GCSE MARKING SCHEME

SUMMER 2022

GCSE
APPLIED SCIENCE (DOUBLE AWARD) - UNIT 3
3445U30-1 & 3445UC0-1

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 (DOUBLE AWARD)

UNIT 3

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

FOUNDATION TIER

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1. FT	(a)	(i)		CDB (2) All correct (2), 1 or 2 correct (1)	2			2		
		(ii)		Bacterium	1			1		
		(iii)		Kill (unwanted) <u>bacteria</u> / get rid of <u>bacteria</u> / no <u>contamination</u> / get rid of <u>microorganisms</u> Not germs	1			1		
		(iv)		Kill (unwanted) <u>bacteria</u> / get rid of <u>bacteria</u> / no <u>contamination</u> / get rid of <u>microorganisms</u> Not germs	1			1		
	(b)	(i)		fat (1) whole (1)	2			2		
		(ii)		pressure (1) cream (1) -1 for 2 words underlined in the same bracket	2			2		
				Question 1 total	**9**			**9**		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2. FT	(a)	(i)		The material of the rods / the metal / the rods	1			1		1
		(ii)		Any 2 × (1) from Same size/shape rod (or reference to length, gauge, thick(ness)) MUST GIVE PROPERTY (1) Heated from same start point / rod ends must be touching / with same flame (1) DO NOT Accept heated by the same amount Same {volume /mass/ amount} of Vaseline (1) Same starting temperature for materials/ heated from room temperature (1) Same {type/mass/weight} of pin MUST GIVE PROPERTY(1) Drawing pin placed equal distance from flame / drawing pin placed at end of rod (1)	2			2		2
		(iii)		time (for the pin) to drop off (1) is shorter for higher (thermal) conductivity (1) OR {Its/thermal conductivity is} higher (1) If the poin drops off quicker (1)	1	1		2		2
	(b)	(i)		Aluminium Copper Brass Iron		1		1		1

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
		(ii)		Copper Aluminium Brass Iron (1 for order) **No,** the data does not agree with the experimental data (ecf) (1) Justification, including metal name (1) e.g. because copper has a greater thermal conductivity than aluminium so the pin should fall off the copper rod before aluminium rod			3	3		1
	(c)			Mercury is a <u>liquid</u> (at room temperature)			1	1		
				Question 2 total	**4**	**2**	**4**	**10**		**7**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3. FT	(a)			A (1) It has a (close), regular structure (1)	1	1		2		
	(b)			Ions held in place / strong forces between ions (1) cannot move in a solid (lattice) (1) **Accept Ions** are free to move in liquid (1) Accept atoms/particles for ions Do not accept electrons	2			2		
	(c)	(i)		{Lower/lowest} density / lighter (1) and strong(er) / high(er) tensile strength (1) Assume 'it' refers to carbon		2		2		
		(ii)		11.3 (1) $\times$ 700 select data 7 910 g (1) 2 marks for correct answer		2		2	2	
				Question 3 total	**3**	**5**		**8**	**2**	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4. FT				**Indicative content:** **Light:** • Initially the rate of photosynthesis increases (linearly) with increasing light intensity. • Gradually the rate levels off • and at after 2/3 units the rate of photosynthesis stays constant. **Temperature:** • The higher the temperature then the greater the rate of photosynthesis, • It reaches a maximum rate at about 30°C • Then the rate slows down to zero at 50°C. **Carbon dioxide:** • The rate of photosynthesis increases (linearly) with increasing carbon dioxide concentration at first. • Gradually the rate levels off • and after 3/4 units the rate of photosynthesis stays constant. **5-6 marks** All three variables described with some numerical data from all 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 4 points from at least 2 areas, with no data given. Or 3 variables not completely described *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** Any point(s) 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.*						
				Question 4 total		**6**		**6**		**6**

<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>5.
FT</td><td>(a)</td><td>(i)</td><td></td><td>Field B (1)
<u>All</u> minerals above <u>threshold</u> value (1)
OR comparison to the 2,16, 28</td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>Field C (1)
Lack of nitrate or potassium (1)</td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td></td><td>Add fertiliser</td><td>1</td><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td><table><tr><th>Argument</th><th>Against (✓) (2)</th></tr><tr><td>cheaper food</td><td></td></tr><tr><td>increased crop yield</td><td></td></tr><tr><td>could cross-pollinate with weeds</td><td>✓ (1)</td></tr><tr><td>long term effects unknown</td><td>✓ (1)</td></tr></table>
-1 for each extra tick</td><td>2</td><td></td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td>(c)</td><td></td><td></td><td>Any 2 × (1) from:
Can cause genetic variation to decrease (1)
Some genes would be lost (1)
Narrows gene pool (1)
Increased risk of genetic disease (1)</td><td>2</td><td></td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 5 total</td><td>3</td><td>4</td><td>2</td><td>9</td><td>2</td><td></td></tr>
</table>

