GCSE MARKING SCHEME

SUMMER 2022

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

INTRODUCTION

This marking scheme was used by WJEC for the 2022 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 2022 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

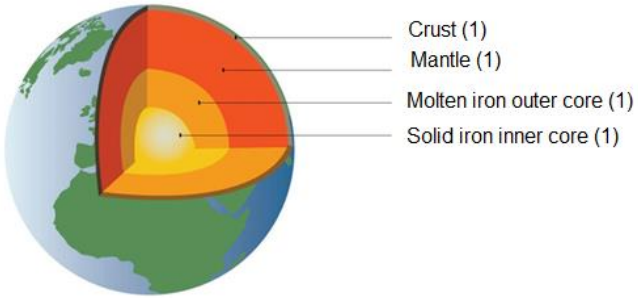
A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide 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)			12 2 boxes ticked (0)		1		1		
	(b)			40 2 boxes ticked (0)		1		1		
	(c)			2,8,8,2 2 boxes ticked (0)		1		1		
	(d)			No because they {have different atomic numbers / different number of protons / different bottom number} Accept: they are different elements Reference to mass no./different nucleus neutral			1			
				Question 1 total		**3**	**1**	**4**		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2.	(a)			 For molten iron outer core accept: Molten core / outer core For solid iron inner core accept: Solid core / inner core	4			4		
	(b)	(i)		drift	1			1		
		(ii)		Any 2 × (1) from: Jigsaw-like fit of the edges of continents / continents fit together / accept South America and Africa used to be one (1) {Similar/same} rocks (of the same age) found on different continents (1) {Similar/same} (plant and animal) fossils found on different continents (1) Accept countries for continents	2			2		
		(iii)		Any 2 × (1) from: Crust made from plates (1) (Slowly) moving (over time) (1) Movement caused by {convection / mantle / currents in mantle} (1) Accept sections/large pieces for plates Neutral: plates underground	2			2		

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td></td><td></td><td>(iv)</td><td></td><td>Earthquakes (1)
(production / eruption of) volcanoes (1)

Accept: Tsunamis</td><td>2</td><td></td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td></td><td>Any 3 × (1) from:

<table><tr><th>Present day:</th><th>4 billion years ago:</th></tr><tr><td>Less carbon dioxide (1) do not accept no carbon dioxide</td><td>More carbon dioxide (1)</td></tr><tr><td>oxygen (present) (1)</td><td>No oxygen (1)</td></tr><tr><td>nitrogen (present) (1)</td><td>No nitrogen (1)</td></tr><tr><td>no ammonia (today) (1)</td><td>ammonia (present) (1)</td></tr><tr><td>no methane (today) (1)</td><td>methane (present) (1)</td></tr><tr><td>argon (today) (1)</td><td>No argon (1)</td></tr></table>
Credit each row only once
Assume answers refer to present day unless stated otherwise
If more than three answers given, where one answer is incorrect, award 2 marks max</td><td></td><td>3</td><td></td><td>3</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>Photosynthesis (1)</td><td>1</td><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 2 total</td><td>12</td><td>3</td><td></td><td>15</td><td></td><td></td></tr>
</table>

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3.	(a)	(i)		Gamma rays X rays Visible microwaves radio waves One correct (1) Two correct (2) All correct (3) If Aled's column is numbered, accept numbers in order column Accept arrows	3			3		
		(ii)		Ultra violet / UV (1) Infra red / IR (1) Do not accept ultra / violet / infra / red Neutral: gamma/x-ray/visible/microwaves/ radio wave	2			2		
	(b)			Substitution: 300 000 000/1.5(1) = 200 000 000 / 2 $\times 10^8$(1) Unit of Hz / Hertz (1) Correct answer only (2)	1 1	1		3	2	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)	(i)		Any 2 × (1) from: ice caps melt (faster) (1) rising sea levels (1) Increased temperature / accept global warming / accept becomes hotter / climate change (1) Changing weather patterns / more droughts / more flooding (1) Accept: destruction of habitats (1) animals become extinct (1) more bush fires (1)	2			2		
		(ii)		Any 3 × (1) from: switch to electric cars / ride your bike / use public transport / walk / less flying (1) Use less coal or gas in the home / solar panels on your home / heat pumps in your home / renewables (1) Use less fossil fuel power stations / use (more) nuclear power / more wind farms / more solar power / more tidal power / more hydroelectric power / use renewables (1) (Better) home insulation (1) Carbon capture (1) Plant more trees / stop cutting down trees (1) Use low energy appliances / don't leave appliances on standby when not in use (1) Recycling (materials) / reusing item (1) Eat less meat (1) Neutral: eco friendly Only accept the word 'renewables' once	3			3		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(d)			Any 2 × (1) from: respiration (1) movement (1) waste materials (1) incomplete digestion (1) reference to growth/reproduction neutral	2			2		
				Question 3 total	**14**	**1**		**15**	**2**	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4.	(a)			230 × 0.02 (subs) (1) = 4.6 W (1) 4.6 only on answer line (2)	1	1		2	2	
	(b)	(i)		LE = 30 (J)(1) HE = 70 (J)(1) Don't penalise incorrect unit		2		2	2	
		(ii)		Efficiency =2.2/44 (1) × 100 = 5 (%) (1) 5 only on answer line (2) 0.05 on answer line (1)	1	1		2	2	
	(c)	(i)		2 300 - 600 = 1 700		1		1	1	
		(ii)		1 700 (ecf) × 0.35 = 595		1		1	1	
		(iii)		595 (ecf)		1		1	1	
				Question 4 total	**2**	**7**		**9**	**9**	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5.	(a)			**Indicative content** How heat loss is reduced: 1. Reduce conduction • Air is trapped (between the glass panes) • Air is an insulator 2. Reduce convection (outside the window) • Air outside window heats up less Advice: No because: 1. Most expensive type 2. Smallest reduction in heat loss 150 J/s 3. Longest payback time OR 1. Install loft insulation first 2. It's the cheapest 3. Biggest reduction in heat loss 580 J/s 4. Shortest payback time OR 1. Install cavity walls first 2. A bigger reduction in heat loss 460 J/s 3. Shorter payback time 4. cheaper than double glazed windows Allow 'mix and match' but only credit cost of installation once		2	2	6		6

