



GCSE MARKING SCHEME

SUMMER 2023

**GCSE
APPLIED SCIENCE (SINGLE AWARD) - UNIT 2
3440U20-1 & 3440UB0-1**

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 (SINGLE AWARD) – UNIT 2

SUMMER 2023 MARK SCHEME

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)			There are more chromosomes in individuals with Down's syndrome (3 rd box down)	1			1		
	(b)	(i)		Nucleus	1			1		
		(ii)		DNA	1			1		
		(iii)		Alleles Accept: heterozygous	1			1		
	(c)	(i)		Ionising radiation	1			1		
		(ii)		Cancer	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)		X-ray / CAT scan	1			1																
		(ii)		C	1			1																
		(iii)		Better image / 3D / clearer / more detailed / higher resolution	1			1																
	(b)	(i)		hinge/synovial	1			1																
		(ii)		<table><tr><td>Statement</td><td>Tick (✓)</td></tr><tr><td>The quadriceps contract to straighten the leg.</td><td>✓</td></tr><tr><td>The quadriceps and hamstring relax at the same time.</td><td></td></tr><tr><td>The quadriceps and hamstring contract at the same time.</td><td></td></tr><tr><td>The quadriceps and hamstring are an antagonistic pair of muscles.</td><td>✓</td></tr><tr><td>The hamstring relaxes when the leg straightens.</td><td>✓</td></tr><tr><td>Muscles push bones.</td><td></td></tr></table> (1st, 4th, 5th) (1) for each correct tick Max (2) for 4 ticks May (1) for 5 ticks	Statement	Tick (✓)	The quadriceps contract to straighten the leg.	✓	The quadriceps and hamstring relax at the same time.		The quadriceps and hamstring contract at the same time.		The quadriceps and hamstring are an antagonistic pair of muscles.	✓	The hamstring relaxes when the leg straightens.	✓	Muscles push bones.		3			3		
Statement	Tick (✓)																							
The quadriceps contract to straighten the leg.	✓																							
The quadriceps and hamstring relax at the same time.																								
The quadriceps and hamstring contract at the same time.																								
The quadriceps and hamstring are an antagonistic pair of muscles.	✓																							
The hamstring relaxes when the leg straightens.	✓																							
Muscles push bones.																								
				Question 2 total	7	0	0	7	0	0														

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3.	(a)			Chemotherapy Accept: 'chemo'	1			1		
	(b)	(i)	I	(Very) long half-life / remains radioactive for (very) long time / long time to become safe / long time to decay Do not accept: half-life of 5 years / tracer in body for 5 years			1	1		
			II	Bismuth(-213)			1	1		
		(ii)		decays (relatively) quickly / not active for long (1) gamma penetrates out of body / gamma detected outside the body (1) Do not accept: technetium penetrates/ it penetrates		2		2		
		(iii)	I	Showing halving (1) 4 half lives (1) 4 seen on answer line (2)		2		2	2	
			II	4 (ecf) $\times$ 25 (1) = 100 min (1) ecf		2		2	2	
		(iv)		This is only 2 half lives / there is a quarter of the radioisotope left		1		1		
				Question 3 total	1	7	2	10	4	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4.	(a)	(i)		590		1		1	1	
		(ii)		$\frac{590 \text{ (ecf)}}{50} \text{ (1)}$ $\times 100 = 1180 \text{ (\%)} \text{ (1)}$	1	1		2	2	
	(b)	(i)		Low immunity to measles Do not allow: vaccination rate has dropped	1			1		
		(ii)		Parents influenced by the media / false social media claims / thinking it was eradicated / thought that herd immunity existed / apathy / religious beliefs Do not allow: no cases of measles	1			1		
	(c)			Flu virus mutates / measles doesn't mutate / immunity after catching measles once	1			1		
				Question 4 total	4	2	0	6	3	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5.	(a)	(i)		96		1		1	1	1
		(ii)		Heart rate increases (on exercise) (1) Heart rate decreases (on resting) (1) Ecf from (a)(i)		2		2		2
		(iii)		Pump <u>blood faster</u> (1) Do not accept: pump more blood provide more {oxygen/glucose} /to remove more carbon dioxide (1)	2			2		
	(b)			STEP 1: count for a longer time period / use a monitor to count (1) STEP 4: (take a series of readings until the) heart rate drops to normal (1)			2	2		2
				Question 5 total	2	3	2	7	1	5

