



GCSE MARKING SCHEME

SUMMER 2023

**GCSE
APPLIED SCIENCE (DOUBLE AWARD) - UNIT 2
3445U20-1 & 3445UB0-1**

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.

WJEC GCSE APPLIED SCIENCE (DOUBLE AWARD) – UNIT 2

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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)			Venus	1			1		
	(b)			Jupiter	1			1		
	(c)			Comet	1			1		
	(d)			Mars (1) and Jupiter (1)	2			2		
	(e)			Oort cloud	1			1		
				Question 1 total	6	0	0	6	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		Respiration	1			1		
		(ii)		Tick in 1 ,2, 4 Photosynthesis uses carbon dioxide from the atmosphere (1) Decomposing dead plants adds carbon dioxide to the atmosphere (1) Respiration adds carbon dioxide to the atmosphere (1) 4 boxes ticked – 2 marks max 5 boxes ticked – 1 mark max	3			3		
		(iii)		Burning (fossil fuels)/driving/flying (1) accept power station, ‘use’ fossil fuels Cutting down trees/deforestation (1) Accept rearing cattle (1)	2			2		
	(b)	(i)	I	1.2×4 (1) $= 4.8$ kg (1)		2		2	2	
			II	0.2×4 $= 0.8$ kg (1)		1		1	1	
		(ii)		4.8 (ecf) – 0.8 (ecf) = 4 kg per day (1) $4 \times 5 = 20$ kg per week (1) Answer of 4 – 1 mark		2		2	2	
				Question 2 total	6	5	0	11	5	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)		10.9 (Read from graph) allow 10.8-11		1		1	1	
		(ii)		(Abundance of) lichen increases as distance (from city centre) increases		1		1	1	
	(b)			Less pollution further from city centre (1) So more lichen present (1)	2			2		
				Question 3 total	2	2	0	4	2	0

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)		<p>Indicative content:</p> <ol style="list-style-type: none"> Set the height of the ramp to about 10cm (above the desk) Measure a distance of 50cm from the end of the ramp and mark this point. Release the squash ball from the top of the ramp starting the stopwatch as you do. When the squash ball reaches the bottom of the ramp press the lap button on the stopwatch. Stop the stopwatch when the squash ball reaches the 50cm mark. Candidate may say there are 2 people using 2 stopwatches. Record the time taken for the ball to travel down the ramp (lap time) and the time to travel 50 cm. To reduce uncertainty could: <ul style="list-style-type: none"> repeat experiment (twice more)/compare with different groups use longer ramp increase the 50 cm distance reduce angle of ramp roll from same point on ramp same person timing record the experiment/light gate <p>5-6 marks Detailed description including both time measurements, sensible distances and how to reduce uncertainty. <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>	6			6		6

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				<p>3-4 marks Appropriate method and some uncertainties <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 Limited method and/or uncertainties only <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>						
	(b)	(i)		0.5/2 subs (1) 0.25 m/s (1)	1	1		2	2	2
		(ii)		0.25 (ecf) /2.5 Subs ecf (1) = 0.1 m/s ² (1)	1	1		2	2	2
				Question 4 total	8	2	0	10	4	10

Question				Marking details	Marks Available														
					AO1	AO2	AO3	Total	Maths	Prac									
5	(a)	(i)		FF		1		1											
		(ii)		<table border="1" style="margin-left: 40px;"> <tr> <td></td> <td>F</td> <td>f</td> </tr> <tr> <td>F</td> <td>FF</td> <td>Ff</td> </tr> <tr> <td>F</td> <td>FF</td> <td>Ff</td> </tr> </table> <p>Parent (ecf) (1) Cross (1) (ecf)</p>		F	f	F	FF	Ff	F	FF	Ff		2		2	1	
	F	f																	
F	FF	Ff																	
F	FF	Ff																	
		(iii)		0% (ecf)			1	1											
		(iv)		(No) because they have a 25% chance (ecf)			1	1											
	(b)			Underlining of statement 2 and 3 ingest bacteria (1) produce antibodies (1) 3 statements underlined – 1 mark max	2			2											
	(c)	(i)		4 (1) 16 (1)		2		2	2										
		(ii)		2 → 4 → 3 → 1 All correct (2) 1 or 2 correct (1)	2			2											
		(iii)		Evolution	1			1											
				Question 5 total	5	5	2	12	3	0									

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			5		1		1	1	1
	(b)			Area of lawn = 150 m ² (1)		1		1	1	1
	(c)			150 (ecf)		1		1		1
	(d)			= 5(ecf) × 150(ecf) = 750 (1)		1		1	1	1
	(e)			(750 (ecf) – 600) ÷ 600 (1) subs = 25 % (1) Ignore negatives Answer of 0.25 – 1 mark	1	1		2	2	2
	(f)			Use more {quadrats / positions}/use bigger quadrat (1) Accept repeats			1	1		1
				Question 6 total	1	5	1	7	5	7

