GCSE
COMBINED SCIENCE: SYNERGY
8465/4F

Foundation Tier Paper 4 Physical Sciences

Mark scheme

June 2023

Version: 1.0 Final

2 3 6 G 8 4 6 5 / 4 F / M S

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

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 their judgement
- 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 (for example, a scientifically correct answer that could not reasonably be expected from a student's knowledge of the specification).

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**.
Alternative words in the mark scheme are shown by a solidus 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** magnetic materials.

[2 marks]

Student	Response	Marks awarded
1	iron, steel, tin	1
2	cobalt, nickel, nail*	2

3.2 Use of symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, or uses symbols to denote quantities in a physics equation, 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. At any point in a calculation students may omit steps from their working. If a subsequent step is given correctly, the relevant marks may be awarded.

Full marks are **not** awarded for a correct final answer from incorrect working.

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

An error can be carried forward from one question part to the next and is shown by the abbreviation 'ecf'.

Within an individual question part, an incorrect value in one step of a calculation does not prevent all of the subsequent marks being awarded.

3.6 Phonetic spelling

Marks should be awarded if spelling is not correct but the intention is clear, **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.

3.11 Numbered answer lines

Numbered lines on the question paper are intended to support the student to give the correct number of responses. The answer should still be marked as a whole.

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, if necessary, 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. 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 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	the distance travelled while the driver reacts		1	AO1 4.7.1.10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	ice on the road surface		1	AO1 4.7.1.10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	friction		1	AO1 4.7.1.10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	the braking distance increases as speed increases		1	AO3 4.7.1.10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	weight = 850 × 9.8 weight = 8330 newtons	 allow N	1 1 1	AO2 AO2 AO1 4.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	the number of people in the car the type of road surface		1 1	AO3 4.7.1.10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	mean braking force = 850 × 10.7 mean braking force = 9095 (N)		1 1	AO2 4.7.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.8	the braking force (on car **A**) was smaller (than on car **B**) (so) the deceleration (of car **A**) was smaller	 allow (so) car **A** takes more time to stop	1 1	AO3 AO2 4.7.1.10 4.7.1.6 4.6.1.3

Total Question 1	**13**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	halogens		1	AO1 4.5.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	iodine / I	allow I_2	1	AO1 4.5.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	2,7		1	AO2 4.5.1.1 4.5.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	small molecules		1	AO1 4.6.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	potassium iodide	allow KI	1	AO2 4.5.1.5

Question	Answers	Mark	AO / Spec. Ref.
02.6			AO2 4.5.1.5

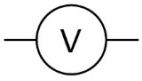
	Aqueous solution		
Element	**Sodium fluoride**	**Sodium chloride**	**Sodium bromide**
Fluorine	×	✓	✓
Chlorine	×	×	✓
Bromine	×	×	×

1
1
1

Total Question 2	8

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	J		1	AO1 4.7.2.2 RPA16

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2			1	AO1 4.7.2.4 RPA16

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	straight line of best fit drawn through all points		1	AO2 4.7.2.2 RPA16

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	(total resistance =) 60 (Ω)	allow an answer consistent with their drawn line of best fit	1	AO3 4.7.2.2 RPA16

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	the resistors were connected in series resistance increases (by the same amount each time)	 dependent on scoring MP1	1 1	AO1 4.7.2.2 4.7.2.3 RPA16

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	power = 3.0 × 0.25 power = 0.75 (W)		1 1	AO2 4.7.2.7

Total Question 3	**8**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(gold) is unreactive		1	AO1 4.8.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	by electrolysis		1	AO1 4.8.2.1 4.8.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	O^{2-}		1	AO2 4.5.1.2 4.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	carbon	allow C	1	AO2 4.8.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	any **two** from: • conserves iron (oxide) • less mining • less energy used • less waste produced	allow less landfill required	2	AO1 4.8.2.9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	(percentage =) $\frac{420}{560} \times 100$ = 75 (%)		1 1	AO2 4.8.2.9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	steel is magnetic		1	AO3 4.6.3.2 4.8.2.9

Total Question 4	**9**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	measuring cylinder		1	AO1 4.7.4.1 4.7.4.3 RPA19

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	balance	allow (weighing) scales	1	AO1 4.7.4.1 4.7.4.3 RPA19

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	to reduce the escape of gas		1	AO3 4.7.4.1 4.7.4.3 RPA19

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	(the volume of gas collected) increases then remains constant **OR** (the volume of gas collected) increases quickly (1) then increases (more) slowly (1)		1 1	AO2 4.7.4.1 4.7.4.3 RPA19

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	(volume from graph at 30 s =) 15 cm^3		1	AO2 4.7.4.1 4.7.4.3
	(mean rate of reaction =) $\frac{15}{30}$		1	RPA19
	= 0.5		1	
	cm^3/s		1	

