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# **GCSE MARKING SCHEME**

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**SUMMER 2019**

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

## **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.

## **WJEC GCSE APPLIED SCIENCE (SINGLE AWARD)**

### **UNIT 1: SCIENCE IN THE MODERN WORLD**

#### **SUMMER 2019 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.

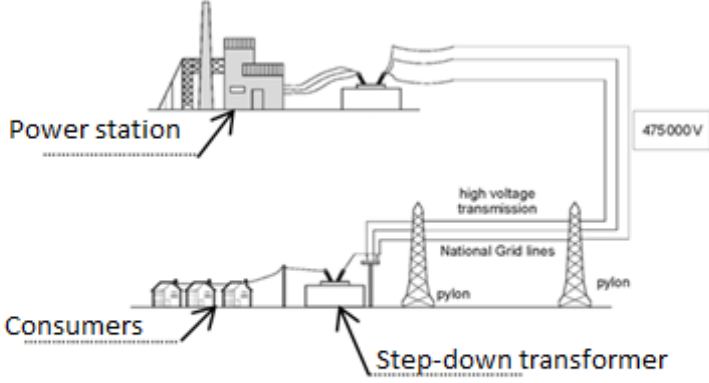
##### Extended response question

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)		Improved reliability / One power station fails others can supply consumers (1) More than one power station contributing to meet high / peak demand (1)	2					
	(b)	(i)	 <p>The diagram illustrates the National Grid system. It shows a power station on the left connected to high voltage transmission lines. These lines pass through pylons and are labeled 'National Grid lines'. A box indicates a voltage of 475,000V. The lines then lead to a step-down transformer, which is connected to a local distribution network. This network includes a step-down transformer and leads to consumers on the right.</p>	2			2		
		(ii)	Reduces {energy/power/heat} losses in the transmission lines / lower currents / makes it more efficient (1)	1					
<b>Question 1 total</b>				<b>5</b>	<b>0</b>		<b>5</b>		

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)	Energy that can be continually supplied / not depleted when used/ energy won't run out (1)  Accept: can be used again	1			1		
		(ii)	Any 2 × (1) from: Reduce carbon footprint / greenhouse contributions (1) Reduce fossil fuel depletion / use less (named) fossil fuels (1) Reduce acid rain (1) Energy that can be continually supplied / not depleted when used/ energy won't run out (1)  Accept: less carbon <u>output</u> / less carbon in the atmosphere as alternative for 1 <sup>st</sup> marking point	2			2		
	(b)	(i)	5443 [GWh] (1)		1		1	1	
		(ii)	$= \frac{783}{5443 (ecf)} \times 100$ (1) (selection and substitution)  $= 14.4\% / 14.39\% / 14\%$ (1)		2		2	2	
		(iii)	Solar increased by <u>696</u> GWh since 2012 (1) Wind has increased by <u>2400</u> GWh so disagree (1)			2	2	1	
			<b>Question 2 total</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>8</b>	<b>5</b>	

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
3	(a)	(i)	Petroleum gases		1		1	1	
		(ii)	petrol		1		1		
		(iii)	15		1		1		
		(iv)	Boiling point	1			1		
		(v)	Boiling points are {higher / above 25 / room temperature} / temperature is not low enough for the petroleum gases to condense / temperature not hot enough to evaporate		1		1		
	(b)		Fractions are flammable / risk of {fire / explosion}(1) Crude oil is imported by tankers / drilled from under sea / access to cooling water (1)			2	2		
	(c)	(i)	<b>Any 2 × (1) from:</b> Each contains C and H (1) Each end C atom bonded to 3 H atoms (1) All single bonds between C atoms (1)		2		2		
		(ii)	<u>double</u> bonds (between C atoms) in ethene / all <u>single</u> bonds in butane		1		1		
			<b>Question 3 total</b>	<b>1</b>	<b>7</b>	<b>2</b>	<b>10</b>	<b>1</b>	

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)	Add soap <u>to water</u> (1) Shake mixture (1) Measure height of froth/time how long it lasts(1)	3			3		3
		(ii)	Ticks in boxes 2 - 3 - 4			3	3		3
	(b)		(Calcium is essential) for healthy bones and teeth (1) Helps prevent heart disease (1)	2			2		
			<b>Question 4 total</b>	<b>5</b>		<b>3</b>	<b>8</b>		<b>6</b>



Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		conduction	1			1		
		(ii)		convection	1			1		
		(iii)		radiation	1			1		
		(iv)		temperature	1			1		
	(b)	(i)		Points plotted within $\pm <1$ small square division (2 – all correct, 1 – 7 correct) Line of best fit $\pm <1$ one small square division (1)		3		3	3	3
		(ii)		Temperature difference of silver foil = 16 °C and temperature difference of black paper = 29 °C (1) OR 45 (ecf from graph) – 32 (1)  Difference in temperature gain = 13 °C (1)		2		2	2	
	(c)			Better absorption / white is poor absorber (1) of IR radiation (1)  OR  White better reflector /(black) poor reflector (1) of IR (1)	2			1		
				<b>Question 5 total</b>	<b>6</b>	<b>5</b>	<b>0</b>	<b>11</b>	<b>5</b>	<b>7</b>

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)	Hydrogen/oxygen		1		1		
		(ii)	water		1		1		
	(b)		O <sub>2</sub> (1) Accept O2 / O <sup>2</sup> H <sub>2</sub> O (1) Accept H2O / H <sup>2</sup> O <u>2</u> H <sub>2</sub> and <u>2</u> H <sub>2</sub> O balancing (1)	2	1		3		
	(c)		16kW		1		1	1	
	(d)		Heat = 1200 J (1) Electricity = 2800 J (1)		2		2	2	
			<b>Question 6 total</b>	<b>2</b>	<b>6</b>	<b>0</b>	<b>8</b>	<b>3</b>	<b>0</b>

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
7			<p><b>Indicative content:</b></p> <p><b>PROCEDURE AND APPARATUS</b></p> <p>1. Use a balance to weigh between 4.4g and 5 g of zinc oxide onto a clean, dry filter paper.</p> <p>2. Use a measuring cylinder to measure 50cm<sup>3</sup> of the 1mol/dm<sup>3</sup> sulfuric acid into a 250cm<sup>3</sup> beaker.</p> <p>3. Heat the acid to approximately 50°C with a Bunsen burner.</p> <p>4. Add the zinc oxide and stir.</p> <p>5. Let the mixture cool then filter into an evaporating basin.</p> <p>6. Boil the mixture in the evaporating basin until half the liquid has evaporated.</p> <p>7. Leave to evaporate to dryness.</p> <p><b>SAFETY</b></p> <p>Sulfuric acid is an irritant – could splash onto skin or into eyes when stirring – gentle stirring / goggles</p> <p>Zinc sulfate is harmful – transfer to skin or eyes during stirring or evaporation – gentle stirring / goggles</p>	5	1		6		6

Question				Marking details	Marks Available						
					AO1	AO2	AO3	Total	Maths	Prac	
				<p><b>5–6 marks</b> Full logical sequence of steps in method. All equipment mentioned. Safety considerations mentioned. Sulfuric acid is named. Zinc oxide to be in excess. <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><b>3–4 marks</b> Some of the sequence of steps in method. Some equipment mentioned. Safety considerations may be mentioned. Sulfuric acid is named. <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><b>1–2 marks</b> At least 1 step in method mentioned / safety mentioned <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></p> <p><b>0 marks</b> <i>No attempt made or no response worthy of credit.</i></p>							
				<b>Question 7 total</b>	<b>5</b>	<b>1</b>		<b>6</b>		<b>6</b>	

Question			Marking details	Marks Available									
				AO1	AO2	AO3	Total	Maths	Prac				
8 F T	(a)	(i)	(Presence of) lichen	1			1						
		(ii)	Same height above the ground Same area (on trunk)	2			2		2				
	(b)	(i)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">10</td> <td style="width: 50%;">2.5 (1)</td> </tr> <tr> <td>2 (1) for both</td> <td>0.5 (1)</td> </tr> </table>	10	2.5 (1)	2 (1) for both	0.5 (1)		3		3	2	3
10	2.5 (1)												
2 (1) for both	0.5 (1)												
		(ii)	LIS = 2 – 1 subs (1) = 1 (1) 1 is equivalent to at risk (1) so different conclusion to data for branches (1)			4	4		4				
	(c)	(i)	avoid confusion/ duplication caused by local or common names/same in every language	1									
		(ii)	Same {order /family} as <i>Ramalina farinacea</i>			1							
			<b>Question 8 total</b>	<b>4</b>	<b>3</b>	<b>5</b>	<b>12</b>	<b>2</b>	<b>9</b>				

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
9 F T	(a)	(i)	>10<32		1		1		
		(ii)	Orbital speed is less (1) Circumference is greater / travels a greater distance (1)		2		2		
		(iii)	$\frac{695700}{12800} = 54(.4)$		1		1	1	
	(b)	(i)	60 years			1	1	1	
		(ii)	E, M and J in same positions as before (1) S at about 8 o'clock (1)			2	2		
			<b>Question 9 total</b>		4	3	7	2	