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<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>6. FT</td><td>(a)</td><td>(i)</td><td></td><td>
<table>
<tr><td colspan="4">H_3C-N=C=O</td></tr>
<tr><td>Bond type</td><td>Number of bonds</td><td>Energy to break one bond (kJ/mol)</td><td>Energy to break all of each bond type (kJ/mol)</td></tr>
<tr><td>H-C</td><td>3</td><td>413</td><td>1 239 (1)</td></tr>
<tr><td>C-N</td><td>1</td><td>305</td><td>305</td></tr>
<tr><td>N=C</td><td>1</td><td>615</td><td>615 (1)</td></tr>
<tr><td>C=O</td><td>1</td><td>745 (1)</td><td>745</td></tr>
</table>
<table>
<tr><td colspan="4">H_2O</td></tr>
<tr><td>Bond type</td><td>Number of bonds</td><td>Energy to break one bond (kJ/mol)</td><td>Energy to break all of each bond type (kJ/mol)</td></tr>
<tr><td>H-O</td><td>2</td><td>467</td><td>934 (1)</td></tr>
</table>
Total energy = 3 838 kJ/mol (ecf) (1)
</td><td></td><td>5</td><td></td><td>5</td><td>5</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>Greater than, exothermic , increases (3 × 1)</td><td>3</td><td></td><td></td><td>3</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td></td><td>Thermal runaway occurs when an increase in temperature (1) increases the reaction rate that causes a further increase in temperature (1)</td><td>2</td><td></td><td></td><td>2</td><td></td><td></td></tr>
</table>

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(b)	(i)		4 100 units		1		1	1	
		(ii)		12		1		1	1	
		(iii)		Correct sequence of halving (ecf)(1) = 2 (1)		2		2	2	
				Question 6 total	**5**	**9**		**14**	**9**	

HIGHER TIER

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7./1. HT	(a)	(i)		In the nucleus Accept mitochondria Neutral: chromosomes/genes	1			1		2
		(ii)		Suspect 1 not a match / Suspect 2 matches (1) so not all alibis are sufficient (1)			2	2		2
		(iii)		Paternity tests / identify genetic diseases / identify relations / identify dead people	1			1		
	(b)	(i)		5 plots correct ± <1 small square (2) 4 plots correct ± <1 small square (1) smooth curve through plotted points (1) must join to existing points		3		3	3	3
		(ii)		25 cm^3		1		1	1	1
		(iii)		0.5/50 (1) × answer b(ii) (1) = answer 9b(ii)/100 (which is greater than 0.01) so has been tampered with (1)			3	3	2	2
		(iv)		salt (1) + water (1)	2			2		
		(v)		{outliers/anomalies/rogue/odd} will {be identified / ignored} (1) making the mean closer to true value (1) Accept converse Not: less chance of anomalous result	2			2		2

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			A – calcium (1) chloride (1) B – iron(II) (1) carbonate (1)			4	4		4
				Question 7/1 total	**6**	**4**	**9**	**19**	**6**	**15**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2. HT	(a)	(i)		Add <u>bacteria</u> (culture) to milk (so lactic acid is produced) (1) Add rennet (to produce curd) (1) Drain off <u>whey</u> <u>and</u> {press/squeeze/separate} <u>curds</u> (to make cheese solid) (1) Must be in correct sequence for 3 marks	3			3		
		(ii)		Suitable temperature/ warm / cool / best temperature / accept any stated temp from 10^{o}C - 40^{o}C (1) Moisture / wet / water (1) Food source (1)	3			3		
	(b)			growth rate drops after 40^{o}C / almost nil growth at 60^{o}C (1) (At 70^{o}C it is certain) all bacteria will be killed (1)		2		2		
				Question 2 total	**6**	**2**		**8**		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3. HT	(a)			Any 2 × (1) from Same size/shape rod (or reference to length, gauge, thick(ness)) MUST GIVE PROPERTY (1) Heated from same start point / rod ends must be touching / with same flame (1) DO NOT Accept heated by the same amount Same {volume /mass/ amount} of Vaseline (1) Same starting temperature for materials/ heated from room temperature (1) Same {type/mass/weight} of pin MUST GIVE PROPERTY(1) Drawing pin placed equal distance from flame / drawing pin placed at end of rod (1) Accept: repeats (1)	2			2		2
	(b)			Copper is the best (thermal) conductor (1) so should drop off quickest (1) But it didn't, so not as expected (1) OR According to their results the order of conductivity is aluminium, copper, brass, iron (1) Theoretical values order them copper, aluminium, brass, iron (1) So not as expected since true order not obtained / So brass and iron as expected but aluminium and copper not as expected (1) For 2 marks: Iron is the poorest (thermal) conductor (1) so should drop off last (1) it did, so as expected – 0 marks For 1 mark: The higher the (thermal) conductivity the shorter the time to drop off (1) Allow converse Do not credit 'not as expected' alone			3	3		3

