



GCSE MARKING SCHEME

SUMMER 2023

**GCSE
APPLIED SCIENCE (SINGLE AWARD) - UNIT 1
3440U10-1 & 3440UA0-1**

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 1: SCIENCE IN THE MODERN WORLD

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

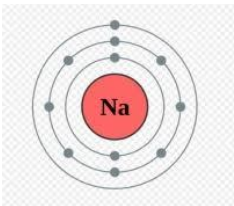
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

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)	(i)		Inner (core)	1			1		
		(ii)		Outer (core)	1			1		
		(iii)		Crust	1			1		
	(b)			Ticks next to boxes 1 (1) 3 (1) 5 (1) 4 boxes ticked – 2 marks max 5 boxes ticked – 1 mark max	3			3		
	(c)	(i)		mining (1) fracking (1) If no response on the dls, accept words circled in the box	2			2		
		(ii)		Metal	1			1		
				Question 1 total	9	0	0	9	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2.	(a)	(i)		Units = $0.005 \times 15\,000$ (1) = 75 kWh (1)	1	1		2	2	
		(ii)		225 [kWh] (ecf)		1		1	1	
		(iii)		225 (ecf) $\times$ 30 (1) = 6750 p (1) Accept £67.50 (2) Allow £6750 for (1) only Allow 67.5 for (1) only if no working shown 675 – no marks	1	1		2	2	
	(b)	(i)		They have the same voltage / can be operated separately / when one breaks the others still work Accept: all brighter	1			1	1	
		(ii)		12/240 (1) = 0.05 A (1)		2		2	2	
		(iii)		3×0.05 (ecf) = 0.15 A		1		1	1	
				Question 2 total	3	6	0	9	9	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3.	(a)	(i)		increases (1) decreases (1) ref to 40-45°C / ref to 49 g (1) Increases then decreases – 2 marks Decrease then increase – 0 marks		3		3		3
		(ii)		27°C		1		1	1	1
	(b)	(i)		All plots correct ($\pm$ <1 small square) (2) 6 correct ($\pm$ <1 small square) (1) <6 correct (0) Straight line (1)		3		3	3	3
		(ii)		MOST sodium carbonate → ammonium chloride potassium chloride sodium chloride All correct (2) one correct (1)			2	2	2	2
	(c)			Pair of temperatures selected that show doubling e.g. 10°C and 20°C, 20°C and 40°C, 30°C and 60°C (1) Corresponding solubilities e.g. 24 and 29, 29 and 39, and 34 and 49 (g per 100 g of water) (1) which are less than double (so disagree) / doubled values shown e.g. 24 should be 48 / 29 would have been 14.5 at start / 29 is not double 24 etc.....(1) no data – no marks except for: no because line doesn't go through origin for (1) only			3	3	3	3
				Question 3 total	0	7	5	12	9	12

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4.	(a)	(i)		 11 electrons (1) arranged 2,8,1 (1) 2:8:1 written only (1) mark		2		2		
		(ii)		They have different atomic numbers / they have different mass numbers / they have different numbers of electrons / K has 19 and Na has 11 / K has eight more (protons) (so disagree) Reference to neutrons neutral			1	1		
	(b)			$16 \times 3 / 48 / 3 \times O$ (1) $23 + 14 + 48$ (ecf) = 85 (1) Do not allow $23+14+16 = 53$		2		2	2	
	(c)			KOH (1) H ₂ O (1)		2		2		
	(d)			Elements are composed of {one <u>type</u> of / the same} atom(s) (1) Compounds are made of {two (or more) types of / different} atom(s) (that are chemically joined) / compounds are made from elements (1) ref to mixtures neutral	2			2		

Question				Marking details	Marks Available											
					AO1	AO2	AO3	Total	Maths	Prac						
	(e)	(i)		<table><tr><td>1</td><td>5</td><td>2</td><td>3</td><td>4</td><td>6</td></tr></table> All correct (3) 2 or 3 correct (2) 1 correct (1)	1	5	2	3	4	6	3			3		
1	5	2	3	4	6											
		(ii)		Food chains (1) Toxic (1)	2			2								
				Question 4 total	7	6	1	14	2	0						

