GCSE MARKING SCHEME

SUMMER 2019

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

INTRODUCTION

This marking scheme was used by WJEC for the 2019 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.

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UNIT 3

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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

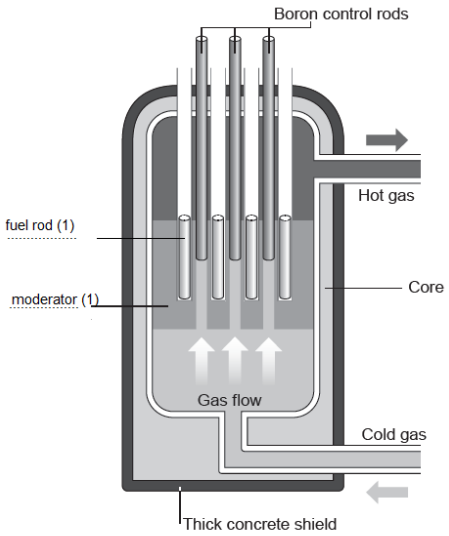
The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

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)			Any 2 × (1): Using a pen line (1) Adding water (until) above the line (1) Colourings may not dissolve in water (1)	2			2		2
	(b)	(i)		E110		1		1		1
		(ii)		A, B, C		1		1		1
		(iii)		B and D contain <u>E160</u> (1) B also contains E102 and E110/B contains the other two (1) so the prediction is incorrect Conclusion must be included for 2nd mark			2	2		2
		(iv)	I	8 cm		1		1	1	1
			II	3/8 (ecf) (1) select, read and subs 0.375 /0.38(1) 0.37 if seen on answer line without working (1)		2			2	2
				Question 1 total	**2**	**5**	**2**	9	**3**	**9**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			2 (1) H_2O(1) Accept H_2O in box as long as no other product on the dotted line Don't award balancing mark if H_2O not given	1	1				
	(b)			Increase the temperature / increase concentration (1)	1					1
	(c)	(i)		32		1			1	1
		(ii)		Between 11 and 12		1			1	1
		(iii)		it produces the lowest (volume of O_2) (1) At each time interval (1) Accept: it is the slowest for (1) Student is incorrect Conclusion must be included for 2nd mark			2		1	2
	(d)			1.2 g		1				1
	(e)	(i)		20°C		1			1	
		(ii)		Double twice (1) 40 (hours) (1)(ecf) 40 on answer line without workings (2)		2			2	
				Question 2 total	**2**	**7**	**2**	**11**	**6**	**6**

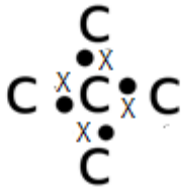
Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			5 points correct (2) 4 correct (1) 3 correct (0) (±>1 small square) Straight line through origin with 1 small square (1)		3		3	3	3
	(b)			As the concentration of beta-carotene increases the absorbance increases		1		1		1
	(c)			Consistent with graph e.g. 0.06		1		1	1	1
	(d)			One matching pair for (1) e.g. concentration doubles from 0.02 to 0.04 Another matching pair for (1) e.g. absorbance doubles from 0.1 to 0.2 so agree – needed for second mark No data mentioned (0) (Also for 0.04 to 0.08 cf 0.2 to 0.4 or for 0.08 to 0.16 cf 0.4 to 0.8) Accept a concentration and absorbance pair for (1) and doubled pair for (1)			2	2	2	2
				Question 3 total		**5**	**2**	**7**	**6**	**7**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			 Accept uranium rod for fuel rod	2			2		
	(b)	(i)		16		1		1	1	
		(ii)		(Control rods) absorb neutrons (1) so the number of neutrons in (5th generation) will decrease (1)		2		2		
		(iii)		Meltdown / overheats Do not accept explodes	1			1		
				Question 4 total	**3**	**3**		**6**	**1**	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5				**Indicative content:** 1. Use the small funnel to fill the burette with acid. Run a little acid out into a waste beaker to fill the part of the burette that is below the tap. Record the starting volume of acid in the burette. 2. Accurately measure 25cm^3 of sodium hydroxide solution into a conical flask. 3. Add 2 drops of indicator. 4. Add 0.1cm^3 of acid at a time, swirl the flask after each acid addition. Keep adding acid until the indicator changes colour. Record the final volume of acid in the burette. 5. Repeat steps 1-4 twice more. Hydrochloric acid and sodium hydroxide are irritants/corrosive. Wear gloves and wash hands immediately after contact with solutions. Wear goggles to prevent acid splashing into eyes when filling burette. **5 – 6 marks** Detailed description of method, hazards and precautions. *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

