SPECIMEN MATERIAL

GCSE
COMBINED SCIENCE: SYNERGY

PAPER 2H

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	$N_2 + 2O_2 \longrightarrow 2NO_2$	correct formulae for reactants correct balancing	1 1	AO1/1 AO2/1 4.4.1.6
01.2	2.96 – 0.98 1.98 ÷ 2.96 (×100) = 66.9(%)	correct values read from graph allow ecf from readings from graph allow 66.9 shown without working for the **3** calculation marks incorrect number of sig. figs max **2** marks	1 1 1	AO2/2 4.4.1.6
01.3	less acid rain **or** fewer respiratory problems in humans	allow improved air quality	1	AO1/1 4.4.1.6
Total			**6**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	**mobile phase** propanone **stationary phase** paper		1 1	AO2/2 RPA9
02.2	any **three** from: • contains chlorophyll a, b and carotene • contains Pigment B • does not contain pheophytin • contains (at least) one unknown substance • contains five substances • contains a substance that does not dissolve in the solvent		3	AO3/1a RPA9
02.3	$Rf = \frac{distance\ moved\ by\ substance}{distance\ moved\ by\ solvent}$		1	AO1/1 4.2.2.4
02.4	both measurements correct R_f = 5.0/9/0 = 0.56	solvent front = 9.0 cm and pigment B distance = 5.0 cm allow ecf from incorrect measurements	1 1 1	AO2/2 RPA9
02.5	origin line drawn in ink so it will run **or** dissolve in the solvent **or** split up spots under solvent **or** solvent above spots/origin line so they will mix with solvent **or** wash off paper **or** colour the solvent **or** dissolve in the solvent		1 1 1 1	AO3/3a RPA9
Total			**13**	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	**Level 3:** A full, detailed and coherent plan covering all the major steps is provided, which outlines what needs to be measured to calculate specific heat capacity. The steps are set out in a logical manner that could be followed by another person to calculate the specific heat capacity.		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 calculation of the specific heat capacity.		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 calculate specific heat capacity.		1–2	
	No relevant content.		0	
	Indicative content • measure the mass of metal • correct use of balance • description of how work is done or energy transferred to metal • how energy transfer or work done is measured • equate work done/energy transferred = increase in thermal energy store of the metal • calculate specific heat capacity	**extra information** eg electrical work, mechanical work (eg dropping lead shot) eg electrical using joulemeter, mechanical decrease in potential energy store of falling lead shot		RPA2

Question 3 continues on the next page

Question 3 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	4 600 = 1 × 657 × temperature change temperature change = 4 600/657 = 7 (°C)	 allow 7 with no working shown for **3** marks	1 1 1	AO2/2 4.1.1.4
03.3	Type of material		1	AO3/3b RPA2
03.4	heat loss then any **one** from: • turned off the power supply too early • incorrectly measured mass of material • incorrectly measured temperature incorrectly read the change in thermal energy		1 1	AO3/3a RPA2
03.5	would give a more accurate value **or** the calculated specific heat capacity will be smaller because the bubble wrap insulates the material **or** prevents heat loss		1 1	AO3/3b RPA2
Total			**14**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	0.92 = 76.2 × time		1	AO2/1
	time = 0.92 ÷ 76.2		1	AO2/1
	= 0.012	allow 0.012 with no working shown for **3** marks	1	AO2/1 4.2.1.6
04.2	pathway **B** has two synapses	allow converse for pathway **A**	1	AO3/1a
	chemicals diffuse across each synapse		1	AO2/1
	which slows down the impulse		1	AO2/1 4.2.1.6
04.3	140–203		1	AO3/2a RPA8
04.4	use the same person for each test		1	AO3/3b RPA8
	use left hand **and** right hand		1	
	use a bigger sample size **or** more people	allow take more readings with each person	1	
04.5	mean drop distance = (230 + 211 + 279 + 215 + 264) ÷ 5 = 239.8		1	AO2/1 RPA8
	239.8 mm = 0.2398 m		1	
	mean reaction time = $\sqrt[2]{\frac{2 \times 0.2398}{9.8}}$		1	
	= 0.221	incorrect sig. figs max. **3** marks allow 0.221 with no working shown for **4** marks	1	
Total			**14**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	cross / breed / mate different breeds of horse		1	AO2/2
	if the offspring are fertile then the two breeds are of the same species		1	AO2/1 4.4.4.2
05.2	select the fastest male and female to cross/mate	allow any relevant characteristic, eg stamina	1	AO1/2 4.4.4.5
	select the fastest offspring and breed them		1	
	repeat over several generations to produce faster horses		1	
05.3	gene for the Bt poison is cut from the bacterial DNA / plasmid / chromosome	ignore characteristic accept *Bacillus thuringiensis*	1	AO1/2 4.4.4.6
	using enzymes(s)		1	
	and transferred to cotton plant cells / DNA / chromosome	do **not** allow to cotton plant plasmid	1	