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				5-6 marks **At least 5 points including reference to heat transfer section** *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.* **3-4 marks** **At least 3 points from any region** *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.* **1-2 marks** **Up to two points from any region** *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.* **0 marks** *No attempt made or no response worthy of credit.*						
	(b)	(i)	I	830 – 250 = 580 (1) 670 – 210 = 460 (1) Total = = 580 (ecf) + 460 (ecf) = 1 040 (1) Ecf only applied if subtractions shown		3		**3**	**3**	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
			II	1 040 (ecf)		1		**1**		
		(ii)	I	800 + 1 300 = 2 100 (1)		1		**1**	**1**	
			II	2 100 (ecf)/150 (1) = 14 (1)		2		**2**	**2**	
				Question 5 total	**2**	**9**	**2**	**13**	**7**	**6**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6./1.	(a)			A: potassium / K^+ (1) iodide / I^- (1) B: calcium / Ca^{2+}(1) carbonate / CO_3^{2-}(1) Accept formulae KI, $CaCO_3$ Do not accept iodine for iodide			4	4		4
	(b)			Any 3 × (1) from: Chlorine is (too) high (1) pH is (too) low / acidic (1) Hardness ideal (1) bromine ideal (1) total alkalinity is low (1) Conclusion must be present for full marks If mixture of ideal and problems accept a conclusion uncertain/disagree			3	3		3
	(c)	(i)		Y scale (0.1 per 2cm accept 0.11 per 2cm) points occupy at least half the grid(1) 5 correct plots, ignore 0,0 (<1 small square tolerance) (2) 4 correct plots (<1 small square tolerance) (1) Straight line of best fit to 0,0 (1) Scales of 1 → 2 → 3 etc or 10→20 etc just penalise scale mark Seen x-axis scale 0.1 →0.2 etc lose scale mark Non-linear X or Y axis scale / no scales / bar chart (total 0)		4		4	4	4

