



GCSE MARKING SCHEME

SUMMER 2023

**GCSE
APPLIED SCIENCE (DOUBLE AWARD) - UNIT 1
3445U10-1 & 3445UA0-1**

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 1: ENERGY, RESOURCES AND THE ENVIRONMENT
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)			Sodium sulfate Accept compound circled in the box		1		1		1
	(b)	(i)		Colourless (1) Pink (1) Do not accept pale pink Allow bright pink			2	2		2
		(ii)		Tick (✓) 2, 4, 5 4 boxes ticked – max 2 marks 5 boxes ticked – max 1 mark		3		3		3
	(c)	(i)		11 (1) 8 (1) 1 (1)		3		3	3	3
		(ii)		Lithium/Potassium/Rubidium/Cesium/Francium Accept symbols		1		1		
				Question 1 total	0	8	2	10	3	9

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2.	(a)			solar	1			1		
	(b)	(i)		4 correct plots $\pm < 1$ small square (2) 3 correct plots $\pm < 1$ small square (1) Point to point (1) Ignore plots after 16:00		3		3	3	
		(ii)		Wind speed changes / not always windy	1			1		
		(iii)	I	1.2 MW		1		1	1	
			II	08:00		1		1	1	
			III	16:00 – 20:00 Accept 4 pm-8 pm Do not accept 4-8		1		1	1	
		(iv)		Line all the way across graph (1) No ecf for incorrect line however ecf possible for incorrect graph {13 / 00:00 – 13:00} (1) + {1 / 23:00 – 24:00} (1) = 14 hrs (1) (so disagree) 14 hours only on answer line and no line – 3 marks 14 hours only on answer line with line – 4 marks Accept workings that show its below 0.6 for 10 hours, with correct line. Therefore only above for 14 hours (4)			4	4	4	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			3600/0.6 (1) = 6000 (1)		2		2	2	
				Question 2 total	2	8	4	14	12	0

Question			Marking details			Marks Available					
						AO1	AO2	AO3	Total	Maths	Prac
3.	(a)			Plant cells	Animal cells	3			3		
			Cell wall	✓	x						
			Cytoplasm	✓	✓						
			Chloroplast	✓	x						
			Nucleus	✓	✓ (1)						
			Cell membrane	✓	✓ (1)						
			Vacuole	✓	x (1)						
(1) per row											
	(b)		<p>Indicative content Candidates can name and describe the function of the main components of a plant cell to include: Cell membrane - controls the {exit / entry} of substances Nucleus – site that contains {the chromosomes/genetic material/DNA} / controls the cell Cytoplasm – site of reactions Chloroplast – site of photosynthesis Cell wall – gives (structural) support / keeps the shape NOT protect / keeps things in Vacuole –make the cell firm / supports the cell / control the cells water balance</p> <p>5-6 marks Clear description of the function of at least five parts and functions which must be linked. <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		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				<p>3-4 marks At least three parts and functions which must be linked. <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 two parts and functions which must be linked. <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 used limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</i></p> <p>0 marks No attempt made or no response worthy of credit</p>						
				Question 3 total	9	0	0	9	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4.	(a)			Reliable	1			1		
				Inceases (1) Decreases (1)	2			2		
				Safely	1			1		
	(b)	(i)		D		1		1		
		(ii)		C		1		1		
		(iii)		$(4.8+5.8+7.1+10.8+10.1) / 38.6$ (1) $\div 5 = 7.7 / 7.72(1)$		2		2	2	
	(c)	(i)		CO ₂ produced (1) by activities (of a company /individual) (1)	2			2		
		(ii)		A = 4.8 + 63.0 = 67.8% from fossil fuels (1) This is less than D (73.8%) (1) (so incorrect) OR Sum of nuclear <u>and</u> renewable for A = 32.2, Sum of nuclear <u>and</u> renewable for D = 26.2 (1) A has more than D (1) (so incorrect) Comparisons with B, C, E can't achieve 2 nd marking point Accept for (1) only – company D has the <u>highest</u> carbon footprint			2	2	2	
				Question 4 total	6	4	2	12	4	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		The same as (1)	1			1		1
		(ii)		The same as (1)	1			1		1
	(b)	(i)	I	Current = $4.5/2.25(\text{subs})(1) = 2$ (1)	1	1		2	2	2
			II	Power = 2 (ecf) \times 4.5 (subs) (1) = 9W (1)	1	1		2	2	2
		(ii)		4.5V		1		1		1
	(c)	(i)		A_2		1		1		1
			(ii)		9V		1		1	1
		(iii)	I	4A		1		1		
			II	8A (ecf)		1		1		
				Question 5 total	4	7	0	11	4	8

