feature
		tensile strength	less-close chains AND weaker intermolecular forces	closer chains AND greater intermolecular forces ✓		
		hardness	less packing - easier to scratch	greater packing - less easy to scratch ✓		
		melting point	less-close chains AND weaker intermolecular forces	closer chains AND greater intermolecular forces ✓		
		Total			8	

OCR (Oxford Cambridge and RSA Examinations)
The Triangle Building
Shaftesbury Road
Cambridge
CB2 8EA

OCR Customer Contact Centre

Education and Learning

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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