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5.				Indicative content: 1. Measure the area using the tape measures (at right angles) 2. Work out how many quadrats fit in the area 3. Roll the (two 20-sided) dice to determine the coordinates (accept other randomization methods) 4. Place the quadrat (at the place where the coordinates meet). 5. Count the number of daisy (plants) within the quadrat and record this result. 6. Repeat (steps 3-5 for at least 5) quadrats 7. Calculate the mean daisies per quadrat 8. Multiply up from the mean for area of 20×20 5-6 marks Detailed method including at least 5 of the points above, one of which must be points 6,7, or 8 <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 Method including at least 3 of the points above. <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 Limited method <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> 0 marks <i>No attempt made or no response worthy of credit.</i>	6			6		6
				Question 5 total	6	0	0	6	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6.	(a)	(i)		Any 2 × (1) from: Both have 4 (black) <u>lines</u> (1) <u>Lines</u> in {C/2} are moved closer to red / to the right / (corresponding black) <u>lines</u> have longer wavelengths in {C/2} (1) Same (background) spectrum / same colours (1) Accept: (black) <u>lines</u> are the same distance apart (1)		2		2		
		(ii)		{1 / B / it} is moving (away) slower / {2/C} is faster		1		1		
		(iii)		{B / 1 / it} is closer / {2/C} is further away		1		1		
	(b)			Absorbed (1) atoms of gas (1)	2			2		
				Question 6 total	2	4	0	6	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7/1	(a)	(i)		8 m		1		1	1	
		(ii)		04:00 / 4 o'clock Accept 4		1		1	1	
		(iii)		12 hours		1		1	1	
		(iv)		At {00:00/ 06:00/ 12:00/18:00/24:00} (1) Any 2 × (1) from: the sea water level is the same as water level behind the barrage (1) so no water flow through barrage (1) Turbines do not rotate (so no electricity produced so disagree) (1) Accept for (1) only: water is always flowing Accept for (2) only: water is always flowing so turbines always {rotate / create electricity}			3	3		
	(b)	(i)		Selection of 12 000 [kW] and 15 000 [kW] (1) 80% (1) Which is 4 × bigger than 20 so agree (1) Justification is needed for 3 marks			3	3	3	

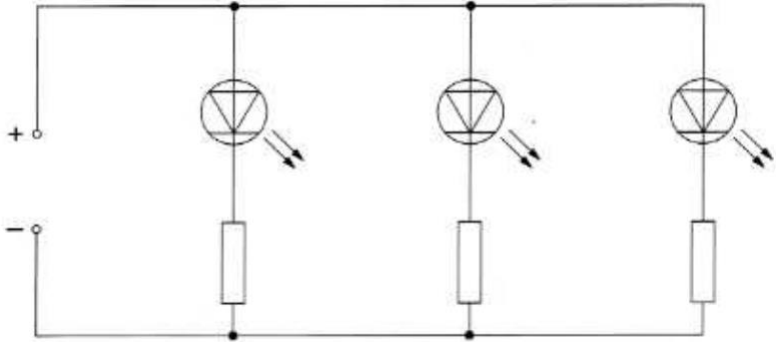
Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		Selection of 12 000 [kW] and 4.8 [kV] (1) 12 000/4.8 (1) subs Ans = 2 500 A (1) $2.5 \times 10^n = 2$ marks where n is not = 3	1	1 1		3	3	
		(iii)		Selection of 2500 [kW](1) $\times 25$ = 62 500 [kW] (1) 62 500 (ecf)/0.4 = 156 250 (so agree) (1)			3	3	3	
	(c)			$410 \times 135\,000$ (1) ($\times 1$) = 55 350 000 kg (1) No ecf		2		2	2	
	(d)			Advantages: Tides are predictable / wind is not secure power source would need lots of wind turbines less noise pollution longer lifespan less visual pollution more efficient Disadvantages: (greater) impact on habitats /marine life Uses lots of concrete to build Hard(er) to repair Takes longer to build Ref to global warming neutral	2			2		
				Question 7/1 total	3	7	9	19	15	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2.	(a)			Mantle (1) {Liquid / outer} core (1) {Inner / solid / iron} core (1)	3			3		
	(b)			On the edges of {continents/coastlines} (e.g. the west coast of Africa and the east coast of South America) Jigsaw-like fit of the edges (1) {Similar/same} rocks (of the same age) (1) Similar (plant and animal) fossils (1)	3			3		
	(c)			(surface and subsurface) mining - metal (ores) or coal (1) Fracking – <u>shale</u> gas (1) Drilling – (crude) oil (1) If no pairs correct, allow one mark only for the three extraction methods or three raw materials	3			3		
				Question 2 total	9	0	0	9	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3.	(a)	(i)		$\text{KOH} + \text{HNO}_3 \rightarrow \text{KNO}_3 + \text{H}_2\text{O}$ LHS (1) RHS (1)		2		2		
	(b)	(i)		Correct A_r : 1, 14 and 16 (1) $16 \times 3 = 48$ (1) $M_r = 63$ (1) Answer of 32 – 2 marks Answer of 24 – 1 mark		3		3	2	
		(ii)		Sodium has 11 electrons <u>and</u> potassium has 19 / both have one electron in the outer shell / potassium has 8 more electrons / sodium's electronic structure is 2:8:1 <u>and</u> potassium is 2:8:8:1 (1) Sodium has 11 protons <u>and</u> potassium has 19 / potassium has 8 more protons (1) Sodium has 12 neutrons <u>and</u> potassium has 20 / potassium has 8 more neutrons (1) Potassium has more protons, electrons and neutrons (than sodium) – (1) only if no other marks awarded		3		3		
				Question 3 total	0	8	0	8	2	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4.				Any 3 × (1) from: Plants absorb more nitrates / produce more protein (1) Less nitrate remains in the soil (1) Less rain expected in spring (1) So less {run off / leaching / in water systems} (1) AND 2 marks Less {eutrophication / algal bloom / contamination of water} (1)	4			4		
				Question 4 total	4	0	0	4	0	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5.	(a)			Halogen lamp power = 0.05 kW (1) Units used over 15 000 h = 0.05 (ecf) $\times$ 15 000 = 750 (1) Running cost of each halogen lamp = 750 (ecf) $\times$ 0.3 = £225 (1) Running cost of 3 halogen lamps = £675 (1) Running cost of 3 LED = 675 (ecf)/10 = £67.50 (1) (Cost of lamps is the same since need to buy 6 sets of halogen lamps) Saving to homeowner is £675 (ecf) - £67.50 (ecf) = £607.50 (so worth paying the extra £10 for the LED lamp at the start) (1) Or Halogen lamp power = 0.05 kW (1) Units used over 2500 h = 0.05 (ecf) $\times$ 2500 = 125 (1) Running cost of each halogen lamp = 125 (ecf) $\times$ 0.3 = £37.50 (1) Running cost of 3 halogen lamps = £112.50 (1) Running cost of 3 LED = 112.5 (ecf)/10 = £11.25 (1) (Cost of lamps is the same since need to buy 6 sets of halogen lamps) Saving to homeowner is £112.50 (ecf) - £11.25 (ecf) = £101.25 (so worth paying the extra £10 for the LED lamp at the start) (1) The lamps need to be compared over the same length of time			6	6	6	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		Led and resistor symbols (1) 3 pairs in parallel (1) To correct battery symbol / mains supply symbol (1) 	3			3		
		(ii)		$1/240 + 1/240 + 1/240$ (1) $= 3/240$ (1) $R = 240/3 = 80 \Omega$ (1)		3		3	3	
	(c)			Higher up the food chain (mercury) concentrations become higher and higher / bioaccumulation (1) Reach <u>toxic / poisonous</u> levels	2			2		
				Question 5 total	5	3	6	14	9	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6.	(a)			Indicative content: - Add slightly more weighed solute than will dissolve to a measured volume of water at room temperature - heat solution until all solute dissolves - allow to cool and record temperature at which crystals first appear - repeat several times and determine solubility at each temperature in g/100 g of water - and plot solubility curve OR - Add known mass of solute to a measured volume of water at room temperature - which will only dissolve a portion of the solute; - filter, dry and weigh excess solute; determine solubility - repeat several times and determine solubility at each temperature in g/100 g of water - and plot solubility curve 5-6 marks Clear description of how the mass of solute is calculated and planned for measuring the solubility at a range of temperatures for a fixed volume of water. <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 Clear description of either how the mass of solute is calculated OR planned for measuring the solubility at a range of temperatures for a fixed volume of water. OR Part description of both. <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		6