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6/1	(a)	(i)		Acid can {spill/splash/transfer} onto {skin/eyes} {whilst handling/pouring}	1			1		1
		(ii)		Wear gloves/goggles	1			1		1
	(b)			ZnSO ₄ (1) H ₂ O (1)		2		2		2
	(c)			Filter (1) (to remove ZnO) <u>Evaporate</u> water / leave in <u>evaporating</u> dish for a few days / allow to dry in <u>evaporating</u> dish (1) Not heat	2			2		2
	(d)			(Zn) 65 + (O) 16 (1) = 81 (1) (so Robert is incorrect)			2	2	2	
				Question 6 total	4	2	2	8	2	6

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
7/2	(a)	(i)	<p><u>Concentration</u> (of dye) (1) Do not allow: blue dye</p>	1			1		1
		(ii)	<p>Any 2 × (1) from: Length/size/diameter of chip (1) Temperature/ water bath at 20°C / 20°C (1) Volume of {solution/dye} (1) Same concentration (of dye) in each tube <u>at start</u> (1)</p> <p>Do not allow: How much potato / concentration / same time /colour / amount of dye</p>	2			2		2
	(b)	(i)	(Concentration of dye/it) decreases (1)		1		1		1
		(ii)	<p>{Movement/diffusion} (of dye) <u>into</u> {the cell/potato/chip/cylinder} (1) From high conc to low conc / down a concentration gradient (1)</p> <p>Do not allow: absorbed</p>	2			2		2
	(c)		<p>Decreases (at a decreasing rate) for 60 minutes (1)</p> <p>No change {between 60 and 80 minutes/ after 60 min/last 20 min} accept: last 10 min/stops changing at 60 min (1)</p> <p>If rate of diffusion was constant there would be a straight line sloping downwards (1)</p> <p>so disagree – judgement needed for (3) marks</p>			3	3		3

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			Start at 14 (1) Curve below the one plotted line <u>and</u> flattens at 7 before 60 minutes (1)			2	2	2	2
				Question 7 total	5	1	5	11	2	11

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
3.	(a)		0.8 (1) Conversion to 800 kW (1) 6 hrs (1) $800 \times 6 = 4800$ (1) ecf can be allowed for incorrect data taken from the graph as long as working shown Answer of 4.8×10^n on answer line – 3 marks where n is not 3	1	3		4	4	
	(b)	(i)	$3600/0.6 = 6000$ (1) $6000 \times 3 = 18\,000$ (1)		2		2	2	
		(ii)	6000 (1) 6000×0.55 (1) = 3300 km^2 (1) Allow: answer for part (i) $\times 0.55$ (1) = ans (1) e.g. $18\,000 \times 0.55$ (1) = 9900 (1)		3		3	3	
	(c)	(i)	Cost of generating electricity per kW/hr is 2.8p with nuclear compared with 5.6 p for wind/ nuclear unit is half the price of wind (1) Need to replace wind turbine 3 times / Need 18 000 turbines for each nuclear power station / accept you need 6000 turbines (1) $\pounds 54\,000$ million compared $\pounds 4000$ million for one nuclear power station (over lifetime) (1) No numerical values – 0 marks			3	3		

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
		(ii)	No waste by wind compared to <u>radioactive</u> waste in nuclear (1) { <u>more</u> land required / <u>more</u> habitats destroyed/ <u>more</u> visual pollution} for the equivalent number of wind turbines (1)			2	2		
	(d)		Carbon footprint is much <u>greater</u> in a coal fired power station (1) As it (continually) <u>burns</u> coal (which releases CO ₂) (1)	2			2		
			Question 3 total	3	8	5	16	9	0

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
4			<p>Indicative content Inspiration</p> <ul style="list-style-type: none"> • Intercostal muscles contract • Rib cage moves up / out • Diaphragm contracts / flattens (moves down) • Increase in volume/decrease in pressure (so air rushes in) <p>Limitations</p> <ul style="list-style-type: none"> • bell jar represents ribs – this is rigid / does not move • No intercostal muscles – no ribs moving up and out • Diaphragm is curved in body and flattens - but is pulled down in the model <p>5-6 marks at least 5 points <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 three points <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 two points <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 used limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</i></p>	4		2	6		

Question				Marking details	Marks Available						
					AO1	AO2	AO3	Total	Maths	Prac	
				0 marks No attempt made or no response worthy of credit							
				Question 4 total	4	0	2	6	0	0	

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
5.	(a)		<p>Any 2 pairs of marks:</p> <p>Less energy is used to produce bioplastic (1) So less carbon footprint to produce electricity / less impact on global warming / climate change / greenhouse effect (1)</p> <p>does not rely on crude oil / made from plants <u>not oil</u> / does not rely on fossil fuel (1) renewable /crude oil is limited/less CO₂ produced (1)</p> <p>biodegradable (1) so less land fill / can be used as {biofuels/compost} (1) Not litter: / plastic waste</p> <p>requires less water (1) saves natural resources/less processing of water (1)</p> <p>smaller carbon footprint (1) less impact on global warming / climate change / greenhouse effect (1)</p> <p>less landfill (1) Less habitats destroyed / less land used (1)</p>	2	2		4		

