GCSE
COMBINED SCIENCE: SYNERGY
8465/4F

Foundation Tier Paper 4 Physical Sciences

Mark scheme

June 2022

Version: 1.0 Final Mark Scheme

226G8465/4F/MS

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 view with Table 1				AO2 4.7.5.1

	Metal sulfate solution		
Metal	**Magnesium sulfate**	**Zinc sulfate**	**Copper sulfate**
Magnesium	×	✓	✓
Zinc	×	×	✓
Copper	×	×	×

1

1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	zinc + copper sulfate → zinc sulfate + copper		1	AO2 4.5.2.1 4.7.5.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	alkaline		1	AO1 4.5.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	hydrogen		1	AO1 4.5.1.4 4.7.5.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	any **one** from: • fizzing • flame • potassium floats • potassium melts • potassium moves (on the surface)	ignore a gas is produced ignore colour of flame allow potassium disappears	1	AO1 4.5.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	sodium is less reactive than potassium		1	AO1 4.5.1.4 4.7.5.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	Mg^{2+}		1	AO3 4.6.2.2

Total Question 1		**8**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	any **one** from: • launch angle • extension of spring • air resistance • wind	allow elastic potential energy (in spring) allow any valid factor including changes to the plane or the spring	1	AO3 4.6.1.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	$E_e = 0.5 \times 27 \times 0.20^2$ $E_e = 0.54$ (J)		1 1	AO2 4.6.1.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	force and extension have a linear relationship		1	AO3 4.6.1.6 RPA13

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	34 cm line (of best fit) is no longer straight	dependent on scoring MP 1	1 1	AO3 4.6.1.6 RPA13

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	extension decreases but not to zero	 allow spring does not return to the original length allow to an extension of 2.5 cm	1 1	AO3 4.6.1.6 RPA13

Total Question 2		**8**

Question 3

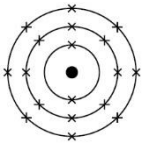
Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	gas		1	AO2 4.5.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	⇌	allow reversible sign / arrow(s)	1	AO1 4.7.4.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	6		1	AO2 4.5.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	when the forward reaction and the reverse reaction have the same rate		1	AO1 4.7.4.8 4.7.4.9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	so none of the substances can escape		1	AO1 4.7.4.9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6			1	AO2 4.5.1.1 4.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	(percentage =) $\frac{14}{17} \times 100$		1	AO2 4.5.2.3
	= 82.35 (%)		1	
	= 82 (%)	allow an answer correctly calculated to 2 significant figures from an incorrect calculation which uses the values in the question	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.8	(single covalent) bond(s)		1	AO1 4.6.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.9	molecule		1	AO1 4.6.2.4

Total Question 3		**11**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	battery		1	AO1 4.7.2.2 4.7.2.4 RPA15

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	the ammeter reading decreases		1	AO1 4.7.2.2 RPA15

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	the line is closer to more points (as) the points are not in a straight line	 allow the line of best fit should be curved	1 1	AO3 4.7.2.2 RPA15

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	a random error		1	AO3 4.7.2.2 RPA15

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	resistance = $\frac{1.5}{0.3}$ resistance = 5 (Ω)		1 1	AO2 4.7.2.2 RPA15

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6				AO1 4.7.2.2 RPA16

Variable	Control variable	Dependent variable	Independent variable
Length of the wire			✓
Resistance of the wire		✓	
Temperature of the wire	✓		

1
1
1

1 mark for each correct row

an extra tick in the columns for independent variable or dependent variable negates the mark for that variable

Total Question 4		10

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	(concentration =) $\frac{24}{0.4}$ = 60 (g/dm^3)		1 1	AO2 4.5.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	soluble substance	allow a substance that dissolves (in water / solvent)	1	AO1 4.5.2.6