Question	Marking details	Marks Available					
		AO1	AO2	AO3	Total	Maths	Prac
3	<p><b>Indicative content:</b></p> <p>The Earth consists of a solid iron core, molten iron outer core, mantle and crust.</p> <p>The Earth's outer layer, (the crust and the rigid upper part of the mantle), is broken into tectonic plates. These plates continuously move at a rate of a few centimeters per year in relation to one another. The process occurring at tectonic plate boundaries where plates slide past one another, move towards one another and move apart.</p> <p>Rock in some parts of the mantle becomes heated by the core and melts. Convection currents in molten rock in the mantle is an explanation for plate movement.</p> <p><b>5–6 marks</b> Detailed structure. Reference to tectonic plates. Description of convection currents in the mantle.</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><b>3–4 marks</b> 2 of: Detailed structure. Reference to tectonic plates. Description of convection currents in the mantle.</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		

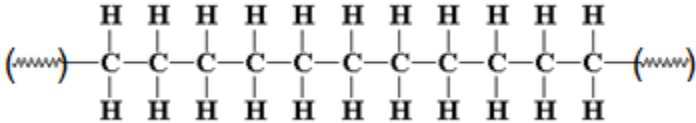
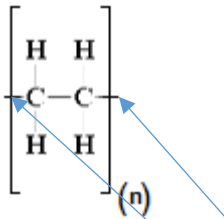
Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
				<p><b>1-2 marks</b></p> <p>Limited detail about structure of the Earth or tectonic plates or convection currents.</p> <p><i>There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</i></p> <p><b>0 marks</b></p> <p><i>No attempt made or no response worthy of credit.</i></p>						
				<b>Question 3 total</b>	<b>6</b>			<b>6</b>		



Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)	elements are composed of one type of atom (1) while compounds are made of two or more <u>different types</u> of <u>atom</u> (that are chemically joined) (1)	2			2		
		(ii)	$2 \text{ H}_2 + \text{O}_2 \rightarrow 2 \text{ H}_2\text{O}$ reactants (1) product (1) balancing (1)	2	1		3		
	(b)		KE = 5kJ Heat energy = 1.5kJ		2		2	2	
	(c)		(Connecting them in parallel) decreases the overall resistance (1) which increases the <u>current</u> (from the fuel cell) (1)	2			2		
	(d)		Reduce carbon emissions of transport (1) so less additions to greenhouse effect (1)  Less petrol or diesel used(1) Less damage to the environment during extraction (1)  less SO <sub>2</sub> /NO <sub>x</sub> (1) so less acid rain (1)  linked marks	2			2		
			<b>Question 4 total</b>	<b>8</b>	<b>3</b>	<b>0</b>	<b>11</b>	<b>2</b>	

Question		Marking details		Marks Available						
				AO1	AO2	AO3	Total	Maths	Prac	
5	(a)			Add sulfuric acid (to excess zinc oxide powder) (1) Filter the solution (to remove the insoluble excess ZnO) (1) Allow to evaporate (to remove the water) (1)	2	1		3		3
	(b)			Name of insoluble salt if produced						
				Lead iodide (1)		3		3		4
				Copper carbonate (1)						
				None produced (1)						
				<b>Question 5 total</b>	<b>2</b>	<b>4</b>		<b>6</b>		<b>6</b>

Question		Marking details	Marks Available					
			AO1	AO2	AO3	Total	Maths	Prac
6	(a)	Fractional distillation (to separate the fractions) (1) Cracking /to break down the longer molecules into shorter ones (1) Polymerisation / join {monomers/alkenes} together (1)	3			3		
	(b)	They are saturated / cannot accommodate further bonds/no double bonds to {react/join} together / all single C-C bonds  Accept: all bonds are used up		1		1		
	(c) (i)	$  \begin{array}{cccc}  & \text{H} & \text{H} & \text{H} & \text{H} \\  &   &   &   &   \\  \text{H} & - \text{C} & - \text{C} & - \text{C} & = \text{C} \\  &   &   & &   \\  & \text{H} & \text{H} & & \text{H}  \end{array}  $ <p style="text-align: right;">(2)</p> <p>OR</p> $  \begin{array}{cccc}  & \text{H} & \text{H} & \text{H} & \text{H} \\  &   &   &   &   \\  \text{H} & - \text{C} & - \text{C} & = \text{C} & - \text{C} - \text{H} \\  &   & & &   \\  & \text{H} & & & \text{H}  \end{array}  $ <p style="text-align: right;">(2)</p> <p>If incorrect diagram, one carbon double bond (1)</p>		2		2		
	(ii)	C <sub>4</sub> H <sub>10</sub>		1		1		

Question				Marking details	Marks Available						
					AO1	AO2	AO3	Total	Maths	Prac	
	(d)			e.g.  OR  need otherwise (1) max C joined by single bond (1) Each C joined to 2 H (1)							
				<b>Question 6 total</b>	<b>3</b>	<b>6</b>	<b>0</b>	<b>9</b>			

