



GCSE MARKING SCHEME

SUMMER 2023

**GCSE
APPLIED SCIENCE (DOUBLE AWARD)
UNIT 4 HIGHER TIER
3445UD0-1**

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 4 – PACK B

SUMMER 2023 MARK SCHEME

HIGHER TIER

General Instructions

Recording of marks

Examiners must mark in red ink.

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.

Crossed out responses not replaced should be marked.

A banded 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 all 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

ACTIVITY 1 TASK A: PLANNING - Generic Mark Scheme

	Level 1	Level 2	Level 3
Planning	<p>The candidate outlines a brief method to solve a practical problem. The candidate makes a plan to collect some relevant data without necessarily controlling variables.</p> <p>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.</p> <p>Some equipment is identified for the task. Guidance may be required.</p> <p style="text-align: center;">1-3</p>	<p>The candidate independently devises a method to solve a practical problem which, with some changes or elaboration, could be followed by another person. Most variables are controlled</p> <p>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.</p> <p>The candidate identifies the equipment needed for the task.</p> <p style="text-align: center;">4-7</p>	<p>The candidate independently devises a method to solve a practical problem, which would enable the investigation to be carried out successfully by another person. All variables are controlled.</p> <p>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.</p> <p>The candidate identifies the equipment needed for the task, without the inclusion of unnecessary apparatus.</p> <p style="text-align: center;">8-10</p>
	Total Available Marks: 10		
	Zero marks to be awarded where there is insufficient evidence to achieve a mark at level 1.		

Indicative content

1. Identifies the independent variable: depth of the water / depth	5. Produces a diagram: main equipment must be shown – tray / water / stopwatch / ruler Must be experimental set-up, not just pictures of each piece of apparatus	8. Uses appropriate scientific language: ruler or splint / stopwatch or timer or reference to timing
2. Identifies the dependent variable: time (to travel 76 cm) / owtte	6. Produces a method: must include changing IV and measuring DV	9. Uses accurate spelling: 1 mistake allowed Scientific words only
3. Identifies 1 controlled variable: {dimensions of tray / length of tray / width of tray / size of tray} / drop height / use water (fluid) / same person dropping or measuring NOT APPARATUS	7. Produces a method that would work: (must inc. repeats / correct range Must have already attained point 6	10. Uses capital letters and full stops consistently: 1 mistake allowed
4. Identifies 2 or more controlled variables: as point 3 above – any 2		

ACTIVITY 1 TASK B: COLLECTING AND RECORDING - Generic Mark Scheme for Activity 1

	Level 1	Level 2	Level 3
Collecting and Recording Data	The candidate uses procedures to collect data of low quality or of limited value or relevance. The quantity of data may be limited 1	The candidate uses procedures to collect mainly appropriate data of reasonable quality. The quantity of data is adequate for purposes of investigation. 2-3	The candidate uses procedures to collect data of high quality. The data is suitable and relevant to their investigation. The candidate collects a wide range of data for the investigation. 4-5
	The candidate partially records data or observations into a given template. 1	The candidate independently devises methods to record data. Their records of data are clear and largely error free. 2-3	The candidate independently devises their own format for recording results and accurately records data or observations to an appropriate degree of precision. Their data is recorded to a high standard and is easy to follow. All units correctly recorded. 4-5
	Total Available Marks: 10		
	Zero marks to be awarded where there is insufficient evidence to achieve a mark at level 1.		

Indicative content

Collecting Credit 2,3,4,5 from bottom table if no rough table drawn		
1. Resolution stated = 0.1 cm Allow 0.5 cm	3. All 5 depths tested	5. Repeats similar in magnitude unless identified as anomaly in rough or final table: $\pm 10\%$ of mean
2. Rough measurements taken	4. Time to travel repeated and recorded	
Recording (Bottom / best table)		
1. Clear table so that it is easy to see rows and columns AND Words or numbers clear to read	3. appropriate time column header (repeats AND {mean/average})	5. Units given (s) and depth (cm) (not in body of table)
2. appropriate 1 st column header: depth (of water)	4. Common dp used for times mean neutral water depth sf neutral	