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6.	(a)	(i)		5s		1		1	1	
		(ii)		10s Accept 15s		1		1	1	
		(iii)	I	A-B			1	1	1	
			II	{Line/Graph} is steepest / change in distance is greatest in 5 seconds		1		1		
		(iv)		Selection of 20 (m) (1) and 15 (s) (1) Substitution (1) = 1.3/1.33 m/s (1) Answer of 0.75 due to incorrect substitution (2)	1	2 1		4	4	
	(b)			Line from D (at 20) (1) To 25 on x axis (1) No marks if two lines drawn		2		2	2	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			Calculation of Jacob's BMI: $\text{Height}^2 = 2.89$ (1) $74/2.89$ (1) $= 25.6/26$ (1) Calculation of Josie's BMI = $22.2/22$ (1) (Therefore Jacob is incorrect) OR Calculation of Josie's BMI: $\text{Height}^2 = 2.25$ (1) $50/2.25$ (1) $= 22.2/22$ (1) Calculation of Jacob's BMI = $25.6/26$ (1) (Therefore Jacob is incorrect) 3 marks max for incorrect judgement			4	4		
				Question 6 total	1	8	5	14	9	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7.				Indicative content A: Red blood cells – carry oxygen (bound to haemoglobin) B: White blood cell – defence, produce antibodies, produce antitoxins, involved in immune response, ingest bacteria C: Plasma – carry (named) food, (most) carbon dioxide, heat, other blood components, minerals, salt, water D: Platelet – clotting 5-6 marks At least 3 identified parts with functions <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> 3-4 marks. up to 2 identified parts with function <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> 1-2 marks list of up to four correctly identified parts or one non-identified part with correct function <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>	6			6		
				Question 7 total	6	0	0	6	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8/1	(a)			Any 3 × (1) from: (Same) concentration of acid (1) (Same) temperature (1) (Same) mass of calcium carbonate (1) (Same) volume of hydrochloric acid (1) Do not accept 'amount'	3			3	3	3
	(b)	(i)		40		1		1		1
		(ii)		40 (ecf)/180 (1) =0.22 / 0.2 cm ³ /s (1)		2		2	2	2
	(c)			Conclusion: The rate of reaction is faster for powdered calcium carbonate / the gas is produced more quickly for the powder (1) Explanation: Powder (calcium carbonate) has a larger surface area (1) More collisions occur (per unit time) (1)			3	3		3
				Question 8/1 total	3	3	3	9	2	9

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
9/2	(a)	(i)		$9.6/20 \times 100$ (1) $=48\%$ (1) OR 8×6 (1) $= 48\%$ (1) OR $(6/1.2) \times 9.6$ (1) $= 48\%$		2		2	2	
		(ii)		$34 \times 100/38$ (1) 89.47g / 89.5g (1)		2		2	2	
	(b)			Meal A: 0.9 (1) $\times 3 = 2.7$ (1) Meal B: $1.39 \times 2 = 2.78$ (1) (No/slight difference so equally good or bad) OR Meal A: $15(1) \times 3$ $= 45\%$ of GDA (1) Meal B: $2 \times 23 = 46\%$ of GDA (1) (No/slight difference so equally good/bad) Allow: difference is 0.08 g (2) Allow: 0.08 g higher on Thursday (3) Comparison must be clear for full marks			3	3	2	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			Jogging: $250/8.5 = 29.41$ mins (1) Cycling: $250/5.5 = 45.45$ mins (1) $45.45 - 29.41 = 16.04$ mins (1) If a method is shown allow ecf on the two calculated times Allow for (2) marks only: Jogging: $1046/8.5 = 123.05$ mins Cycling: $1046/5.5 = 190.18$ mins $190.18 - 123.05 = 67.13$ mins		3		3	3	
				Question 9/2 total	0	7	3	10	9	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3.	(a)			Indicative content - Chromosomes are found in the nucleus - A gene is a part of a chromosome - There are 23 pairs of chromosomes - Pairs of {genes/alleles} - Offspring inherit one {allele/gene} from each parent - Dominant / recessive {alleles/genes} - Dominant allele is always expressed - The combination of {genes/alleles} determine the characteristics of the child - Siblings will have different combinations of {alleles/genes} 5-6 marks Detailed description of how chromosomes and genes are inherited. Recognise that there are dominant and recessive alleles and these can give rise to different characteristics. At least 6 points from the indicative content should be covered <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> 3-4 marks Description of how chromosomes or genes are inherited. May recognise that there are dominant and recessive alleles and these can give rise to different characteristics. At least 3 points from the indicative content could be covered <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>	6			6		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				1-2 marks Description of how chromosomes or genes are inherited. OR Recognise that there are dominant and recessive alleles and these can give rise to different characteristics. 1 or 2 points from the indicative content should be covered. <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>						
	(b)			Extra chromosome (in each cell)	1					
	(c)			{DNA/genes} may be damaged (1) causing mutations /may lead to cancer / other genetic disease (1)	2					
				Question 3 total	9	0	0	9	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4.	(a)	(i)		Emits alpha as paper reduced the count (1) Aluminium makes no difference so must be gamma (1)		2		2		2
		(ii)		Use tongs/don't point towards body/keep a safe distance away/store in lead box when not in use/limit exposure time	1			1		1
	(b)	(i)		G (1) Beta will penetrate the skin but not too deep into the body (1) (relatively) long half life so the source doesn't have to be replaced too often (1) Allow C/D -will penetrate the skin (1)			3	3		
		(ii)		A / C / D (1) (Highly) ionising / short range (so doesn't penetrate healthy parts) (1) Doesn't remain active for too long (1) Or D (1) (Highly) ionising / short range (so doesn't penetrate healthy parts) (1) Active for sufficient time to destroy the cancer cells (1)			3	3		
	(c)			Sequence of halving shown / 4 half-lives stated (1) 21.(2) years (1)		2		2	2	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			{Chemicals / medicine} is used to kill cancer cells (by damaging them) (1) so they don't divide/reproduce (1)	2			2		
				Question 4 total	3	4	6	13	2	3

