SPECIMEN MATERIAL

GCSE
COMBINED SCIENCE: SYNERGY

PAPER 4H

Mark scheme

Specimen 2018

Version 1.0

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. The final mark scheme will include any amendments made at the standardisation events which all examiners participate in and is the scheme which is used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for standardisation each examiner analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, examiners encounter unusual answers that have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working.

Full marks can, however, be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient are used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes. Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	Ionic		1	AO2/1 4.6.2.3
01.2	electrolyte		1	AO1/1 4.7.5.2
01.3	because the ions are free to flow		1	AO1/1 4.7.5.2
01.4	because potassium is higher in the reactivity series than hydrogen so less easily discharged than hydrogen		1 1	AO2/1 RPA21
01.5	because water is covalent / molecular /contains molecules so there are no free electrons to move **or** does not have an overall electrical charge		1 1	AO2/1 AO2/1 RPA21
01.6	conductivity of the solution increases with concentration in a linear relationship **or** directly proportional		1 1	AO3/1a RPA21
Total			**9**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(as concentration increases)	answers **must** refer to data from graph to gain full marks		AO3/1b RPA19
	relationship identified from the graph	eg the same volume of gas is collected in a shorter time **or** more gas is collected in the same time **or** reaction reaches completion in a shorter time	1	
	reference to relevant data to evidence relationship	eg 20 ml collected in 10 seconds at 0.5 mol/dm^3 in 6.5 s at 1.0 mol/dm^3 and in 4 s at 2.0 mol/dm^3 **or** at 10 seconds volume collected is 20 cm^3 with 0.5 mol/dm^3, 30 cm^3 with 1.0 mol/dm^3, 50 cm^3 with 2.0 mol/dm^3 **or** total volume collected reaches maximum of 100ml in 20 seconds at 2.0 mol/dm^3 but takes twice as long at 1.0 mol/dm^3 and at 0.5 mol/dm^3	1	
02.2	reactions occur when particles collide		1	AO1/1
	increasing concentration means there are more particles in the same volume		1	AO2/1
	so there are more collisions		1	AO2/1 4.7.4.3

Question 2 continues on the next page

Question 2 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	leave for longer if gas continues to be produced student A is right **or** repeat with more acid (1) if more gas is produced student B is right (1)		1 1	AO3/3b RPA19
Total			**7**	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	4.5 circled on table (15 °C, test 1)		1	AO3/1a RPA20
03.2	1.8	do not allow 1.83	1	AO2/2 RPA20
03.3	16 (minutes)	correct number extrapolated from curve	1	AO3/2b RPA20
03.4	4.0 min – blue / black / purple 7.0 min – yellow / orange / brown		1 1	AO3/2a RPA20
03.5	The amylase solution had been prepared with water 95 °C		1	AO3/2b RPA20