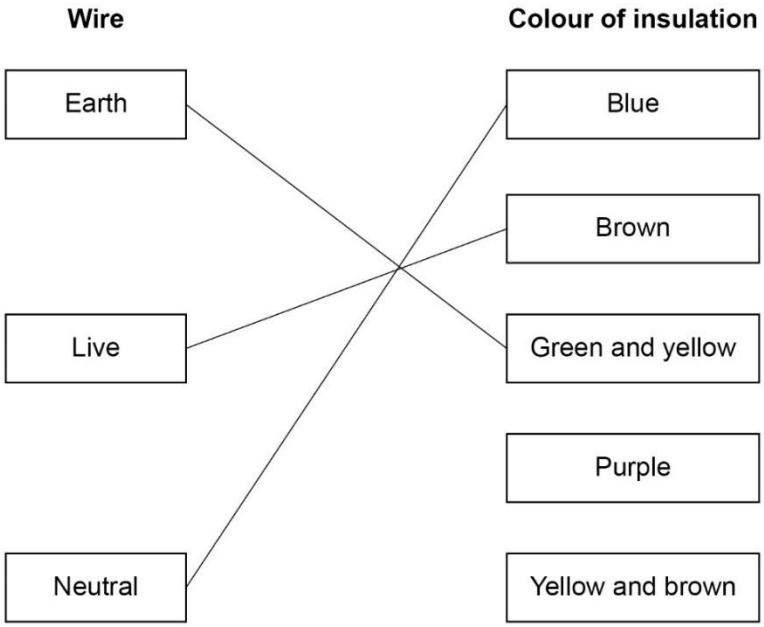
Question	Answers	Mark	AO / Spec. Ref.
05.3	**Level 3**: The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO3 4.5.2.6
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not 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 **key steps** • use measuring cylinder to measure the volume of sugar solution • add sugar solution **X** to an evaporating dish • heat in oven (at 40 °C) • leave in oven until evaporation is complete • measure the mass of sugar • repeat using sugar solution **Y** • use the same volume (of each sugar solution) **interpretation of results** • the sugar solution containing the greater mass of sugar has the higher concentration **or** calculate concentration = mass / volume to determine which sugar solution has the higher concentration **other points** • use a balance to measure mass • repeat and calculate a mean mass of sugar for each sugar solution interpretation of results needed for Level 3		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	0.01 g		1	AO3 4.5.2.6

Total Question 5		**10**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	potential difference		1	AO1 4.7.2.9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	 do **not** accept more than **one** line from a box on the left		1 1 1	AO1 4.7.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	$E = QV$		1	AO1 4.7.2.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	260 000 = Q × 1.3 $Q = \frac{260\,000}{1.3}$ Q = 200 000 (C)		1 1 1	AO2 4.7.2.8

Total Question 6		**8**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	a large proportion of the total energy input is usefully transferred		1	AO1 4.8.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	(temperature) increases		1	AO1 4.7.2.8 4.8.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	energy transferred = 2.8 × 60 energy transferred = 168 (J)		1 1	AO2 4.7.2.7

Question	Answers	Mark	AO / Spec. Ref.
07.4	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	3–4	AO3 4.7.2.6
	Level 1: Relevant features are identified and differences noted.	1–2	
	No relevant content	0	
	Indicative content • both 50 Hz ac and 10 000 Hz ac cause pain • smaller currents of 50 Hz ac cause more pain • 10 000 Hz ac needs much larger currents to cause pain • 20 mA of 50 Hz ac causes severe pain, but 10 000 Hz ac wouldn't cause any pain at 20 mA • 10 000 Hz ac needs at least 4× greater current to have the same effect (as 50 Hz ac)		

Total Question 7		**8**

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	the length of the card and the time taken to pass the light gate		1	AO1 4.7.1.2 RPA14

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	acceleration = $\frac{0.50}{0.40}$ acceleration = 1.25 (m/s^2)		1 1	AO2 4.7.1.4 RPA14

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	force **and** acceleration are (directly) proportional (because) line of best fit is straight and passes through the origin	if no other marks awarded allow **1** mark only for as force increases, acceleration increases	1 1	AO3 4.7.1.6 RPA14

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	change in gravitational potential energy = 0.025 × 9.8 × 0.60 change in gravitational potential energy = 0.147 (J)		1 1	AO2 4.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	the friction between the wooden block and the wooden board would be greater		1	AO3 4.7.1.6 RPA14