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5.	(a)			MRI scans – non ionising / X-rays – ionising (1) X-rays {only show bones/ don't show soft tissues} / MRI show soft tissues (+bones) (1) X-rays are 2D / MRI images can be 3D (1)	3			3		
	(b)	(i)		Sound {bounces off /reflected} (1) from boundary between tissues / different density (1)	2			2		
		(ii)		Hamstring contracts and quadriceps relax to move leg backwards (1) Hamstring relaxes and quadriceps contracts to {straighten leg /move lower leg forward} (1) Allow: one contracts and one relaxes to move the leg (1)	2			2		
				Question 5 total	7	0	0	7	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6.	(a)	(i)		For comparisons (with other region/populations)	1			1		
		(ii)		$1025 \times 100\,000 / 19\,400\,000$ (1) $= 5.28/5.3(1)$ 1025 and 19 400 000 seen – allow (1)		2		2	2	
	(b)			Any 2 × (1) from: Worries about negative news stories (eg MMR link to autism) (1) Religious /cultural beliefs which don't allow vaccination (1) Immigration/ new people moving into population (1) AND EXPLANATION Less {population vaccinated/immunity} (means more chance of spreading) (1)	3			3		
	(c)			Any 4 × (1) from: pathogens have antigens (1) white blood cells / lymphocytes (1) which stimulate antibody production (1) memory cells are produced (1) that produce antibodies very quickly if the same antigen is encountered again (1)	4			4		
				Question 6 total	8	2	0	10	2	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7.	(a)			${}_{38}^{90}\text{Sr} \longrightarrow {}_{39}^{90}\text{Y} (1) + {}_{-1}^0\beta$ ${}_{39}^{90}\text{Y} \rightarrow {}_{40}^{90}\text{Zr} (1) + {}_{-1}^0\beta (1)$ Both beta particles necessary for mark		4		4		
	(b)	(i)		correct construction line(s) (to determine one half-life) (1) = answer from candidate line – expect 29 (Value 28>T<30) (1)		2		2	2	
		(ii)		Upward curve with decreasing gradient (1) Starts at 0,0 and ends at 120,95 (1)		2		2	2	
				Question 7 total	0	8	0	8	4	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8.	(a)			{Uniform/constant} acceleration from 0-10 m/s in 10 s (1) Constant speed of 10 m/s for 10 s (1) (Constant) deceleration from 10 m/s to 0m/s in 5 s (1) 10m/s only needs to appear once to gain credit Allow: Acceleration – constant speed – deceleration (1 mark)		3		3	3	
	(b)			Selection of reduction in speed = 10 m/s and time = 5(1) Answer = $10/5 = 2$ (1) m/s ² (1) Allow 50 (1) m/s ² (1) Allow 0.5 (1) m/s ² (1)		3		3	3	
	(c)			Area of triangle: $2.5 \times 10 = 25$ (1) Area of rectangle: $10 \times 10 = 100$ (1) 100 is 4 times greater than 25 so disagree / if it was double should be 50 not 100 (1)			3	3	2	
				Question 8 total	0	6	3	9	8	0

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	6	0	0	6	0	0
2	7	0	0	7	0	0
3	1	7	2	10	4	0
4	4	2	0	6	3	0
5	2	3	2	7	1	5
6	1	8	5	14	9	0
7	6	0	0	6	0	0
8	3	3	3	9	2	9
9	0	7	3	10	9	0
TOTAL	30	30	15	75	28	14

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	3	3	3	9	2	9
2	0	7	3	10	9	0
3	9	0	0	9	0	0
4	3	4	6	13	2	3
5	7	0	0	7	0	0
6	8	2	0	10	2	0
7	0	8	0	8	4	0
8	0	6	3	9	8	0
TOTAL	30	30	15	75	27	12