				3 – 4 mark Detailed description of method, or hazards and precautions. *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** Limited description of method or hazards and precautions. *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	**6**			**6**		**6**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			Tick boxes 1,4,6: • The environment benefits because natural habitats are less threatened. • Artificial fertilisers are not used. • Less harm to bees and other insects as less chemicals are used.	3			3		
	(b)			Any 2 × (1) from: Increase (from 2005 to 2007 or 2008) (1) But has decreased from 2008 (1) Slight increase in 2016 (1)			2	2	2	
	(c)			2016: 57.8 (1) 64.7-57.8 (ecf) = 6.9 (1)		2		2	2	
	(d)	(i)		Cruel / disease spreads (easier) / cramped / inhumane / stressed animals	1			1		
		(ii)		Any 2 × (1) from: There has been an increase in the numbers of poultry farmed organically (1) But the number of sheep have dropped (1) {Cattle / pigs} show no or little change (1) So not supported			2	2		
				Question 6 total	**4**	**2**	**4**	**10**	**4**	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		 B		1		1		
		(ii)		Each C atom with 4 electrons/4 pairs of electrons shared on 4 surrounding carbons/forms 4 bonds/connected to four other carbons/creates a full outer shell		1		1		
		(iii)		Covalent	1			1		
	(b)	(i)		Any 2 × (1) from: Each carbon atom has a free electron / one electron not involved in bonding / only 3 electrons involved in bonding(1) that is free to carry charge (1)	1	1		2		
		(ii)		(Layers of) carbon atoms can slide over each other (1) Because {bonds/forces} between them are weak (1)	1	1		2		
				Question 7 total	**3**	**4**		**7**		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8 FT 1 HT	(a)			carbon dioxide + water (1) Accept CO_2/CO2/CO^2 and H^2O/H2O/H^2O	1			1		
	(b)			glucose may be respired / provide energy (1) converted to starch (for storage) (1) used to make cellulose / proteins / amino acids (1)	3			3		
	(c)			Any 3 × (1) from: As light intensity increases then the rate of photosynthesis increases (1) As carbon dioxide increases then the rate of photosynthesis increases (1) As temperature increases then the rate of photosynthesis increases (1) The rate levels off for light intensity(1)	1	2		3		
				Question 8/1 total	**5**	**2**		**7**		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
9FT2HT	(a)	(i)		Toxins are produced (1) as bacteria grow / multiply (1)	2			2		
		(ii)		Stomach pains /vomiting / diarrhoea/nausea/dizziness **Any 2** for (1)	1			1		
		(iii)		Any 2 × (1) from: Hygiene e.g. wash hands, disinfect surfaces (1) Avoid cross contamination (from raw meat) (1) cook properly (1)	2			2		
	(b)	(i)		Notifications have dropped (1) Since less hens are infected (with Salmonella) (1)		2		2	1	
		(ii)		Highest percentage of food poisoning cases occur during third quarter or July to September or summer months(1) Either Temperatures are warm(er) (1) so bacteria grow more quickly (1) OR Mixed raw and cooked meats during barbecues (1) Contamination by bacteria (1)			3	3	1	
		(iii)		No because: Higher notification rates for males (1) and unequal rates for age ranges (1) Judgement must be given for 2 marks			2	2	2	
				Question 9/2 total	**5**	**2**	**5**	**12**	**4**	

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3				**Indicative content:** The control rods are designed to be lowered into the reactor to absorb more neutrons to reduce or stop nuclear fission, which will reduce the core temperature. The power cut prevents this level of control. Power cut results in failure of pump so coolant cannot circulate. Rods are automatically released fully into the reactor to stop any more fission reactions. Otherwise eventually high enough temperatures to cause a meltdown are reached. There are immediate consequences to human health from a possible explosion. There are long term consequences to health and the environment due to radiation contamination. **5 – 6 marks** Detailed description of the effects of the power cut, why T increases and consequences of meltdown. *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 mark** Full description of two of: the effects of the power cut, why T increases and consequences of meltdown. *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.*	6			6		