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		As concentration increases so does absorbance (1) At a constant rate (1) Accept In direct proportion (2) Every 0.01 increase in concentration the absorbance increases by 0.11 (2) Accept 11 times more / 11:1 ratio (2)		2		2	2	2
		(iii)		Read from graph – expect 0.032 (± 0.002) Accept reading from candidates graph		1		1	1	1
		(iv)	I	Need to change filter (1) to blue / greenish-blue (1) test iodine solutions of known concentration / plot new calibration curve and (measure absorbance of the unknown)(1)			3	3		3
			II	All light passes through (a colourless solution) (1) Different concentrations will remain colourless/unable to tell the concentration of a colourless solution/different concentration will give the same result/ no difference in results whatever filter used (1)			2	2		2
				Question 1/6 total		**7**	**12**	**19**	**7**	**19**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2.	(a)			230 × 22 (1) =5 060 (1) / 1 000 = 5.06 W (1) 5.06 on answer line (3) 5 060 an answer line (2)	1	1 1		3	3	
	(b)			5 = useful power/42 (1) × 100 (1) = 2.1 W (1) 210 W (2) Final answer of 2.1 then additional procedure (2)	1	1 1		3	3	
				Question 2 total	**2**	**4**		**6**	**6**	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3.	(a)	(i)		Less energy lost (per minute) (1) Less money spent on {heating bills/fuel/ energy} (1) Less use of fossil fuels / less additions to greenhouse gases (so agree) (1)			3	3		
		(ii)		Loft: 58 100 – 15 600 = 42 500 (1) Cavity wall: 43 800 – 14 200 = 29 600 (1) Total/60 = 1 202 / 1 201.67 / 1 201.7 J (1) 72 100 (2) 1 698.33 (1) 496.67 (1)		3		3	3	
		(iii)		1.2 kW (previous answer /1 000)		1		1	1	
	(b)	(i)		Units = 32 × 0.5 (1) = 16 (1) Cost = 16 (ecf) × 12 = 192 (p) (1) Weekly = 1 344 (p) (1) 1 344 (4) 9 408 (3) 10 752 (3) 192 (3) 112 (3) 1 536 (2) 16 (2)		4		4	4	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		Answer (b)(i) / 100 (1) = 178.6 or 179 weeks (1) ecf answer from (b)(i) 1.79 (1)		2		2	2	
				Question 3 total		**10**	**3**	**13**	**10**	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4.	(a)	(i)		**Indicative content** Causes: • hardness in water is caused by the presence of Ca^{2+} and Mg^{2+} ions • from dissolved calcium and magnesium compounds) • Temporary hardness caused by HCO^{3-} • permanent harness caused by SO_4^{2-} Action with soap: • hard water forms a 'scum' and poor lather when shaken with soap solution. • Soft water lathers easily • Takes less soap to form lather with soft water compared to hard Effect on hot water system: • Hard water causes boilers and hot water pipes become 'furred up' as calcium carbonate precipitates • boilers become less efficient • pipes can become completely blocked. **5-6 marks** **At least 5 points from 3 areas** *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.*	6			6		6

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				3-4 marks **At least 3 points from at least 2 areas** *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.* **1-2 marks** **Up to 2 points from any area** *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.* **0 marks** *No attempt made or no response worthy of credit.*						
		(ii)		Improves heart health / strong teeth or bones (1) Because of mineral content e.g. magnesium /calcium (1) Points must be linked	2			2		
		(iii)		Any 3 × (1) Advantages: • removes temporary and permanent hardness (1) • is a continuous process; (1) • uses {salt solution / sodium chloride/sodium and chloride ions} which is {cheap/widely available} (1) Disadvantage: • exchange columns are expensive (1) • needs to be regenerated after a period of time (1) At least one advantage and one disadvantage for full marks	3			3		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)			Acts as a disinfectant / oxidises / bleach / sterilizes (1) Inhibits the growth of harmful micro-organisms / removes odour / removes colour (1)	2			**2**		
	(c)			Breaking down {organic matter/carbohydrates} (1) into carbon dioxide and water / by (aerobic) respiration (1)	2					
				Question 4 total	**15**			**15**		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5.	(a)			$(Fe_2O_3) + 3CO \rightarrow 2\ Fe + 3CO_2$ LHS (1) RHS (1) balancing (1)	1	2		3	1	
	(b)			Any 2 × (1) from: Iron reacts with {oxygen / water} (1) Causing corrosion / rust (1) Making it become weaker (1)	2			2		
	(c)			Any 3 × (1) from: Ore is extracted from the ground by mining (1) Cost of raw materials (1) High energy costs when using blast furnace (1) Transportation costs conveying ore around the world (1) Cost of labour (1)	3			3		
				Question 5 total	**6**	**2**		**8**		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6.	(a)			$< 2 \times 10^{-24}$ 2×10^{-24} to 2×10^{-22} 3×10^{-19} to 5×10^{-19} 2×10^{-17} to 2×10^{-14} $> 2 \times 10^{-14}$ Top **and** bottom (1) Middle 3 (1) Accept energies in reverse order for (1)		2		2	2	
	(b)	(i)		(UV) 1		1		1		
		(ii)		Conversion to 30.4×10^{-9} m (ecf) (1) Substitution: $3 \times 10^{8} = f \times 30.4 \times 10^{-9}$ (1) Manipulation and answer = 9.87×10^{15} (1) Unit of Hz/Hertz (1) Answers of 9.87×10^{n} where n is not 15 (2)	1 1	1 1		4	2	
	(c)	(i)		280 re-emitted (1) 20 retained (1)		2		2		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		Light (energy) used by (green) plants to make their own food / photosynthesis (1) + any 2 × (1) from Energy lost at each stage because of: Respiration (1) Movement (1) waste materials (1) incomplete digestion (1) reference to growth/reproduction neutral	3			3		
		(iii)		Any 2 ×(1) from: Taken up by plant roots (1) and used to {make new protein/amino acids/DNA} (1) used for growth / repair (1)	2			2		
				Question 6 total	**7**	**7**		**14**	**4**	