



GCSE MARKING SCHEME

SUMMER 2018

**GCSE (NEW)
APPLIED SCIENCE (DOUBLE AWARD) - UNIT 3
3445U30-1 / 3445UC0-1**

INTRODUCTION

This marking scheme was used by WJEC for the 2018 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 (NEW)

SUMMER 2018 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 FT	(a)	(i)		Ceramics (1) Metals (1) Alloys (1)	3					
		(ii)		Long chain molecules (1) With cross links / of repeated units (1) Accept many units joined together for (1)	2					
	(b)	(i)		Aluminium (1)		1				
		(ii)	I		Aluminium (1)		1			
			II	Lowest density (1) Accept density is <u>only</u> 2700		1				
		(iii)	I	Vanadium (1)		1				
			II	Highest (tensile) strength (1)		1				
				Question 1 total 9	5	5		10		

Question		Marking details		Marks Available						
				AO1	AO2	AO3	Total	Maths	Prac	
2 FT	(a)			stops bacterial growth (1) cooking/heating/boiling (1) salting (1)	3			3		
	(b)	(i)		Any 1 × (1) from: Vomiting (1) diarrhoea (1) stomach pains /nausea (1)	1			1		
		(ii)		<i>Campylobacter</i> / <i>E. coli</i> / <i>Salmonella</i> (1)	1			1		
		(iii)		Toxins / poisons (1)	1			1		
	(c)	(i)	I	colonies have clumped together (1) Unable to count individual colonies/too many colonies to count (1)			2	2		2
			II	Not enough colonies (for valid results) (1)			1	1		1
		(ii)	I	Plate 4 Accept 15			1	1		1
			II	Mean number of colonies = $\frac{150}{5}$ (ecf) (1) = 30 (1) (Allow sum of remaining 5 values as ecf from previous answer) Count = 30 (ecf) × 10 000 = 300 000 / cm ³ (1) subs Or Mean number of colonies = $\frac{165}{6}$ = 27.5 (1) Count = 27.5 (ecf) × 10 000 = 275 000 / cm ³ (1) subs Accept 280 000 Allow (1) if candidate has ignored anomaly but calculated the answer incorrectly	1	2		3	3	3
				Question 2 total 13	7	2	4	13	4	7

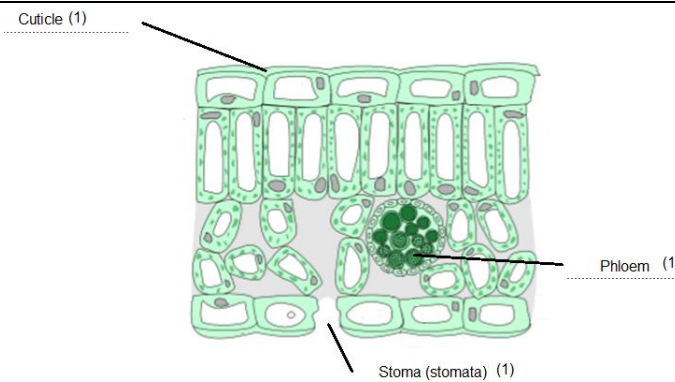
Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3 FT	(a)	(i)		Ca ²⁺ and Mg ²⁺ (1) Accept Ca ²⁺ /Mg ²⁺ Do not accept Ca ₂ ⁺ /Mg ₂ ⁺			1	1		1
		(ii)		(Place powder in flame and) observe colour (1) If brick red Ca ²⁺ OR if no colour Mg ²⁺ (ecf)(1)	1	1		2		2
	(b)			Carbonate/CO ₃ ⁽²⁻⁾ (1) chloride/Cl ⁽⁻⁾ (1)			2	2		2
	(c)			Calcium carbonate/chloride / magnesium carbonate/chloride (ecf)(1) Do not accept formulae			1	1		1
					Question 3 total 7	1	1	4	6	

Question			Marking details			Marks Available										
						AO1	AO2	AO3	Total	Maths	Prac					
4 FT	(a)	(i)	${}_{56}^{141}\text{Ba} (2) + {}_{36}^{92}\text{Kr} + 3 {}_0^1\text{n} (1)$				3		3	3						
		(ii)	Fission , a moderator , neutrons , control rods (1) × 4			4			4							
		(iii)	<table border="1"> <thead> <tr> <th>Uranium isotope</th> <th>Number of protons</th> <th>Number of neutrons</th> </tr> </thead> <tbody> <tr> <td>uranium-235</td> <td>92</td> <td>143</td> </tr> <tr> <td>uranium-236</td> <td>92</td> <td>144 (1)</td> </tr> </tbody> </table>	Uranium isotope	Number of protons	Number of neutrons	uranium-235	92	143	uranium-236	92	144 (1)		2		2
Uranium isotope	Number of protons	Number of neutrons														
uranium-235	92	143														
uranium-236	92	144 (1)														
(b)	(i)	3 rd and 4 th statements correct: The time taken for the number of undecayed nuclei to halve ✓(1) The time taken for the activity to halve ✓(1)			2			2								
		(ii)	One half life (1) So ½ (1) ½ alone as answer (2)			1	1		2							
		(iii)	U-235 will have gone through more than 6 half lives / U-235 decays quicker (1) Therefore {fraction/amount} (of U-235) must be smaller so don't agree (1) OR U-238 has only gone through 1 half life /U-238 decays slower (1) Therefore {fraction/amount} of (of U-238) must be larger so don't agree (1)					2	2							
			Question 4 total 15	7	6	2	15	5								