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
7	(a)		Convection would cause hot air to rise(1) Air is a poor conductor / no physical contact (1)	2			2		2
	(b)	(i)	Black plate has the greatest (rate of) absorption (1) of IR radiation (1)		2		2		
		(ii)	Temperature change – foil (16.1 °C) and black paper (29.0 °C) (1)(substitution)  Silver plate = $(16.1^{\circ}\text{C} \div 14) = 1.15 (^{\circ}\text{C}/\text{minute})$ (1) Black plate = $(29.0^{\circ}\text{C} \div 14) = 2.07 (^{\circ}\text{C}/\text{minute})$ which is not double so Andrew is incorrect (1)	1		2	3	3	
			<b>Question 8 total</b>	<b>3</b>	<b>2</b>	<b>2</b>	<b>7</b>	<b>3</b>	<b>2</b>

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
8	(a)	(i)	Minimum level of demand on the (grid over a period of time) / Electrical power needed to satisfy the minimum demand placed on the grid (1)	1			1		
		(ii)	Step-up – increases the voltage (1) in order to reduce the energy loss in the cables / make it more efficient (1) Step-down – reduces the voltage to <u>safe levels</u> for consumers (1)	3			3		
	(b)		Number of nuclear power stations to meet demand = $8/3.2 = 2.5$ (1)  Would require $(8\,000\text{ MW} \div 4\text{ MW}) = 2\,000$ wind turbines Would require $(8\,000\text{ MW} \div 1\text{ MW} \times 5\text{ acres}) = 40\,000$ acres of land for solar panels Would require $(8\,000\text{ MW} \div 50\text{ MW}) = 160$ Hydro-electric stations Would require $(8\,000\text{ MW} \div 53\text{ MW}) = 151$ Bio-energy plants  Any one calculated (2) - (Division (1) Ans (1))  Bob is correct / Nuclear best – based on only needing 3 power stations (1)  OR  Number of nuclear power stations to meet demand = $8/3.2 = 2.5$ (1) e.g. Number of bio-energy plants compared to nuclear = $3200/53$ (1) = 60 (1) So Bob is correct as you would need 180 bio-energy plants compared to 3 nuclear power stations (1)				4	4	3

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
(c)	(i)		Label y axis and both scales (1) Points plotted within $\pm 1$ small square division (2 – 6 correct, 1 – 5 correct) (ignore 0,0) Curve of best fit $\pm 1$ one small square division must go through origin (1)		4		4	4	
	(ii)		8 MW [ $\pm 0.2$ ] (value from the graph) (1) 22 % output ( $8 \times 0.22$ ) = 1.76 MW (1) 1.76 MW <b>ecf</b> $\times$ £45 MWhr = £79.20 per hour (1) Payback = set-up cost $\div$ income per hour = $\frac{9000000}{79.20}$ ( <b>ecf</b> ) = 113 636 hrs (1) 113 636 hrs <b>ecf</b> $\div$ (24 $\times$ 365) = 12.97 / 13 years (1) No rounding penalty Accept 365.25 for 1 year  OR  8 MW [ $\pm 0.2$ ] (value from the graph) (1) 22 % output ( $8 \times 0.22$ ) = 1.76 MW (1) 24 $\times$ 365 = 8 760 ; Energy = 8 760 $\times$ 1.76 = 15 417 (1) Cost = 15 417 $\times$ 45 = (£) 693 792 (1) Payback = 9 000 000 / 693 792 = 12.97 years (1)  OR  9 000 000 / 45 = 200 000 units(1) 200 000 / (24 $\times$ 365) = 22.83 units per hr(1) 8 MW [ $\pm 0.2$ ] (value from the graph) (1) 22 % output ( $8 \times 0.22$ ) = 1.76 MW (1) Payback = 22.83 / 1.76 = 12.97 years (1)		4	1	5	5	
			<b>Question 7 total</b>	<b>4</b>	<b>8</b>	<b>5</b>	<b>17</b>	<b>11</b>	

## Foundation TIER

### SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	5			5		
2	3	3	2	8	5	
3		8	2	10	1	
4	5		3	8		6
5	6	5		11	5	7
6	2	6		8	3	
7	5	1		6		6
8	4	3	5	12	2	9
9		4	3	7	2	
<b>TOTAL</b>	<b>30</b>	<b>30</b>	<b>15</b>	<b>75</b>	<b>18</b>	<b>28</b>



## HIGHER TIER

### SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	4	3	5	12	2	9
2		4	3	7	2	
3	6			6		
4	8	3		11	2	
5	2	4		6		6
6	3	6		9		
7	3	2	2	7	3	2
8	4	8	5	17	11	
<b>TOTAL</b>	<b>30</b>	<b>30</b>	<b>15</b>	<b>75</b>	<b>20</b>	<b>17</b>