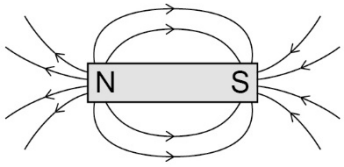
Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	decreases		1	AO1 4.7.4.3
	increases		1	RPA19

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	activation energy		1	AO1 4.7.4.3 4.7.4.4

Total Question 5	**12**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	the outer core		1	AO1 4.6.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2			1	AO1 4.6.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	control variable		1	AO3 4.6.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	7 (paperclips Test 3, 40 turns)		1	AO3 4.6.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	did not include it (when calculating the mean)	allow ignored it	1	AO3 4.6.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	44 paper clips	allow answer in range 43−45	1	AO3 4.6.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7		MP2 is dependent on MP1 being awarded		AO3 4.6.3.4
	a line with a positive gradient drawn above the original line		1	
	(a line) curving upwards starting from 0,0		1	
		ignore any line drawn beyond 80 turns		

Total Question 6	**8**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	maximum height = $\frac{(6.0 \times 0.60)}{2}$ maximum height = 1.8 (m)		1 1	AO2 4.7.1.2 4.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	gradient = $\frac{(-)6.0}{0.60}$ gradient = (-) 10	allow any correct pair of values ignore any unit given	1 1	AO2 4.7.1.2 4.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	the deceleration of the ball		1	AO1 4.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	the deceleration would be greater the maximum height of the ball would be less		1 1	AO2 4.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	10.0 m		1	AO2 4.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	0.0 m		1	AO2 4.7.1.1

Total Question 7	**9**

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	water	allow H_2O	1	AO1 4.8.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	(test) (bubble through) limewater (result) (limewater turns) cloudy / milky	MP2 is dependent on MP1 being awarded allow calcium hydroxide solution for limewater allow white precipitate formed	 1 1	AO1 4.7.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	measure mass of fuel (and burner / container) before **and** after heating calculate the difference (to measure the mass of fuel burnt)		1 1	AO3 4.8.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	any **one** from: • volume of water • time the water is heated for • distance between the flame and the conical flask	 allow use 100 cm^3 of water allow heat the water for 5 minutes allow initial temperature of the water	1	AO2 4.8.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	(because) **C** used the least fuel to produce the greatest temperature increase	 allow **2** marks for calculations showing that 50/1.23 is greater than 45/1.65 **and** 40/1.72	1 1	AO3 4.8.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	any **one** from: • more energy is transferred to the water • draughts are reduced	allow less energy is transferred to the surroundings	1	AO3 4.8.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.7	the temperature increase would be more uniform	allow so the water is all at the same temperature allow so the water is heated evenly allow the temperature increase would be more accurate	1	AO3 4.8.1.3

Total Question 8	**10**

Question 9

Question	Answers	Mark	AO / Spec. Ref.
09.1	**Level 3**: The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO3 4.7.2.2
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content: • use a clamp stand to fix the torch in position • measure the distance between the solar cell and the torch • measure distance with a metre rule • record the corresponding potential difference • vary the height of the torch above the solar cell • use a range of heights between 0 cm and 40 cm • use an interval of 5 cm • ensure there are no other light sources in the lab • ensure the torch is directly above the solar cell • take repeat readings and remove anomalies • take repeat readings and calculate a mean		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	1.8 to 3.7 (V)	allow answers in the range 1.8 to 1.9 for 1.8	1	AO3 4.7.2.2 RPA15

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	$V = I\,R$		1	AO1 4.7.2.2 RPA15

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	I = 0.09 (A)		1	AO2 4.7.2.2 RPA15
	2.7 = 0.09 × R	allow a correct substitution of a value of current of 0.9 (A) or 0.21 (A)	1	
	$R = \frac{2.7}{0.09}$	allow a correct rearrangement of an equation with a value of current of 0.9 (A) or 0.21 (A)	1	
	R = 30 (Ω)	allow an answer consistent with a value of current of 0.9 (A) or 0.21 (A)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5		allow values in the range 1.8 to 1.9 for 1.8		AO3 4.7.2.2 RPA15
	between 0 and 1.8 V the resistance is (very) high		1	
	above 1.8 V the resistance decreases		1	
		if no other marks awarded allow for **1** mark only for 'the resistance decreases as potential difference increases'		

Total Question 9	**14**

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	power output (power output) is higher	 allow more electricity generated (each second) allow more energy is transferred (each second)	1 1	AO3 4.8.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	power output increases with frequency the relationship is non-linear	allow positive correlation allow a description of the non-linear relationship dependent on scoring MP1	1 1	AO3 4.8.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	$Q = I\,t$		1	AO1 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.4	$216\,000 = 5.0 \times t$ $t = \frac{216\,000}{5.0}$ $t = 43\,200$ seconds / s	 allow 720 minutes allow 12 hours	1 1 1 1	AO2 AO2 AO2 AO1 4.7.2.1

Total Question 10	9