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
5 F T	(a)	(i)	<p>Indicative content: Draw a cross on a square of white paper. Measure (25 cm³) of hot sodium thiosulfate using the (25 cm³) measuring cylinder and pour into the conical flask. Record the temperature of the solution using a thermometer. Using the 10 cm³ measuring cylinder, measure out 5cm³ of the hydrochloric acid. Place the conical flask onto the cross and add the hydrochloric acid. Swirl the flask to mix the contents and at the same time start the stopwatch. Look down at the cross from above the mixture. Stop the stopwatch as soon as the cross disappears. Record the time taken for the cross to disappear. Repeat for the same temperature and then for different temperatures of sodium thiosulfate.</p> <p>5– 6 marks Full sequential account of method including measuring instruments and suggested volumes</p> <p><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 Most steps and measuring instruments included.</p> <p><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 Limited method and some instrumentation included. Candidates may have investigated an independent variable other than temperature.</p> <p><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>	2	4		6		6

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
		(ii)	Any 2 × (1) from: Same concentration of acid (1) Same concentration of sodium thiosulfate (1) Same volume of acid (1) Same volume of sodium thiosulfate (1) Same flask / same cross = neutral		2		2		2
		(iii)	(A change in concentration/volume) changes the rate of reaction/time to obscure cross	1			1		
(b)	(i)		As {more water added / less sodium thiosulfate} (concentration of sodium thiosulfate decreases) so {cross takes longer to disappear/decreases rate of reaction} (1)			1	1		2
	(ii)		Thiosulfate particles become less crowded/ less thiosulfate particles to react (1) Smaller chance of collisions between (reacting) particles/ lower rate of collision between (reacting) particles (1) Accept converse answer	2			2		2
			Question 5 total 12	5	6	1	12	0	12

Question			Marking details	Marks Available						
				AO1	AO2	AO3	Total	Maths	Prac	
6 FT 1 HT	(a)	(i)	Both springs stretch elastically (over the range) (1) Spring 2 stretches easier than spring 1 / up to 20 N spring 1 extends less / after 20 N /spring 1 extends more (1)			2	2	1	2	
		(ii)	Pair of values from graph e.g. 47.5/10 (2) Answer = 4.75/4.8 N/cm (1) Allow tolerance of one small square when reading values from graph.		3		3	3	3	
		(iii)	Spring 1- all points on the line OR converse for spring 2		1		1		1	
	(b)	(i)	Scales – x axis: each large square = 4/5/6 cm; y axis: 1 large square = 10 N (1) 7 points correct \pm < one small square tolerance (2) 6 points correct \pm < one small square tolerance (1) 5 or less (0) straight line until 50 N then curve \pm < a square tolerance (1)		4		4	4	4	
		(ii)	I	E labelled where line starts to curve (e.g.12, 50)		1		1		1
			II	e.g. 50 N (follows from prior answer)		1		1		1
		(iii)	Extension is no longer proportional to extension (when it is 30 cm) / past elastic limit (1) So spring will not return to its original length so not suitable (1)			2	2		2	
			Question 6/1 total 14		10	4	14	8	14	

Question		Marking details		Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
7 FT 2 HT	(a)			3			3		
	(b)		Allows more light (to reach the palisade cells/in for photosynthesis/to reach the chloroplasts)	1			1		
	(c)		Allows gas exchange or description	1			1		
			Question 7/2 total 6	5			5		

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
3 HT	(a)	(i)	(Strong) attraction between positive ions (1) and (a sea of) {delocalised/free} electrons (1)	2			2		
		(ii)	Malleable(1) (Regular array of) atoms in layers that can easily slide over one another (1)	1	1		2		
		(iii)	{Free/Delocalised} electrons (1) are able to move (1)	2			2		
	(b)	(i)	Regular {pattern of atoms/layers} is 'broken' (1) so more difficult to make them slide (1)		2		2		
		(ii)	I any 2 × (1) from: Lower density / lighter (1) and stronger (1) more flexible (1) Accept converse argument for steel			2	2		
			II % of vanadium = 4% (1) 4% of 2500 = 100 kg (1) volume = $\frac{100}{5700}$ (ecf)(1) substitution and manipulation = 0.0175/0.018 [m ³] (1) Do not accept 0.02 unless working shown Accept $\frac{2500}{5700}$ (1) =0.439 [m ³] (1)		4		4	4	
			Question 3 total 14	5	7	2	14	4	