Total Question 8		**8**

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	distance travelled under the braking force	allow distance travelled while decelerating do **not** accept references to time	1	AO1 4.7.1.10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	weight = mass × gravitational field strength **or** $W = m \times g$		1	AO1 4.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	$14\,700 = m \times 9.8$ $m = \frac{14\,700}{9.8}$ $m = 1500$ (kg)		1 1 1	AO2 4.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	$\Delta t = 0.35 \times 0.50$ $\Delta t = 0.175$ (s) reaction time = 0.675 (s) **or** reaction time = 1.35 × 0.50 (2) reaction time = 0.675 (s) (1)		1 1 1	AO2 4.7.1.10

Question	Answers	Mark	AO / Spec. Ref.
09.5	**Level 2:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	3–4	AO3 4.7.1.10
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	
	Indicative content • all activities using a mobile phone increase reaction time • using a mobile phone increases your reaction time more than driving at the legal alcohol limit • driving at legal alcohol limit increases reaction time (by12%) to 0.56 (s) • hands-free phone call increases reaction time by 26% (to 0.63 s) • hand-held phone call increases reaction time by 41% (to 0.705 s) • typing text message increases reaction time by 35% (to 0.675 s) • using a hands-free kit doesn't greatly change the reaction time compared with hand-held • using a mobile phone is more dangerous than drinking alcohol (at the legal limit) while driving		

Total Question 9		**12**

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	36 (cm^3)		1	AO2 4.7.3.1 4.7.4.3 RPA19

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	the reaction starts before the stopper is fitted (so) hydrogen / gas escapes	allow difficult to fit stopper and start timer at same time	1 1	AO3 4.7.3.1 4.7.4.3 RPA19

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	80 (s)	allow a value in the range 78 to 82 (s)	1	AO3 4.7.3.1 4.7.4.3 RPA19

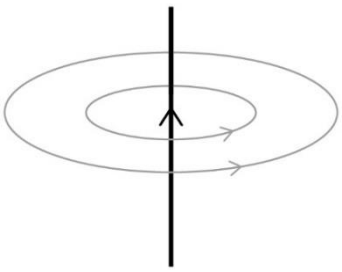
Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.4	initially the line of best fit would have a higher gradient		1	AO3 4.7.3.1 4.7.4.1 4.7.4.3 RPA19

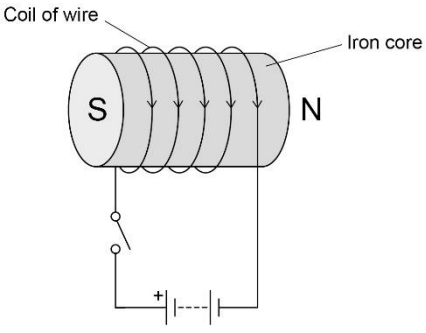
Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.5	(test) burning splint (result) (burns rapidly with) a pop sound	 MP2 is dependent on MP1	 1 1	AO1 4.7.3.1 4.7.5.4

Total Question 10		**7**

Question 11

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.1	move the magnetic compass close to the magnet the needle of the compass will point towards the south pole of the magnet		1 1	AO1 4.6.3.1 4.6.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.2		at least 2 concentric rings with correct arrows	1	AO1 4.6.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.3		**N** and **S** labels need to be next to the vertical surfaces of the poles both labels needed	1	AO2 4.6.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.4	resultant force = mass × acceleration **or** $F = m \times a$		1	AO1 4.7.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.5	$4.8 \times 10^{-3} = 4.0 \times 10^{-4} \times a$ $a = \frac{4.8 \times 10^{-3}}{4.0 \times 10^{-4}}$ $a = 12$ (m/s^2)		1 1 1	AO2 4.7.1.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.6	(as distance decreases the magnetic) force on paper clip increases (so) the paper clip's <u>acceleration</u> increases		1 1	AO1 4.6.3.2 4.7.1.6

Total Question 11		**10**