ACTIVITY 1 TASK C: ANALYSIS - Generic Mark Scheme

	Level 1	Level 2	Level 3
Analysis of Data	<p>The candidate carries out very simple and limited processing of data.</p> <p>The candidate makes a very limited attempt to analyse and interpret data.</p> <p>The candidate gives a simple statement of findings.</p> <p>The candidate demonstrates a limited ability to structure the work in an appropriate way.</p> <p style="text-align: center;">1-3</p>	<p>The candidate carries out mainly suitable and appropriate processing of data.</p> <p>The candidate makes an appropriate interpretation of the data using mainly appropriate methods of analysis.</p> <p>The candidate gives detailed conclusions largely consistent with the evidence.</p> <p>The work is well structured and logically argued with relatively minor errors.</p> <p style="text-align: center;">4-7</p>	<p>The candidate carries out suitable and appropriate processing of data, transforming data into useful information. The candidate makes a detailed interpretation of data using suitable methods of data analysis. All their work can be easily followed.</p> <p>The candidate makes detailed conclusions consistent with the evidence. They identify and explain all the patterns within the data.</p> <p>The work is logically argued and is well structured.</p> <p style="text-align: center;">8-10</p>
	Total Available Marks: 10		
Zero marks to be awarded where there is insufficient evidence to achieve a mark at level 1.			

Indicative content

1. Mean travel times calculated correctly with suitable dp: same as data with correct rounding	4. Suitable linear scale filling most of graph paper.	8. Value dependent on graph (ecf from 7) tolerance $\pm <1$ small square
2. Mean wave speeds calculated correctly (ecf from 1 and 2) correct rounding used, common sf (2/3/4 sf)	5. All points plotted correctly $\pm < 1$ small square tolerance (ecf from 3)	9. wavelength = $46.666666/46.48$
3. Line graph of mean wave speed v depth graph plotted NB: no marks for bar chart as question told candidates to plot graph	6. Suitable line drawn: best-fit straight line or curve, not join the dots	10. answer must be to 2 sf: 46 m or 47 m
	7. Pattern described: mean wave speed increases with increasing depth (ecf)	

ACTIVITY 1 TASK D: EVALUATION - Generic Mark Scheme

	Level 1	Level 2	Level 3
Evaluating	The candidate gives a simple evaluation of the data or procedure. 1	The candidate gives a clear evaluation of their investigation/ procedure. The candidate makes an assessment of the validity and quality of evidence. 2-3	The candidate gives a detailed evaluation of their investigation/procedure. They suggest suitable/relevant improvements to their method. The candidate makes a detailed assessment of the validity and quality of data. 4-5
	Total Available Marks: 5		
Zero marks to be awarded where there is insufficient evidence to achieve a mark at level 1.			

Indicative content

<p>1. Suitability of method discussed Yes: a clear pattern is seen / {time / speed} changes with depth / reference to quality of data</p> <p>No: no clear pattern. No mark for Yes/No alone</p>	<p>3. Inaccuracy stated: Drop height / human reaction times / Judging when the wave starts or stops / resolution of ruler / tray not level at bottom / other acceptable answer</p>	<p>5. No don't agree because water waves moving against the swimmer will reduce the swimmers overall speed. Or the faster the waves could push the swimmer along so the greater his resultant speed or waves could push swimmer from the side</p>
<p>2. Qualified statement about the repeatability of the data. Repeatability because repeated values are similar / Not repeatable because repeated values are not similar No mark for repeatable/not repeatable No mark for reference to reliability</p>	<p>4. Suggested improvement: More repeats / Use of light gate timing / record and watch in slow motion / greater resolution of ruler / more precise way of measuring drop height / use a flat tray / other acceptable answer</p>	

ACTIVITY 2 TASK A: ANALYSIS - Generic Mark Scheme

	Level 1	Level 2	Level 3
Analysis of Data	<p>The candidate carries out very simple and limited processing of data.</p> <p>The candidate makes a very limited attempt to analyse and interpret data.</p> <p>The candidate gives a simple statement of findings.</p> <p>The candidate demonstrates a limited ability to structure the work in an appropriate way.</p> <p style="text-align: center;">1-3</p>	<p>The candidate carries out mainly suitable and appropriate processing of data.</p> <p>The candidate makes an appropriate interpretation of the data using mainly appropriate methods of analysis.</p> <p>The candidate gives detailed conclusions largely consistent with the evidence.</p> <p>The work is well structured and logically argued with relatively minor errors.</p> <p style="text-align: center;">4-7</p>	<p>The candidate carries out suitable and appropriate processing of data, transforming data into useful information.</p> <p>The candidate makes a detailed interpretation of data using suitable methods of data analysis. All their work can be easily followed.</p> <p>The candidate makes detailed conclusions consistent with the evidence. They identify and explain all the patterns within the data.</p> <p>The work is logically argued and is well structured.</p> <p style="text-align: center;">8-10</p>
	Total Available Marks: 10		
Zero marks to be awarded where there is insufficient evidence to achieve a mark at level 1.			