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				1-2 marks Limited description of either how the mass of solute is calculated OR planned for measuring the solubility at a range of temperatures for a fixed volume of water. <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> 0 marks <i>No attempt made or no response worthy of credit.</i>						
	(b)	(i)		Any 2 × (1) from: At the start sodium nitrate is more soluble than potassium nitrate (1) At the end potassium nitrate is more soluble than sodium nitrate (1) the solubility of potassium nitrate increases at a greater rate (1) + solubilities the same at 67°C (1)		3		3		3
		(ii)		At 60°C solubility is 28 g/100g water (1) So solubility is 56 g/200 g water (1) Remaining mass = 44 g (1) Accept 72 for (2) marks		3		3	3	3
				Question 6 total	6	6	0	12	3	12

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7.	(a)			Sodium Y Hydrogen Y Oxygen N Helium Y All correct (3) 2 or 3 correct (2) 1 correct (1)		3		3		
	(b)			Conversion of 410 to 410×10^{-9} (1) Rearrange and subs $3 \times 10^8 / 410 \times 10^{-9}$ (ecf) (1) Answer = $7(.3) \times 10^{14}$ Hz (1) $7 \times 10^n - (2)$ if n is not 14		3		3	3	
	(c)			The wavelengths (of the emitted radiation) are lengthened / so (black) lines are red shifted (1) due to the expansion of the Universe (1) following the Big Bang (1) (1)	3			3		
				Question 7 total	3	6	0	9	3	0

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	9	0	0	9	0	0
2	3	6	0	9	9	0
3	0	7	5	12	9	12
4	7	6	1	14	2	0
5	6	0	0	6	0	6
6	2	4	0	6	0	0
7	3	7	9	19	15	0
TOTAL	30	30	15	75	35	18

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	3	7	9	19	15	0
2	9	0	0	9	0	0
3	0	8	0	8	2	0
4	4	0	0	4	0	0
5	5	3	6	14	9	0
6	6	6	0	12	3	12
7	3	6	0	9	3	0
TOTAL	30	30	15	75	32	12