GCSE
COMBINED SCIENCE: SYNERGY
8465/4H

Higher Tier Paper 4 Physical Sciences

Mark scheme

June 2020

Version: 1.0 Final Mark Scheme

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate 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, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

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.

Further copies of this mark scheme are available from aqa.org.uk

Copyright information

AQA retains the copyright on all its publications. However, registered schools/colleges for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to schools/colleges to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Copyright © 2020 AQA and its licensors. All rights reserved.

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
- the Assessment Objectives, level of demand 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 errors / 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 ecf 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 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is 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.

3.10 Do <u>not</u> accept

Do **not** accept 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 two 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.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise 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.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 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	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	number of repeating units **or** a large number	allow number of monomers (joined together)	1	AO1 4.6.2.4
01.2	any **one** from: • only shows in 2D • doesn't show the shape of the molecule • only shows a very small proportion of all atoms bonded together.		1	AO1 4.6.2.4
01.3	50 nm = 0.000 000 05 m = 5×10^{-8} (m)	allow 50×10^{-9} (m) allow correct value in standard form obtained from an incorrect conversion	1 1	AO2 4.6.2.4 4.8.1.3
01.4	marine animals eat them build up in food chain	 allow too small to be seen	1 1	AO3 4.8.2
01.5	any **two** from: • stop using plastic items • recycle plastic items • reuse plastic items • charge for plastic bags • refill own water bottle instead of buying new bottle • deposit schemes for plastic bottles.	allow specific examples eg, stop using plastic drinking straws, or plastic bags	2	AO3 4.8.2
Total			**8**	

Question	Answers	Mark	AO/ Spec. Ref
02	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	4–6	AO3 4.7.3.2 RPA 17
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1–3	
	No relevant content	0	
	Indicative content • place sulfuric acid in beaker • add copper carbonate one spatula at a time • until no longer dissolves **or** no effervescence seen • filter mixture • to remove excess copper carbonate • add solution to an evaporating basin • heat to crystallisation point **or** heat till half water gone **or** heat till crystals just start to form • using water bath or electric heater • leave to cool (until crystals form)		
Total			**6**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	measure initial length and final length of spring extension = final length – initial length	 allow extension = 1.3 cm	1 1	AO1 4.6.1.6 RPA13
03.2	force = spring constant × extension **or** $F = ke$		1	AO1 4.6.1.6 RPA13
03.3	$3.0 = k \times 0.12$ $k = \frac{3.0}{0.12}$ k = 25 (N/m)		1 1 1	AO2 4.6.1.6 RPA13
03.4	extension = 9 (cm) extension = 0.09 (m) $E_e = 0.5 \times 40 \times 0.09^2$ E_e = 0.162 (J)	 allow a correct conversion from an incorrect extension allow a correct substitution of their incorrectly / not converted extension allow a correctly calculated value for E_e using their incorrectly / not converted extension	1 1 1 1	AO3 AO2 AO2 AO2 4.6.1.7 RPA13
Total			**10**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	length of card time that light gates are blocked by the card		1 1	AO1 4.7.1.6 RPA14
04.2	to compensate for the effect of friction		1	AO1 4.7.1.6 RPA14
04.3	no reaction time error performs calculations automatically		1 1	AO3 4.7.1.6 RPA14
04.4	resultant force = mass × acceleration **or** F = ma		1	AO1 4.7.1.6 RPA14
04.5	1.2 = m × 2.4 $m = \frac{1.2}{2.4}$ m = 0.50 (kg)		1 1 1	AO2 4.7.1.6 RPA14
Total			**9**	

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>05.1</td><td>correct scale on y-axis

magnesium plotted with a value of 19.5 °C on y-axis</td><td></td><td>1

1</td><td>AO2
4.7.3.3
4.7.5.1
RPA 18</td></tr>
<tr><td>05.2</td><td><table><tr><th></th><th>Magnesium sulfate</th><th>Nickel sulfate</th><th>Zinc sulfate</th></tr><tr><td>Magnesium</td><td>x</td><td>✓</td><td>✓</td></tr><tr><td>Nickel</td><td>x</td><td>x</td><td>x</td></tr><tr><td>Zinc</td><td>x</td><td>✓</td><td>x</td></tr></table>award 1 mark for each correct row</td><td></td><td>1

1

1</td><td>AO3
4.7.5.1
RPA 18</td></tr>
</table>

05.3	(mass of $NiSO_4$ = 0.0025 × 155 =) 0.3875 (g)		1	AO2 4.5.2.4 4.5.2.6
	(5 cm^3 = $\frac{5}{1000}$ =) 0.005 dm^3		1	
	$\left(\text{concentration} = \frac{0.3875}{0.005}\right)$ = 77.5 (g/dm^3)	allow correct use of an incorrectly determined value for mass and/or volume	1	
	OR			
	(concentration =) $\frac{0.0025}{0.005}$ **or** 0.5 (mol/dm^3) (1)			
	(concentration =) 0.5 × 155 (g/dm^3) (1)	allow correct use of an incorrectly determined value for concentration in mol/dm^3		
	(concentration) = 77.5 (g/dm^3) (1)			