Question 3 continues on the next page

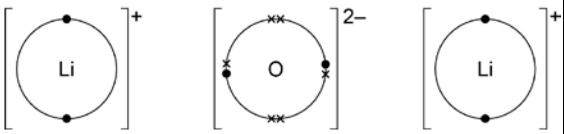
Question 3 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	**Level 3:** A clear and coherent method is described using logical steps and demonstrating a good understanding of how to improve the validity of the method. The method would lead to the production of valid results that would give rise to a more valid conclusion.		5–6	AO3/3a AO3/3b
	Level 2: The substantive content of a method is present and demonstrates reasonable understanding of how to improve the validity but may be missing some detail. The plan may not be in a completely logical sequence but leads towards the measurement of rate of the reaction.		3–4	
	Level 1: Simple relevant statements made, which demonstrate limited understanding of how to improve the experimental method. The response lacks logical structure and would not lead to the production of valid results or a more precise optimum temperature		1–2	
	No relevant content		0	
	Indicative content • conduct at a greater range of temperatures • use temperatures both above and below 40 °C • use smaller temperature intervals to get a more accurate optimum (eg go up in 2 °C increments) • take samples at smaller time intervals to get a more accurate result for ‘time taken’ • control the volume of starch used (eg 5 cm^3) • control the volume of the amylase solution (eg 1 cm^3) • control the temperature (eg using a water bath) • heat the two solutions separately before mixing • control the concentration of the starch solution • control the concentration of the amylase solution			RPA20
Total			**12**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	weight = mass × gravitational field strength		1	AO1/1 4.6.1.4
04.2	mass = weight ÷g = 1.4 ÷ 9.8 = 0.143 (kg)	allow 0.143 with no working shown for **3** marks	1 1 1	AO2/1 AO2/1 AO2/1 4.6.1.4
04.3	momentum = mass × velocity momentum before = momentum after 143 × 7.9 = 150 × v $v = \frac{143 \times 7.9}{150}$ = 7.5 (m/s)	allow 7.5 (m/s) with no working shown for **4** marks incorrect number of sig. figs max. **3** marks	1 1 1 1	AO1/1 AO2/1 AO2/1 AO2/1 4.7.1.8
04.4	ball is falling / moving down at terminal velocity air resistance and weight have the same magnitude / size so no acceleration / constant speed		1 1 1 1	AO3/2b AO1/1 AO2/1 AO3/2b 4.6.1.2
Total			**12**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	because they form hydroxides		1	AO1/1 4.5.1.4
	that give alkaline solutions (in water)		1	
05.2	the atoms have more electron shells (as move down the group)		1	AO1/1 4.5.1.1
	so the electron in the outer shell is further away from the nucleus		1	AO1/1 4.5.1.4
	which reduces the attraction to the nucleus		1	AO1/1 4.5.1.4
	so the electron is lost more easily from the atom		1	AO1/1 4.5.1.2
05.3		electronic structure of lithium drawn correctly	1	AO2/1 4.5.1.4 4.6.2.2
		electronic structure of oxygen drawn correctly	1	
		correct charge on ions (Li^+ and O^{2-})	1	
		correct number of each ion (2 lithium, 1 oxygen)	1	
Total			**10**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	**Level 3:** A full, detailed and coherent plan covering all the major steps is provided, which outlines the apparatus required and sets out the steps needed in a logical manner that could be followed by another person to produce a pure, dry sample of copper nitrate.		5–6	AO1/2
	Level 2: The substantive content of a plan is present but may be missing some steps. The plan may not be in a completely logical sequence but leads towards the production of a pure, dry sample of copper nitrate.		3–4	
	Level 1: Simple statements relating to relevant apparatus or steps are made but they may not be in a logical order. The plan would not allow another person to produce the sample.		1–2	
	No relevant content		0	
	Indicative content • pour a suitable volume of nitric acid into a suitable container • add a small amount of copper carbonate to the acid and stir until the effervescence stops • continue to add small amounts of copper carbonate to the acid and each time stir until any effervescence stops • eventually when there is no reaction/effervescence when the copper carbonate is added filter the mixture to remove the excess copper carbonate • pour the filtrate (copper nitrate solution) into an evaporating basin and heat to evaporate a small amount of the water • leave the copper nitrate solution to crystallise • remove the crystals from the solution remaining and dry the crystals			RPA17
06.2	1 mole carbon dioxide = 14 + (16 × 2) = 46 g		1	AO2/1
	14 g is 0.30 mole		1	AO2/1
	1 mole is 6.02×10^{23} molecules		1	AO1/1
	so 14 g has 1.81×10^{23} molecules	allow 1.81×10^{23} with no working shown for **4** marks answer not given in standard form max. **3** marks	1	AO2/1 4.5.2.4
Total			**10**	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	gravity (of moon and sun)		1	AO1/1 4.8.2.4
07.2	any **two** from: • tidal energy is renewable (1) • so won't run out like fossil fuels (1) **or** • doesn't emit carbon dioxide • so won't contribute to global warming/climate change **or** • doesn't emit oxides of sulfur or nitrogen • so doesn't cause acid rain **or** • doesn't use fossil fuels • so less impact on environment of extraction/transport **or** • doesn't produce particulates • so less effect on health/environment	**1** mark for statement, **1** mark for correctly linked reason	Max. 4	AO1/1 AO2/1 4.8.2.4 4.4.1.4 4.4.1.6