Question		Marking details		Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
	(b)		<p>(Land is used to grow plants to make bioplastic) Encourages deforestation reduce habitats / reduces biodiversity (1)</p> <p>OR reduce habitats (1) reduces biodiversity (1)</p> <p>OR Land not used for food production (1) Decreased availability to food / may lead to food shortages (1)</p> <p>OR When it biodegrades it produces methane, carbon dioxide and water / greenhouse gases (1) Which add to greenhouse effect / global warming / climate change (1)</p> <p>OR energy is used to produce bioplastic (1) So impact on global warming / climate change / greenhouse effect / carbon footprint (1)</p> <p>OR requires water (1) uses natural resources/processing of water (1)</p> <p>OR has a carbon footprint (1) impact on global warming / climate change / greenhouse effect (1)</p> <p>OR uses landfill (1) habitats destroyed / less land used (1)</p>		2		2		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			How much CO ₂ equivalent is absorbed by the plant as it is grown (1) Needs to be at least 0.5 gCO ₂ Eq / kg (1)		1	1	2		
				Question 5 total	2	5	1	8	0	0

Question				Marking details	Marks Available						
					AO1	AO2	AO3	Total	Maths	Prac	
6.	(a)	(i)	I	<p>the resistance in the parallel circuit is smaller (1) by 4 × (1)</p> <p>Accept converse answer Accept 'it' as parallel</p> <p>OR</p> <p>Total resistance in series circuit = 2 × R₁ (1) Total resistance in parallel circuit = R₁/2 (1)</p> <p>OR</p> <p>The total parallel resistance is 4.5/4 (1) =1.125 (1)</p>		2		2			3
			II	<p>parallel is (4 ×) bigger than series OR Current is 8 A</p>		1		1			
		(ii)		<p>The voltmeter reading in the parallel circuit is more (1) by 2 × (than the series circuit) (1)</p> <p>OR</p> <p>Voltmeter reading is 9V in parallel (1) 4.5 V in series (1)</p> <p>OR</p> <p>The voltage is shared in series / not shared in parallel (1) So voltmeter reading is bigger in parallel (1)</p>		2		2			1

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
		(iii)	The power {lost/dissipated} in R1 is greater in the parallel circuit (1) By 4 times (1)		2		2		2
	(b)	(i)	Current = $9/2.25$ (1) = 4 [A] (1) Power = 4 (ecf) \times 9 (1) OR Power = $4^2 \times 2.25$ (1) = 36 [W] (1)	1 1	1 1		4	4	4
		(ii)	$\frac{1}{4}$ of 36W (ecf) (1) = 9W (1) OR $9/4.5 = 2$ (1) Power = $2 \times 4.5 = 9$ (1) OR $9/4.5 = 2$ (1) $2^2 \times 2.25 = 9$ [W](1)		2		2	2	2
			Question 6 total	2	11	0	13	6	10

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
7.	(a)		(i) (graphite) anode (1) (ii) Molten aluminium (1) (iii) (graphite) cathode (1)	3			3		
	(b)		$2 \text{ Al}_2\text{O}_3 \rightarrow 4 \text{ Al} + 3 \text{ O}_2$ (1) one mark for balancing (1) formulae must be correct to obtain balancing mark		3		3		
	(c)		Any 3 × (1) from: At cathode/negative electrode – aluminium <u>ions</u> gain (three) electron(s) (1) (Is reduced) and forms aluminium <u>atoms</u> (1) At anode / positive electrode – oxide (ions) lose electrons / oxidized (1) Forms oxygen (molecules) (1) Allow for (1) Aluminium ions gain electrons and oxide (ions) lose electrons	3			3		
	(d)	(i)	Any 2 × (1) from: Less cost of transport of Al ore to the UK (1) Lower cost of labour (1) no {mining/extraction} aluminium (ore) is required (1) less electrical energy needed to recycle / lower energy cost (1) do not accept 'less cost' unless qualified	2			2		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		Less waste in landfill (1) Less habitats destroyed / less land used (1) OR Less energy used for recycling (1) So less impact on global warming / climate change / greenhouse effect / carbon footprint (1)	2			2		
				Question 7 total	10	3	0	13	0	0

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
Question 1 total	0	8	2	10	3	9
Question 2 total	2	8	4	14	12	0
Question 3 total	9	0	0	9	0	0
Question 4 total	6	4	2	12	4	0
Question 5 total	4	7	0	11	4	8
Question 6 total	4	2	2	8	2	6
Question 7 total	5	1	5	11	2	11
Total	30	30	15	75	26	34

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
Question 1 total	4	2	2	8	2	6
Question 2 total	5	1	5	11	2	11
Question 3 total	3	8	5	16	9	0
Question 4 total	4	0	2	6	0	0
Question 5 total	2	5	1	8	0	0
Question 6 total	2	11	0	13	6	10
Question 7 total	10	3	0	13	0	0
Total	30	30	15	75	19	27