Question 5 continues on the next page

Question 5 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	any **four** from: advantages • increased yield as less eaten by insects • fewer pesticides need to be used • (so) producer can make more money Disadvantages: • gene (for poison) could be passed on to wild plants • may kill useful insects • ecosystem / food chain could be affected • gene pool of cotton plants could be reduced	must have both advantages and disadvantages for full marks this point may only be gained if linked to one of the points above allow named insect eg bees allow less variation in cotton plant population	max. 4	AO1/1 4.4.2.2 4.4.2.3 4.4.4.6
Total			**12**	

Question 6

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>06.1</td><td>Man’s genotpe Hh
Woman’s genotype hh</td><td>both needed for the mark</td><td>1</td><td>AO2/1
4.4.3.3</td></tr>
<tr><td>06.2</td><td>gametes correctly derived from parents genotypes in 05.1

offspring genotypes correctly derived from gametes

<u>all</u> Hh circled

<table>
<tr><th rowspan="2">Man’s gametes</th><th></th><th colspan="2">Woman’s gametes</th></tr>
<tr><th></th><th>h</th><th>h</th></tr>
<tr><td></td><td>H</td><td>Hh</td><td>Hh</td></tr>
<tr><td></td><td>h</td><td>hh</td><td>hh</td></tr>
</table>

(Probability =) any one from:
• 50%
• ½
• 2/4
• 0.5
• 1 in 2
• 2 in 4
• 1:1
• 2:2</td><td></td><td>1

1

1

1</td><td>AO2/2

AO2/2

AO3/1a

AO3/2b
4.4.3.3</td></tr>
</table>

Question 6 continues on the next page

Question 6 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	**Level 3:** A detailed and coherent evaluation is provided which considers a range of relevant points and comes to a conclusion consistent with the reasoning.		5–6	AO3/1b AO3/2a
	Level 2: An attempt is made to relate relevant points and come to a conclusion. The logic may be inconsistent at times but builds towards a coherent argument.		3–4	AO3/1b AO3/2a
	Level 1: Discrete relevant points made. The logic may be unclear and the conclusion, if present, may not be consistent with the reasoning.		1–2	AO3/1b AO3/2a
	No relevant content		0	
	Indicative content • adoption / gamete donation unsuitable as offspring not biologically theirs • natural conception too risky / only 50% chance of healthy offspring • natural conception would cause worry whether baby would be healthy or not • (therefore) choice is between PGD and PND **pros of PGD** • baby would be theirs • results obtained at an early stage • high chance baby produced would be healthy • parents would have confidence of having a heathy baby from start of pregnancy • lower risk of miscarriage compared to PND • frozen embryos can be used to have another healthy child • PGD occurs before pregnancy / implantation • PGD does not involve abortion so less trauma / less pain / ethical comparison • spare healthy embryos may be used for research / medical treatment **cons of PGD** • slight / 0.2% chance of misdiagnosed embryo • expensive procedure • cost to NHS of non-essential procedure • (unhealthy) embryos might be destroyed • large number of embryos produced so healthy embryos may be destroyed • ethical issues of using embryos for research • some people are opposed to IVF due to their religious			4.3.1.8