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			Ionic bonding/ionic lattice/ionic stucture/strong bonds between (+ and -) ions (1) ions are free to move (when liquid / molten) / bonds are broken {when liquid/molten}(1) Insulator when solid / conductor when {liquid/molten} (1) Do not accept electrons for ions	3			3		
				Question 3 total	**5**		**3**	**8**		**5**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4. HT	(a)			Fertilisers {increase the yield/ make plants grow {quicker/bigger/more}/prevent deficiency diseases} (1) Fertilisers can pollute waterways/ cause weed growth / cause eutrophication (1) Pesticides kill pests (1) Pesticides can build up in food chain/ harm top consumer/ kills non-target species / bioaccumulation / forms resistance in pests (1)	4			4		
	(b)	(i)		68 - 29 = 39 (1) 39/5 (1) = 7.8 (1) OR 29 ÷ 5 = 5.8 (1) 68 ÷ 5 = 13.6 (1) Difference= 7.8 (mm/week) (1)		3		3	2	
		(ii)		0.2 to 0.4 increase from 29 to 58 / 58 ÷ 29 = 2 (1) 0.4 to 0.8 increase from 58 to 73 / 73 ÷ 58 = 1.2 / should increase for 58 to 116 (1) so do not agree (1) Do not allow 3rd marking point without justification For 2 marks: Incomplete use of data in agreement and disagreement followed by 'do not agree' For 1 mark: Incomplete use of data in agreement or disagreement followed by 'do not agree'			3	3	3	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(c)			• Selective breeding / selection of individuals with {favourable characteristics/largest rice yields} (1) • Collect seeds from plants with largest rice yield / collect seeds from best plants (1) • Cross {breeding/pollination} (of selected individuals) (1) • Further selection of offspring / Repeat process over time (1)	4			4		
	(d)			Any 2 × (1) from: Growing plants without soil / in water / in solution (1) containing minerals/nutrients (1) that is {pumped/moved} around (the plant roots) (1)	2			2		
				Question 4 total	**10**	**3**	**3**	**16**	**5**	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5. HT	(a)			C = 12 H = 1 N = 14 O = 16 (1) 2C = 24 (1) 3H = 3 (1) M_r = 57 24, 3, 14 and 16 seen – 3 marks		4		4	3	
	(b)			Conversion to 30 000 000 g (1) Number = 30 000 000 / 57 (ecf) (1) = 526 000 (1) Answer of 526 = 2 marks 526 320 = 2 marks 526.32 = 1 mark		3		3	3	
	(c)			**Indicative content** **Reaction pathway:** • The reaction pathway shown is for an exothermic reaction. • This means that the difference in PE is released as heat. **Bond energies:** • During a reaction bonds are broken and formed • More energy released when bonds are formed than when bonds are broken **Thermal runaway** • Thermal runaway occurred because an increase in temperature arose • which causes an increase in reaction rate • which further increases the temperature • The gas pressure was so great that the valve blew open releasing the toxic gas.		6		6		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				5-6 marks At least 5 statements taken from all 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.* **3-4 marks** At least 3 points from two 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** Any point 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.*						
				Question 5 total		**13**		**13**	**6**	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6. HT	(a)			Composites are a <u>combination</u> of materials / non-metals (1) with different properties (1)	2			2		
	(b)			Atoms are different sizes. (1) {Breaks up/distorts/changes} the regular structure of the metal (1) Making it more difficult for layers to slide over each other. (1)		3		3		
	(c)			CSA = 5 × 6 (1) = 30 (1) 90 = force/30 (ecf) (1) Force = 90 × 30 (ecf) (1) Conversions $9.0 \times 10^{7} \times 3.0 \times 10^{-3}$ (1) 270 000 N (1) Ans of 2 700 (5) Award 5 marks for ans of 2.7×10^{n} where n is any value other than 5 CSA = 5 × 6 × 22 = 660 no marks Answer of 59 400 (3) marks	1	5		6	6	6
				Question 6 total	**3**	**8**		**11**	**5**	**6**