Indicative content

1.	(a)		B, D, C, E, A (1)
	(b)		Only oil with an anomaly (owtte) (1)
	(c)		Missing mean: 40.4 (1) Missing Drip speeds: 0.743, 0.600 3 sf (penalise 0.6) (1)
	(d)	(i)	Suitable straight line negative gradient (1)
		(ii)	value between 0.620 and 0.640 cm/s (1)
		(iii)	Density of bioplastic increases (linearly) with increasing density of vegetable oil (1)
2.	(a)		Any 2 for (1) Bio-fuel for the vehicles involved Powering bio-waste treatment powering bio-refinery
	(b)		Bioplastics are recycled differently (via composting) owtte (1)
	(c)		Some plastics cannot be recycled / lack of recycling facilities / need for incineration (waste to energy projects) (1)

Activity 2 Task B: Evaluation - Generic Mark Scheme

	Level 1	Level 2	Level 3
Evaluating	The candidate gives a simple evaluation of the data or procedure. 1	The candidate gives a clear evaluation of their investigation/ procedure. The candidate makes an assessment of the validity and quality of evidence. 2-3	The candidate gives a detailed evaluation of their investigation/procedure. They suggest suitable/relevant improvements to their method. The candidate makes a detailed assessment of the validity and quality of data. 4-5
	Total Available Marks: 5		
Zero marks to be awarded where there is insufficient evidence to achieve a mark at level 1.			

Indicative content

1. Suitability of method discussed Yes: a clear pattern is seen / {time/speed changes with oil type/density} / reference to quality of data	3. It is difficult to move the board and start the stopwatch at the same time owtte / easier to start stopwatch as drop passes the line / any other suitable (correct) answer	4. Contamination owtte
2. Repeats needed to spot anomalies / increase precision / calculate a mean value / reduce uncertainty		5. NO – do not agree, because travel times would be shorter so less precise / greater uncertainty / data less accurate

Activity 3: Managing Safety - Generic Mark Scheme

	Level 1	Level 2	Level 3
Managing Safety	<p>The candidate identifies some hazards and risks associated with the activity. Not all significant hazards or risks are identified.</p>	<p>The candidate writes a risk assessment which identifies the significant hazards with the activity and risks associated with the activity. They identify some suitable control measures.</p>	<p>The candidate writes a complete and suitable risk assessment for the activity. They accurately describe all the reasonable hazards and risks associated with the activity. Where necessary, they identify suitable and sensible control measures for hazards/risks listed.</p>
	<p>The candidate demonstrates a limited ability to communicate their knowledge and understanding of safety issues.</p> <p style="text-align: center;">1-3</p>	<p>The candidate demonstrates a reasonable ability to communicate their knowledge and understanding of safety issues.</p> <p style="text-align: center;">4-7</p>	<p>The candidate demonstrates an ability to communicate their knowledge and understanding of safety issues to a high standard.</p> <p style="text-align: center;">8-10</p>
Total Available Marks: 10			
Zero marks to be awarded where there is insufficient evidence to achieve a mark at level 1.			

Indicative content

Stage 1: Preparing the liquid samples Hazard - must state the hazard and nature of the hazard	Risk (must have injury and action) Only award if Hazard given No ecf from incorrect hazard	Control Measure (must be appropriate to risk and hazard) Only award if Hazard and risk given No ecf
1. Bunsen burner flame is hot (1)	2. Skin / eyes / hair (other stated body part) could be burned during heating (1)	i. Wear goggles ii. Ensure hair is tied back
3. amylase powder is an irritant (1) Accept corrosive / health hazard	4. Powder could get {on skin or in eyes /inhaled} during {measuring out / pouring /preparing / setting up / handling}	i. Wear goggles AND ii Wear (plastic / rubber) gloves / ventilation / fume cupboard (1)
5. Starch powder is a low hazard (1)	No specific risks	No specific control measures
Stage 2: Investigating the best temperature Hazard -must state the hazard and nature of the hazard	Risk (must have injury and action) Only award if Hazard given No ecf from incorrect hazard	Control Measure (must be appropriate to risk and hazard) Only award if Hazard and risk given No ecf
6. Dilute iodine solution is low hazard (1)	7. No specific risks / Can stain skin during testing for starch (1)	8. No specific control measures / wear (plastic/rubber) gloves / wear goggles (1)
9. (70 °C) water / waterbath / test tubes / apparatus / solution (in test tube) is hot (1)	10. Hot hazard could {scald/burn} skin when {transferring / handling} (1)	i. Wear goggles ii. Use test-tube holder

Skill Area	AO1	AO2	AO3	Maths	Prac
Activity 1: Planning	5	5			10
Activity 1: Collecting and recording data	9	1		2	10
Activity 1: Analysis		9	1	4	10
Activity 1: Evaluation			5		5
Activity 2: Analysis		9	1	4	10
Activity 2: Evaluation			5		5
Activity 3: Risk Assessment	10				10
Total	24	24	12	10	60