



GCSE MARKING SCHEME

SUMMER 2023

**GCSE
APPLIED SCIENCE (DOUBLE AWARD) - UNIT 3
3445U30-1 & 3445UC0-1**

INTRODUCTION

This marking scheme was used by WJEC for the 2023 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

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GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question			Marking details	Marks Available													
				AO1	AO2	AO3	Total	Maths	Prac								
1	(a)	(i)	chlorophyll (1) carbon dioxide (1) and water (1) any order into glucose (1) and oxygen (1) any order	5			5										
		(ii)	food	1			1										
	(b)	(i)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; height: 20px;"></td> <td style="width: 50%;"></td> </tr> <tr> <td>Add 1 kg</td> <td>Add 1 g</td> </tr> <tr> <td>collect the gas in a beaker</td> <td>Collect gas in a measuring cylinder</td> </tr> <tr> <td>produced in 1 minute</td> <td>Produced in 1 hour</td> </tr> </table> <p>If correct and incorrect circled per row – (0 marks)</p>			Add 1 kg	Add 1 g	collect the gas in a beaker	Collect gas in a measuring cylinder	produced in 1 minute	Produced in 1 hour			3	3		3
Add 1 kg	Add 1 g																
collect the gas in a beaker	Collect gas in a measuring cylinder																
produced in 1 minute	Produced in 1 hour																
		(ii)	<u>Repeat</u> / do again / re-do} the experiment at different temperatures Accept list of different temperatures			1	1		1								
			Question 1 total	6	0	4	10	0	4								

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		Blue is present in brown (1) and purple (so disagree) (1) and vice versa			2	2		2
		(ii)		4 (cm) extracted from diagram (1) accept 3.9 - 4.1 cm Subs (1) = 0.4 (1) Accept 0.39-0.41 (3) Correct answer only (3) 4 see anywhere (1) No ecf from incorrect distance	1	1 1		3	3	3
	(b)	(i)		sodium chloride	1			1		1
		(ii)	I	lithium carbonate	1			1		1
			II	carbon dioxide	1			1		1
		(iii)	I	sodium chloride	1			1		1
			II	Risk – could cause eye damage if splashes in the eyes whilst {pouring / pipetting / handling / adding / mixing} (1) Do not accept 'when doing the experiment' Control measure - wear eye protection (1)	2			2		2
				Question 2 total	7	2	2	11	3	11

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)		${}_{36}^{92}\text{Kr}$		2		2	2	
		(ii)		Moderator	1			1		
		(iii)		3		1		1		
	(b)	(i)		To absorb (excess) neutrons (1) so a mean of 1 neutron from each fission produces further fission / so that for one neutron in there is one neutron out (causing further fission) / prevent an uncontrollable chain reaction (1)	2			2		
		(ii)		The control rods may not be able to absorb {sufficient/enough} neutrons (to control the reaction) (1) and so the reactor may so overheat / or meltdown / uncontrollable chain reaction (1) Do not accept: explode		2		2		
	(c)	(i)	I	700 million years (1)		1		1	1	
			II	700 million years (1) ecf		1		1	1	
		(ii)		50 (1) 12.5 (1) Do not accept 13		2		2	2	
				Question 3 total	3	9	0	12	6	0

Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths	Prac
4	(a)	<p>Indicative content</p> <ul style="list-style-type: none"> • Refrigeration/chilling – slows down (but does not stop) bacterial growth. Do not accept: stops growth • freezing – stops bacteria multiplying (but does not kill them) Do not accept: slows growth • drying/smoking – removes water (so bacteria cannot digest and absorb the food source) • salting / curing– bacteria lose water (from their cells so they dehydrate and cannot reproduce) • pickling – (addition of vinegar to) lower pH (and inactivate microorganisms.) • Accept: irradiation of food – kills bacteria • Allow ref to removal of oxygen – stops/kills bacteria <p>5-6 marks 2/3 methods with 2/3 correct explanations. <i>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</i></p> <p>3-4 marks Up to 3 methods with at least 1 correct explanation. <i>There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</i></p> <p>1-2 marks Up to 3 methods stated but no explanations. <i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</i></p> <p>0 marks <i>No attempt made or no response worthy of credit.</i></p>						

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		2 800 (1) 4 (1)		2		2	2	2
		(ii)		UHT – no bacteria present (1) Nothing to grow / temperature doesn't need to be lowered (and storage time is long so agree) (1)			2	2		
				Question 4 total	6	2	2	10	2	2