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
4 HT	(a)	(i)	Time taken for a halving of (1) number of (radioactive) nuclei / mass / atoms/ amount of material / amount of substance/activity (1)	2			2		
		(ii)	4.2 billion = 4.2×10^9 (1) number of half lives = $4.2 \times \frac{10^9}{7} \times 10^8 = 6$ (1) fraction = $\frac{1}{2^n} = \frac{1}{64}$ (1)		3		3	3	
	(b)	(i)	Control rods (1) Absorb (excess) neutrons (1) Allowing one fission neutron to continue (to cause more fission) (1)	3			3		
		(ii)	Contains 56 protons (1) 85 neutrons (1)		2		2		
	(c)		${}_{92}^{239}\text{U} \text{ (1)}$ $\rightarrow {}_{93}^{239}\text{Np} \text{ (1)} + {}_{-1}^0\beta$ $\rightarrow {}_{94}^{239}\text{Pu} \text{ (1)} + {}_{-1}^0\beta$ both beta (1)		4		4		
			Question 4 total 14	5	9	0	14	3	0

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
5 HT	(a)		Qualitative involves identifying the presence of substances (1) Quantitative involves measuring /how much of a substance/masses/volumes/ amounts / concentrations of substances (1)	2			2		
	(b)	(i)	Calcium & magnesium (1) Accept $\text{Ca}^{2+}/\text{Ca}^{2+}/\text{Mg}^{2+}/\text{Mg}^{2+}$			1	1		1
		(ii)	Sulfate & carbonate & chloride (1) Accept $\text{SO}_4^{2-}/\text{SO}_4^{2-}/\text{SO}_4^{2-}/\text{CO}_3^{2-}/\text{CO}_3^{2-}/\text{CO}_3^{2-}/\text{Cl}^-/\text{Cl}^-$			1	1		1
	(c)		Flame test (1) Compare colour of flame (against a chart) (1)	2			2		2
	(d)		Calcium sulfate/carbonate/chloride (1) $\text{CaSO}_4/ \text{CaCO}_3/ \text{CaCl}_2$ (1) OR magnesium sulfate/carbonate/chloride (1) $\text{MgSO}_4/ \text{MgCO}_3/ \text{MgCl}_2$ (1) allow ecf from (b)			2	2		2
			Question 5 total 8	4	0	4	8	0	6

Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths	Prac
6 HT	(a)	<p>Indicative content: While food is stored or transported the growth of bacteria must be slowed down or stopped by:</p> <ul style="list-style-type: none"> • refrigeration – slows down but does not stop bacterial growth • freezing – stops bacteria multiplying but does not kill them • heating – heating then rapid cooling kills nearly all microbes • cooking – kills microorganisms • drying – removes water so bacteria cannot digest and absorb the food source • salting – bacteria lose water from cells so they dehydrate and cannot reproduce • pickling – addition of vinegar to lower pH and inactivate microorganisms. <p>5– 6 marks Very good even coverage of precautions and storage options linked with effect on bacteria – at least 5 methods linked</p> <p><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 Good coverage with some correct linking (at least two methods explained)</p> <p><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>	6			6		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				<p>1-2 marks Simple list of precautions/one precaution linked</p> <p><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>						
	(b)	(i)		<p>1:10000 (1) CFU have not clumped together but there are (>20 therefore) enough (1)</p>			2	2		
		(ii)		<p>total number of CFU ignoring anomaly = 171 (1) mean number = $\frac{171(ecf)}{5} = 34.2$ (1) Count = $34.2(ecf) \times 100\,000 = 3\,420\,000$ per 0.1 cm^3 (1) So number of bacteria = $34\,200\,000(ecf) / \text{cm}^3$ (1)</p> <p>If anomaly not ignored then (3) max for answer of 32 000 000</p>		4		4	4	
				Question 6 total 12	6	4	2	12	4	0

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7 HT	(a)			Lower energy required (1) for <u>successful</u> collisions (1)	2			2		
	(b)			Any 3 × (1) from: Increasing yield (1) Preserving raw materials / less burning of raw materials(1) Reducing energy costs (1) Can be re-used (1)	3			3		
	(c)			Points 1-3 or 6-8 show no increase in temperature (so no exothermic reaction) (1) Therefore catalyst activity is poor (in these zones) (1) from 3 to 6 catalyst activity is good because temperature increases (1)			3	3		
				Question 7 total 8	5	0	3	8	0	0

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	0	10	4	14	8	13
2	5	0	0	6	0	3
3	5	7	2	14	4	0
4	5	9	0	14	3	0
5	4	0	4	8	0	6
6	6	4	2	12	4	0
7	5	0	3	8	0	0
Total	30	30	15	75	19	22

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	5	5	0	10		
2	7	2	4	13	4	7
3	1	1	4	6		6
4	7	6	2	15	5	
5	5	6	1	12		8
6		10	4	14	8	14
7	5	0	0	5		
Total	30	30	15	75	17	36