	beliefs **pros of PND** • natural conception less invasive for mother • psychological benefit of producing child naturally • 99% / high chance that result of test will be conclusive **cons of PND** • sampling technique invasive to mother • risk of miscarriage • risk of infection • long wait before test can be carried out • 50% chance baby will have allele for Huntington's disease • parents will have a difficult decision to make if baby is unheathly • baby may be aborted • ethical / religious issues of abortion • a justified conclusion		
Total		**11**	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	most alpha particles went straight through, suggesting lots of empty space		1	AO1/2
	a few alpha particles bounced back, suggesting small central nucleus		1	AO1/2
	with all the positive charge		1	AO1/2
	the plum pudding model does not explain the results because it shows the whole atom as a ball of positive charge with no empty space		1	AO3/1a 4.1.2.1
07.2	the figures show that the radius of an atom is 10 000 times bigger than the nucleus		1	AO2/1 4.1.2.2
	consistent with the nuclear model, which says that the atom has a tiny nucleus at the centre of the atom		1	
07.3	all hydrogen atoms have just one proton (in the nucleus)		1	AO2/1
	some hydrogen atoms also have one neutron		1	AO2/1
	protons and neutrons have the same relative mass so mass number of these atoms is 2		1	AO1/1 4.1.2.4
07.4	neutrons are not attracted or repelled by a positive nucleus		1	
	so the neutrons would all pass through the foil		1	AO3/2a 4.1.2.3
Total			**11**	

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	$6CO_2 + 6H_2O \longrightarrow$ $C_6H_{12}O_6 + 6O_2$	correct reactants correct products	1 1	AO1/1 4.2.2.5
08.2	correct scale and label on x axis all 5 plots correct	 tolerance ±½ small square allow 2 or 3 plots correct for **1** mark	1 2	AO2/2 RPA10
08.3	no although as distance increases, rate decreases the line curves **or** line should be straight suitable data quoted	no mark examples: • supports conclusion between 20–40 (cm) • does not support conclusion between 10–20 (cm)	 1 1 1	AO3/1a RPA10
08.4	volume of 1 bubble = 4/3 × 3.14 × $(0.1)^3$ = 0.00419 at 40 cm there are 7 bubbles vol at 40 cm = 0.02933 Rate per minute = × 2 = 5.86 × 10^{-2} (cm^3 per min)	 allow ecf from incorrect value taken from table allow 5.86 × 10^{-2} with no working shown for **5** marks answer not given in standard form or to incorrect number of sig. figs max **4** marks	1 1 1 1 1	AO2/2 4.2.2.6
Total			**13**	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09	**Level 3:** A full explanation is given that is coherent and logically structured, linking effect of increase in carbon dioxide to climate change and effects on biodiversity.		5–6	AO1/1
	Level 2: An attempt is made to link the effects of rising carbon dioxide levels to climate change and biodiversity. The logic may be inconsistent at times but builds towards a coherent explanation.		3–4	
	Level 1: Discrete relevant points made. The logic may be unclear and attempts at reasoning may not be consistent.		1–2	
	No relevant content.		0	
	Indicative content • rise in carbon dioxide increases atmospheric temperature / causes global warming • global warming causes extreme weather patterns • such as rise in sea levels • increased or decreased rainfall • frequency of storms / droughts • rise in sea levels means habitats will change due to flooding • rise in sea levels could increase salt in soil • increased rainfall will increase water levels • severity of storms/droughts could affect photosynthesis • consequences of changes are loss of or damage to habitats • which will affect animal and plant distributions • by increasing migration or species dying off • which decreases biodiversity			4.4.1.5 4.4.1.3 4.4.2.3

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