Question			Marking details	Marks Available						
				AO1	AO2	AO3	Total	Maths	Prac	
5	(a)	(i)		All plots correct to $< \pm 1$ small square (2) 0,0 ignored 3 plots correct to $< \pm 1$ small square (1) Smooth curve from 0,0 to 45,48 through 0,0 (1) Penalise double lines / wispy lines		3		3	3	3
		(ii)	I	Volume (of hydrogen) increases as time increase (1) Until the volume produced is constant / at a decreasing rate / until it reaches 48 cm ³ / until it reaches 45 seconds (1)		2		2		2
			II	Read from graph (ecf) ± 1 small square Expect 36-38 cm ³		1		1	1	1
			III	45 s		1		1	1	1
	(b)	(i)		Increase {rate/speed } (of reaction) / lower activation energy Accept accelerate the reaction	1			1		
		(ii)		1.5 g	1			1		
		(iii)		Volumes (at each time) would be less	1			1		
	(c)	(i)		Volumes (at each time) would be greater	1			1		
		(ii)		Volumes (at each time interval) would be greater (but final collected volume would be the same) (1) Because particles move faster / collide more often (1)	2			2		
				Question 5 total	6	7	0	13	5	7

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
6/1	(a)		Covalent – shared (electrons) (1) Ionic – donates or accepts / gains or loses / transfer (of electrons) (1) Accept one shares, one transfers for (1) Ignore references to metals and non-metals	2			2		
	(b)	(i)	<p>Diagram 1: Mg (two 'x' electrons) and O (six 'o' electrons) with two arrows showing electron transfer.</p> <p>Diagram 2: Mg (two 'x' electrons) and O (six 'o' electrons) with two arrows showing electron transfer.</p> <p>Diagram 3: Mg (two 'x' electrons circled) and O (six 'o' electrons) with one arrow showing electron transfer.</p> <p>(1)</p>		1		1		
		(ii)	2+ / +2 (1) 2- / -2 (1) Allow ecf		2		2		
Question 6/1 total				2	3	0	5	0	0

Question			Marking details	Marks Available						
				AO1	AO2	AO3	Total	Maths	Prac	
7/2	(a)		<p>Weight: (from 1920-1950) gets heavier / weight increases (1) (from 1950-1970) gets lighter / weight decreases (1)</p> <p>Strength: (from 1920-1950) gets stronger (1) (from 1950-1970) gets weaker (1)</p> <p>If 1950 is not included then gets heavier (1), and gets weaker (1)</p> <p>Just a list of numbers from table (0 marks)</p>			4	4	4		
	(b)	(i)	<p>Any 2 × (1) from No wood that can rot (1) (Metal) would not corrode (1) Stronger material used (1) Lighter materials used (apart from wood) (1) Do not accept: lower density</p>			2	2			
		(ii)	Body is brittle / may crack			1	1			
	(c)	(i)	<p>Selection of 1.5 (1) 1.5 × 300 (1) = 450 g (1)</p> <p>Alternative: 1.5 + 2.4 (0) 3.9 × 300 (1) = 1170 g (1)</p>		3		3	3		

Question				Marking details	Marks Available						
					AO1	AO2	AO3	Total	Maths	Prac	
		(ii)	I	Selection 3 500 (1) Conversion to 350 000 (1) no ecf from incorrect selection							
			II	350 000 (ecf) \times 0.00015 (1) = 52.5 N (1)		4		4	4		
				Question 7/2 total	0	7	7	14	11	0	

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
3	(a)		<p>Any 2 × (1) from: Green plants {use chlorophyll / have chloroplasts} (1) to absorb light energy (1) and convert carbon dioxide and water (1) into <u>glucose</u> and oxygen (1) AND Photosynthesis can't occur / leaves are black / no chlorophyll (1) Ash trees unable to make {food/glucose} (so they are unable to grow/die) (1)</p>	3	1		4		
	(b)		<p>Indicative content</p> <ul style="list-style-type: none"> • start with lamp near/far away from <i>Elodea</i> • count number of bubbles in a certain time • change position of lamp • count bubbles again • keep temperature and sodium hydrogen carbonate conc. constant <ul style="list-style-type: none"> • Repeat the experiment at different temperatures • with the lamp in a constant position • Keep sodium hydrogen carbonate conc. constant <ul style="list-style-type: none"> • Repeat the experiment at different sodium hydrogen carbonate conc. • with the lamp in a constant position • with temperature constant 			6	6		6

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				<p>5-6 marks A full description for at least two limiting factors <i>There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</i></p> <p>3-4 marks A full description for one limiting factor including one or two controlled variables Or Part descriptions for two or more limiting factors which may not include any controlled variables <i>There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</i></p> <p>1-2 marks Part of method described for one limiting factor Or List of limiting factors given <i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</i></p> <p>0 marks <i>No attempt made or no response worthy of credit.</i></p>						
				Question 3 total	3	1	6	10	0	6