Total			**8**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	Mean = $\frac{29.5 + 31.5}{2}$ Mean = 30.5 (cm)	 an answer of 33.8 (cm) scores **1** mark	1 1	AO3 AO2 4.6.1 4.6.1.6
06.2	55.8 (cm)		1	AO3 4.6.1 4.6.1.6
06.3	drop height is (directly) proportional to (mean) bounce height		1	AO3 4.6.1.6
06.4	range of results = 1.0 (cm) uncertainty = (±) 0.5 (cm)		1 1	AO3 4.6.1.6
06.5	video (playback) could be used in slow motion to reduce the difficulty in judging when the ball is at the highest point of the bounce	allow video (playback) could be paused	1 1	AO3 4.6.1.6
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	step-up transformer increases potential difference		1	AO1 4.7.2.9
	and decreases current		1	
	reducing thermal energy transfer to surroundings from transmission cables		1	
	step-down transformer decreases potential difference		1	
	so the electricity supply is safer for consumers		1	
07.2				AO2 4.7.2.8
	E = 50 000 000 (W)		1	
	t = 86 400 (s)		1	
	E = 50 000 000 × 86 400	this mark may score if P or t are incorrectly/not converted	1	
	E = 4.32×10^{12} (J)	allow 4 320 000 000 000 (J) allow an answer consistent with their incorrectly/not converted values of P and t	1	

Question	Answers	Mark	AO / Spec. Ref.
07.3	**Level 2:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	3–4	AO3 4.8.2.4
	Level 1: Some logically linked reasons are given. There may also be a simple judgement.	1–2	
	No relevant content	0	
	Indicative content: • power stations that emit less carbon dioxide cause less global warming • coal and geothermal power stations contribute to global warming • nuclear power doesn't contribute to global warming • sulfur dioxide causes acid rain • coal power stations contribute to acid rain • geothermal and nuclear power stations don't contribute to acid rain • radioactive waste needs burying • radioactive waste has a long half-life • radioactive waste remains radioactive for a long period of time • indication of which power station is best/worst environmentally.		

Total			13

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	so the electrodes do not react (with electrolyte / gas / chlorine / hydrogen)		1	AO1 4.7.5.2 4.7.5.3 RPA 21
08.2	**similarity** any **one** from: • both collected at a constant rate from 10 to 25 minutes • hydrogen is collected at the same rate as chlorine from 10 minutes. **difference** any **one** from: • rate of collection for hydrogen is greater than chlorine for the first 10 minutes • overall rate of collection of hydrogen is greater than chlorine • rate of collection of hydrogen is constant from 0 to 10 minutes but chlorine varies.		1 1	AO3 4.7.5.3 RPA 21
08.3	less chlorine is collected (because) most chlorine produced at the start of the reaction dissolves in the water		1 1	AO3 4.7.5.3 RPA 21

08.4	water molecules break down to produce hydrogen ions (and hydroxide ions) hydrogen ions are discharged as potassium is more reactive than hydrogen (so) hydrogen ions gain electrons to form a hydrogen molecule	 allow (so) hydrogen ions are reduced ignore to form a hydrogen atom	1 1 1 1	AO1 AO1 AO1 AO3 4.7.5.2 4.7.5.3 RPA 21

08.5	$2Cl^- \rightarrow Cl_2 + 2e^-$	allow **1** mark for Cl^- (on the left) **and** Cl_2 (on the right)	2	AO2 4.7.5.3 RPA 21

Total			**11**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	$2\,H_2O_2 \rightarrow 2\,H_2O + O_2$	allow correct multiples	1	AO2 4.5.2.1
09.2	crushed potato has a larger surface area	allow converse	1	AO1
	(so) has more frequent collisions	ignore more collisions unqualified	1	AO1
	(so) has a greater rate of reaction		1	AO3 4.7.4.6
09.3	enzyme is denatured (by high temperature)		1	AO2
	(so) active site changes shape **or** (so) hydrogen peroxide / substrate no longer fits		1	AO1 4.7.4.7
09.4				AO2 4.7.4.1
	correctly drawn tangent at 15 s		1	
	correct value for x step **and** y step from tangent		1	
	(rate =) $\frac{\text{value for } \Delta y}{\text{value for } \Delta x}$	allow correct use of an incorrectly determined value for x step and/or y step	1	
	correctly calculated		1	
Total			**10**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	the girl will carry on moving (to the left) with a speed of 20 m/s (because of) Newton's 1st law as there is no / zero resultant force acting on the girl / object	allow the girl will decelerate but with a smaller deceleration than the train	1 1 1	AO1 4.7.1.5
10.2	acceleration = $\frac{\text{change in velocity}}{\text{time taken}}$ **or** $a = \frac{\Delta v}{t}$		1	AO1 4.7.1.4
10.3	$a = \frac{(-)3.6}{6}$ a = (−) 0.6 (m/s^2)		1 1	AO2 4.7.1.4
10.4	Forward distance = $(3.6 \times 5) + \frac{(3.6 \times 6)}{2}$ Forward distance = (+) 28.8 (m) Backward distance = $\frac{(1.5 \times 4)}{2} + (1.5 \times 5)$ Backward distance = (−)10.5 (m) displacement = 18.3 (m)		1 1 1 1 1	AO2 4.7.1.4

10.5	$15^2 - 40^2 = 2 \times (-2) \times s$ $(-)1375 = (-)4s$ s = 343.75 (m)	 allow 340 (m) ignore negative sign if given	1 1 1	AO2 4.7.1.4

10.6	direction is always changing (so) velocity is constantly changing acceleration is rate of change of velocity	 allow velocity is speed in a certain direction 	1 1 1	AO1 4.7.1.1 4.7.1.3 4.7.1.4

Total			**17**