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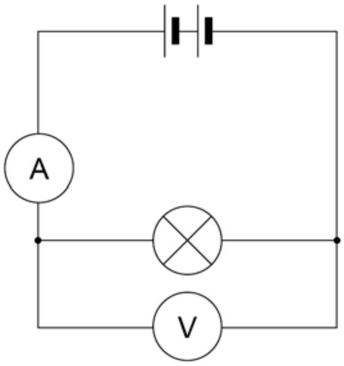
Question 7 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	coal consumption per year = 29.25 × 1000 × 6 million = 175 500 000 000 MJ		1	AO3/2b 4.8.2.4
	1 hectare of willow will produce 9 × 13 × 1000 = 117 000 MJ per year		1	
	so need 175 500 000 000 ÷ 117 000 = 1 500 000 (hectares)	allow 1 500 000 with no working shown for **3** marks	1	
07.4	although has higher direct emissions than other fuels		1	AO3/2b 4.8.2.4
	it has much lower lifetime emissions		1	
Total			**10**	

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1		ammeter connected in series	1	AO1/2 RPA15
		voltmeter connected in parallel	1	
	measure the potential difference across the lamp at known current		1	
	calculate resistance from measured values using V = IR		1	
08.2	for ohmic conductors the current is directly proportional to the potential difference applied across it		1	AO1/1
	this graph is curved so it is not an ohmic conductor		1	AO3/2b RPA15

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Question 8 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	diode because it has a high resistance with negative potential differences and a low resistance for positive potential differences.	allow answers in terms of current	1 1 1	AO3/2b RPA15
08.4	tangent to the curve drawn at 2.3 V correct reading of Δy and Δx from graph **either** substitution of values into *V* = *IR* (1) value of *R* calculated (1) **or** calculation of gradient (1) calculation of *R* = 1/gradient (1)	accept values in the range 0.50 to 0.65 allow ecf from incorrect readings of Δy and Δx accept values in the range 0.50 to 0.65	1 1 1 1	AO2/2 RPA15
Total			**13**	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	600 kg = 5880 N		1	AO2/1
	power = $\frac{5880 \times 35}{45}$		1	AO2/1
	= 4573.3 (W)	this step without the previous steps stated gains **3** marks	1	AO2/1
	% Eff. = $\frac{4573.3}{8000} \times 100$		1	AO2/1
	= 57.17 (%)	allow 57.17 with no working shown for **5** marks	1	AO2/1 4.7.2.7
09.2	gpe = 600 x 9.8 x 35		1	AO2/1
	= 205 800		1	AO2/1
	gpe = KE = ½ m v^2		1	AO2/1
	v = $\sqrt{\frac{2 \times KE}{m}}$		1	AO2/1
	= $\sqrt{\frac{411\,600}{600}}$		1	AO2/1
	= 26.2 (m/s)	allow 26.2 with no working shown for **6** marks	1	AO2/1 4.6.1.5 4.7.1.9
Total			**11**	

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10	**Level 3:** A detailed, coherent and logical justification of the scientist's statement, with relevant links made between statements in the question, phytomining and the effects of other methods of metal production on the environment.		5–6	AO3/2b
	Level 2: An attempt to justify the scientist's statement is made, with some attempt at linking statements. The logic may be inconsistent at times but builds towards a coherent argument.		3–4	
	Level 1: Discrete relevant points made. The logic may be unclear and may not be consistent with the reasoning. Links are not made.		1–2	
	No relevant content		0	
	Indicative content • phytomining conserves supplies of ores • copper will be available for longer as at present rate of use copper ores will run out in about 35 years • phytomining conserves supplies of fossil fuels or energy • less fuel used at a lower cost • mining scars landscape or produces noise pollution • mining destroys wildlife habitats • with more phytomining less need to mine ores • with phytomining less habitat destroyed or less scarring of landscape • with phytomining less need to use landfill for waste • burning fossil fuels produces carbon dioxide/greenhouse gas • burning fossil fuels causes global warming or climiate change • extraction from ores produces sulfur dioxide which causes acid rain			4.8.2.3 4.8.2.4 4.8.1.2 4.4.1.4 4.4.1.5 4.4.1.6
Total			**6**	

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