				1-2 marks Limited description of any of the effects of the power cut, why T increases and consequences of meltdown. *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 3 total	**6**			**6**		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)			(0.37+0.41+ 0.63 +0.39)/4=0.45 (1) (0.37+0.41+0.39)/3 =0.39 (1) Dafydd- Anomalous reading has been used in Rhodri's mean or anomalous reading not used in Dafydd. (1)			3	3	2	3
	(b)	(i)		Labelling including concentration on x-axis with units (1) Scales (50/2cm or x-axis; 0.1/cm on y-axis). Both scales should start at 0. (1) four points correctly drawn (± < 1 small square)(1) Straight best fit line through 0.0 (1)		4		4	4	4
		(ii)		As concentration of haemoglobin increases so does the absorbance (1) in a proportional way (1)		2		2	1	2
	(c)	(i)		Atomic masses from Periodic table: 56, 14, 12, 1,16 (1) 56 + 56 + 72 + 18 + 64 (1) = (266) (ecf)		2		**2**	**2**	
		(ii)		2.5 × 266 (ecf) (1) = 665 (g) (1)		2		**2**	**2**	
				Question 4 total		**10**	**3**	**13**	**9**	**9**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			$2\ H_2O_2 \rightarrow O_2 + 2\ H_2O$ Right hand side (1) Balancing (provided products are correct) (1) Subscripts must be correct	1	1		2		
	(b)			Any 2 × (1) from: mass (of catalyst) (1) surface area (of catalyst) (1) concentration (of H_2O_2)(1) volume (of H_2O_2)(1)	2			2		2
	(c)	(i)		Drawing a reasonable tangent at t=30 (1) y step e.g. 10 and x step e.g. 15 (1) Approx. value of 0.5 - 0.7 (from candidate tangent)		3		3	3	3
		(ii)		Less reactants as reaction progresses (1) Less chance of successful collisions / less successful collisions per second (1) Accept: More dilute(1) Less particles so less successful collision (1)	2			2		
		(iii)		Start at origin and a steeper curve (1) Plateau sooner at 44 (1)		2		2		2
	(d)	(i)		Exothermic (1) because more energy is released when bonds are formed than required to {decompose hydrogen peroxide/break bonds} / Less energy in products than reactants (as energy released) / the energy released is greater than the activation energy (1)	2			2		
		(ii)		ΔH remains constant since products are the same (1) A catalyst lowers the activation energy (1) Which is E_a (1) so disagree Judgement must be given for 3rd mark			3	3		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(e)			Halve 3 times (1) 6/8 = 0.75 days (1)ays		2		2	3	
				Question 5 total	**7**	**8**	**3**	**18**	**6**	**7**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			**Similarities** Both mixtures contain 6 {compounds/peaks/components} (1) Both mixtures contain { A / B / D / E}(1) **Differences (any 2 × 1 from below)** There is more of A and B, D in mixture 2 than 1 There is more of E in mixture 1 than 2 Mixture 2 does not contain either, or both, C and F In mixture 1: B and D have equal responses but not in mixture 2			4	4		4
	(b)			The molecules in F have the weakest relative attraction for the mobile phase (1) And strongest attraction for the stationary phase (1)		2		2		
				Question 6 total		**2**	**4**	**6**		**4**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		In diamond each carbon atom is bonded to four other carbon atoms. (1) There are no free electrons to conduct electricity. (1) Whereas, in graphite each carbon atom is only bonded to three other atoms. (1) Therefore, there are delocalised (free) electrons in graphite, which can move and carry a charge. (1)	4			4		
		(ii)		There are only weak forces between layers (1) which allows layers of carbon to slide over each other in graphite. (1) On the other hand, in diamond all bonds are strong covalent bonds / there are no layers. (1)	3			3		
	(b)			Conversion of 0.36 nm into 3.6×10^{-10} m (1) Volume of cell = 4.7×10^{-29} m^3 (ecf)(1) Mass = $8 \times 2 \times 10^{-26}$ / 1.6×10^{-25} kg (1) Subs and answer = 3 400 (kg/m^3) (ecf) (1)		4		4	4	
	(c)			Carbon nanotubes have a much high(er) strength-to-weight ratio / high(est) strength and low(est) density (1) So will be stronger and lighter (1)		2		2		
				Question 7 total	**7**	**6**		**13**	**4**	

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	5	2	9	3	9
2	2	7	2	11	6	6
3		5	2	7	6	7
4	3	3		6	1	
5	6			6		6
6	4	2	4	10	4	
7	3	4		7		
8	5	2		7		
9	5	2	5	12	4	
TOTAL	30	30	15	75	24	30

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	5	2		7		
2	5	2	5	12	4	
3	7	8	3	18	6	7
4	6			6		
5		10	3	13	9	9
6	7	6		13	4	
7		2	4	6		4
TOTAL	30	30	15	75	23	20