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		10^{-8} to 10^{-12}		1		1	1	
		(ii)		$10^{20} / 10^{21}$ Accept $10^{20.5}$		1		1	1	
	(b)	(i)		70/2 (1) accept 2 seen anywhere unless 3 shown anywhere (and no other working shown) = 35 (1)		2		2	2	
		(ii)		150 days background (1) seen anywhere unless 100 seen anywhere (and no other working shown) $\frac{30}{73} / \frac{150}{365} / 0.41 / 41\%$ (1) Accept $0.4 / \frac{5}{12}$ for (2) Accept $\frac{73}{30} / 2.4 / 2.4333333\dots$ for (1) only due to use of 150		2		2	2	
				Question 7 total	0	6	0	6	6	0

Question				Marking details	Marks Available						
					AO1	AO2	AO3	Total	Maths	Prac	
1/8	(a)			Conversion of 2 MHz to 2 000 000 Hz (1) Subs: 1540/2 000 000 (1) = 0.00077 m / 7.7×10^{-4} m(1) 7.7 $\times 10^n$ where n does not = -4 (2)	1	1 1		3	3		
	(b)	(i)		Iodine-123 (1) Half-life is long enough to carry out trace or short enough to decay relatively quickly (1)			2	2			
		(ii)		Cobalt-60 (1) Gamma rays will penetrate body/is the most penetrating (1) Will not need replacing often due to long(ish) half-life (1) If another gamma emitter given allow 2 nd marking point for (1)			3	3			
	(c)			R4 (1) (Lutetium is a beta and gamma emitter so) Any 2 \times (1) from: paper will not affect reading / both (radiations) go through paper (1) Aluminium will reduce the reading (1) Lead will reduce the reading / there is still a reading when lead is present (1) If incorrect isotope selected, reasoning marks can still be awarded if they correspond to data in figure 6			3	3			
				Question 8 total	1	2	8	11	3	0	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2/9	(a)			Reduce the effect of anomalies Accept: because decay is random	1			1		1
	(b)	(i)		Construction line(s) (tolerance of < 1 small square) (1) expect part of a horizontal line from 300 and must cross line 3 Half-life = 1 throw (1) Accept other lines for pairs of readings which halve		2		2	2	2
		(ii)		Ticks in boxes 3, 4 and 5 (3 × 1) 4 boxes ticked – 2 marks max 5 boxes ticked – 1 mark max			3	3	2	3
	(c)	(i)		Background radiation		1		1		1
		(ii)		Every point would be higher / each point would be 60 higher Accept: each point would be 5 higher / adds to the number of remaining dice at each point Do not accept any stated number other than 5 and 60			1	1		1
				Question 9 total	1	3	4	8	4	8

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			X-rays range from 10^{-8} to 10^{-12} (1) So overlap UV to 10^{-8} / UV range is $10^{-6/-7}$ to 10^{-8} (1) And overlap gamma to 10^{-12} / gamma range is $10^{-9/-10}$ to 10^{-13} (so only partly true) (1)			3	3	2	
	(b)			Total equivalent days = $3 + 225 + 15 = 243$ (1) % = $243/365 (\times 100)$ (1) = $67 / 66.6\%$ (1) 66.5 / 0.67 / 44 on answer line (2) 0.44 on answer line (1)		3		3	3	
				Question 3 total HT	0	3	3	6	5	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			Scale – 1 km/2 cm on the x-axis and increase by 20 / 2 cm on the y-axis (1) Plotting 5 correct plots $\pm < 1$ small square tolerance (1) 4 or less correct plots < 1 small square tolerance (0) line (accept curve / point-to-point) (1)		3		3	3	3
	(b)			as distance increases SO ₂ sulfur dioxide concentration decreases (1) at a decreasing rate (1)		2		2		
	(c)			More sulfur dioxide causes more {air pollution / acid rain} (1) Decreases the lichen (1)	2			2		
				Question 4 total	2	5	0	7	3	3