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)	Slow down neutrons (1) So they {cause fission of uranium / can be captured by an uranium (atom) / can be captured by an uranium (nucleus)} (1)	2			2		
		(ii)	Any 3 × (1) from: Control rods may no longer be free to move (up and down in the channels) (1) If rods are stuck out then the reactor may start to overheat (1) since they will not be able to absorb {sufficient / enough} neutrons (to reduce rate of fission) (1) leading to possible meltdown / uncontrollable chain reaction} / you can't shut the reactor down (1) OR converse	3			3		
	(b)		${}_{36}^{92}\text{Kr} + 3$ (1)		3		3	2	
	(c)	(i)	Correct construction line(s) added (1) 700 million years (1)		2		2	2	
		(ii)	Sequence of halving – expect $1 \rightarrow \frac{1}{2} \rightarrow \frac{1}{4} \rightarrow \frac{1}{8} \rightarrow \frac{1}{16} \rightarrow \frac{1}{32}$ (1) 5 half-lives (1) $5 \times 700\,000\,000(\text{ecf}) = 3\,500\,000\,000$ years (1)		3		3	3	
			Question 4 total	5	8	0	13	7	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		identifying 10 from diagram (1) 4 cm (1) shown on chromatogram (ecf) (1) 3 marks for correct dot only	1	1 1		3	3	3
		(ii)		The brown is a combination of yellow (1) and purple / blue / red (1) (so disagree) OR blue (1) and red (1) (so disagree) If a candidate agrees as brown is made of yellow and purple (1) If a candidate agrees as brown is made of {red/blue} and purple (0) Allow: brown has more than one dot (1)			2	2		2
		(iii)		The mobile phase is the solvent (1) The stationary is the paper/plate/covering on plate (1) The dyes separate because they are not equally soluble (1)	3			3		
	(b)	(i)	I	Sodium carbonate and sodium chloride	1			1		1
			II	Sodium carbonate and lithium carbonate	1			1		1
		(ii)		Acidify with nitric acid (1) and add silver nitrate solution (1) White <u>precipitate</u> (1)	3			3		3
				Question 5 total	9	2	2	13	3	10

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)	Any 2 × (1) from: Milk is heated (to a high temperature) (1) Which kills (harmful) bacteria (1) extending the {storage time/life} of milk (1) Do not accept: kills all bacteria	2			2		
		(ii)	Milk is pumped (at high pressure) through narrow tubes (1) so fat globules are broken into smaller droplets OWTTE (1) so they stay (suspended) in the milk (1) preventing a (cream) layer on the top (1)	4			4		
	(b)	(i)	Number of colonies on plate = 7 (1) $7 \times 400 = 2\,800$ (1)		2		2	2	2
		(ii)	Bacteria present even after pasteurisation (1) So must be stored at a low temperature to <u>slow</u> bacterial growth (1) But dangerous amounts will be present after 7 days (1) UHT – no bacteria present (1) so temperature doesn't need to be reduced (1)		4		4		
			Question 6 total	6	6	0	12	2	2

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)	60÷58 (1) = 1.0 (1) Accept 1.03 for 1 mark only.		2		2	2	2	
		(ii)	Accept 27 to 31		1		1	1	1	
	(b)	(i)	(The rate) increases /quicker/accelerates (1) {increases the number of / more} particles (in the same volume) (1) Increasing the chance of <u>successful</u> collisions (per unit time) (1)	3			3			
		(ii)	The volume of gas produced is limited by the {reactant which is not in excess/calcium carbonate} (1) Since the same mass of calcium carbonate was used throughout (1) OR After 10 minutes all the reactions had completed /all the calcium carbonate had reacted (1) <u>Only</u> the acid was in excess (so the volume of carbon dioxide would always be the same) (1)	2			2			
			Question 7 total	5	3	0	8	3	3	

SUMMARY FOUNDATION TIER

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	6	0	4	10	0	4
2	7	2	2	11	3	11
3	3	9	0	12	6	0
4	6	2	2	10	2	2
5	6	7	0	13	5	7
6	2	3	0	5	0	0
7	0	7	7	14	11	0
TOTAL	30	30	15	75	27	24

SUMMARY HT

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	3	0	5	0	0
2	0	7	7	14	11	0
3	3	1	6	10	0	6
4	5	8	0	13	7	0
5	9	2	2	13	3	10
6	6	6	0	12	2	2
7	5	3	0	8	3	3
TOTAL	30	30	15	75	26	21