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
5	(a)		<p>Indicative content:</p> <p>Processes that add CO₂:</p> <ol style="list-style-type: none"> <u>The role of micro-organisms</u> when living things die and <u>decay</u>. These release carbon dioxide. Animals and plants release carbon dioxide during <u>respiration</u>. Volcanic activity <p>Processes that remove CO₂:</p> <ol style="list-style-type: none"> Carbon was stored during formation of <u>fossil fuels</u> Carbon dioxide is taken up by green plants in <u>photosynthesis</u> Seas and oceans absorb carbon dioxide Carbonate compounds locked in rocks <p>Stabilised conditions:</p> <ol style="list-style-type: none"> Presence of carbon dioxide caused a greenhouse effect so keeping it warmer than it would otherwise be (is important to stabilize conditions for life) lack of human activity meant conditions were stable 	6			6		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				<p>5-6 marks At least 5 points from all sections <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 At least 3 points from at least 2 sections <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 1/2 points from any section. <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)		<p>Values for 30 km are: car 1.8 or train 0.54 (1) Difference = 1.26 (1) $250 \times 1.26 = 315$ (1) 10 journeys so saving = 3150 (kg) (1)</p> <p>OR</p> <p>Car: $1.8 \times 250 = 450$ (1) Train: $0.54 \times 250 = 135$ (1) $450 - 135 = 315$ (1) $315 \times 10 = 3150$ (1)</p> <p>OR</p> <p>Car: $1.8 \times 250 = 450$ (1) Train: $0.54 \times 250 = 135$ (1) $450 \times 10 = 4500$ and $135 \times 10 = 1350$ (1) $4500 - 1350 = 3150$ (1)</p> <p>Ecf on subtractions only</p> <p>630 / 315 / 1575 on answer line (3) 1350 / 4500 on answer line (2)</p>		4		4	4	
			Question 5 total	6	4	0	10	4	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)		Mean number per quadrat = 4.5 (1) Area of lawn = 540 m ² (1) Estimate = 4.5 (ecf) × 540 (ecf) = 2430 (1)		3		3	3	3
		(ii)		2430 (ecf) – 1950 ÷ 1950 (1) subs = 24.6 / 25 % (1) Allow 0.246 for 1 mark Ignore negatives	1	1		2	2	2
	(b)			<u>Mutation</u> has occurred (1) Which is <u>advantageous</u> OWTTE / allows dandelion to survive(1) (Individuals with this mutation are) more likely to be reproductively successful (1) So genes from these individuals are passed on to future generations (1) Do not accept adapted/immune	4			4		
				Question 6 total	5	4	0	9	5	5

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			pancreas (releases insulin) (1) transported in the blood (1) (Glucose stored as) glycogen (1) And stored in the liver / muscles (1) Ignore references to low blood sugar Glycogen must be spelled correctly	4			4		
	(b)			Type 1 diabetes is due to the body not producing (enough) Insulin / genetic (1) Type 2 diabetes is due to the body cells not responding to insulin / linked to obesity (1)	2			2		
	(c)			{Boil/heat} sample with Benedict's solution (1) Changes colour from blue to green/yellow/orange/(brick-)red (1)	2			2		2
				Question 7 total	8	0	0	8	0	2

Question			Marking details	Marks Available																							
				AO1	AO2	AO3	Total	Maths	Prac																		
8	(a)		<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td>F</td> <td>f</td> </tr> <tr> <td>F</td> <td>FF</td> <td>Ff</td> </tr> <tr> <td>f</td> <td>Ff</td> <td>ff</td> </tr> </table> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td>f</td> <td>f</td> </tr> <tr> <td>F</td> <td>Ff</td> <td>Ff</td> </tr> <tr> <td>f</td> <td>ff</td> <td>ff</td> </tr> </table> <p>Parents in 1st Punnett square (1) Parents in 2nd Punnett square (1) Both crosses (ecf) (1) chance: 25 % compared with 50% (ecf) (1) – conclusion must be consistent with Punnett squares</p>		F	f	F	FF	Ff	f	Ff	ff		f	f	F	Ff	Ff	f	ff	ff		4		4	1	
	F	f																									
F	FF	Ff																									
f	Ff	ff																									
	f	f																									
F	Ff	Ff																									
f	ff	ff																									
	(b)		<p>White blood cells / leucocyte / lymphocyte / phagocyte / macrophage (1)</p> <p>+ any 2 × (1) from: ingesting bacteria (1) producing antibodies (1) producing antitoxins (1)</p>	3			3																				

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
	(c)		<p>any 3 × (1) from:</p> <p>Short term effects: breathing rate increases (1) to provide the oxygen and remove carbon dioxide faster (1)</p> <p>Long term effects: the body becomes more efficient at transporting oxygen (1) Increased lung capacity (1) Accept: breathing rate decreases (1) Accept: clears mucus more efficiently (1)</p>	3			3		
	(d)	(i)	<p>A = 0.5 (1) B = 0.83 (1) C = 0.87/0.8666..... (1) C > B > A / Volume higher in CF and higher again in CF with infection (1)</p>	1	3		4	3	
		(ii)	<p>The greater the breaths per minute (1) the lower the blood oxygen level (1)</p> <p>accept comparison with volume of air per breath for (1) only</p>		2		2		
			Question 8 total	7	9	0	16	4	0

SUMMARY FOUNDATION TIER

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	6	0	0	6	0	0
2	6	5	0	11	5	0
3	2	2	0	4	2	0
4	8	2	0	10	4	10
5	5	5	2	12	3	0
6	1	5	1	7	5	7
7	0	6	0	6	6	0
8	1	2	8	11	3	0
9	1	3	4	8	4	8
Total	30	30	15	75	32	25

SUMMARY HIGHER TIER

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	1	2	8	11	3	0
2	1	3	4	8	4	8
3	0	3	3	6	5	0
4	2	5	0	7	3	3
5	6	4	0	10	4	0
6	5	4	0	9	5	5
7	8	0	0	8	0	2
8	7	9	0	16	4	0
Total	30	30	15	75	28	18