GCSE
COMBINED SCIENCE: SYNERGY
8465/3H

Higher Tier Paper 3 Physical sciences

Mark scheme

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1 9 6 G 8 4 6 5 / 3 H / 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 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 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 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 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	protein	allow complex 3D structure allow polymer ignore biological catalyst ignore named enzymes	1	AO1 4.7.4.7
01.2	test add a glowing splint (to the gas) result (glowing splint) relights		1 1	AO1 4.7.5.4
01.3	use universal indicator (paper / solution) compare colour obtained with colour chart	ignore pH paper allow wide range indicator for universal indicator	1 1	AO1 4.7.3.4
01.4	7.0	allow 7 / seven	1	AO3 4.7.4.7
01.5	use smaller pH intervals		1	AO3 4.7.4.7
01.6	(no activity because) pH is too acidic (so) enzyme is denatured (because) active site is changed	allow low / extreme pH allow (because) substrate does not fit active site	1 1 1	AO2 AO1 AO1 4.7.3.4 4.7.4.7
Total			**10**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	1 mm	allow 0.1 cm correct unit essential	1	AO2 4.6.3.2
02.2	paper clip is made of a magnetic material (so) becomes an <u>induced</u> magnet **alternative approach** (as) the paper clip becomes an <u>induced</u> magnet (1) and induced magnetism causes a force of attraction (1)	allow a named magnetic material, eg iron or steel	1 1	AO1 4.6.3.1 4.6.3.2
02.3	the strength of the magnet is a control variable	allow (so) all the magnets have the same strength / force allow so there is only one independent variable allow (so) only factor that affects the distance is the number of magnets ignore to make it a fair test	1	AO3 4.6.3.2
02.4	6.9 (cm)	allow values between 6.9 and 7.0 (cm) inclusive	1	AO3 4.6.3.2
02.5	(resultant) force = mass × acceleration	allow F = ma	1	AO1 4.7.1.6
02.6	0.000168 = 0.0012 × a a = 0.000168 ÷ 0.0012 a = 0.14 m/s^2	an answer of 0.14 m/s^2 scores **4** marks an answer of 0.14 scores **3** marks	1 1 1 1	AO1 AO2 4.7.1.6

02.7	(outer) core	do **not** accept inner core	1	AO1 4.6.3.3

02.8	any **one** from: • (slow) changes to the position of the magnetic north / south pole • the Earth's magnetic field reverses from time to time • magnetic stripes in rocks (either side of mid Atlantic ridge)	ignore references to migration	1	AO1 4.6.3.3

Total			**12**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	0.34 nm		1	AO2 4.8.1.1
03.2	in composites		1	AO1 4.8.1.1
03.3	(graphene) any **one** from: • better conductor (of electricity) • allows greater miniaturisation of electronic circuits • stronger • harder • more flexible	must be comparative allow converse for graphite allow thinner	1	AO3 4.8.1.1

Question	Answers	Mark	AO / Spec. Ref.
03.4	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1 4.6.2.4 4.6.2.5 4.8.1.1 4.8.2.6
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	
	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 **Structure and bonding** • giant structure / lattice • of carbon atoms • in layers • of hexagonal rings • covalent (bonds) • strong (covalent) bonds • where each (carbon) atom bonded to three other (carbon) atoms • one electron on each atom is delocalised • delocalised / free electrons **Explanation for conductivity** • delocalised / free electrons • (which) carry charge through the structure **or** • (which) move through the structure **Explanation for graphite being slippery** • layers free to slide over each other • (because) no covalent bonds between layers **or** (because) only weak (intermolecular) forces between layers		

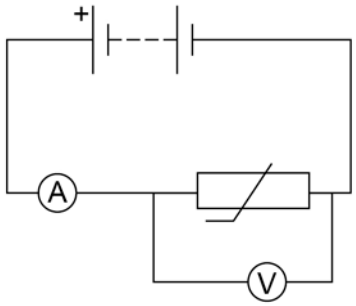
Total			9

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	C_3H_6		1	AO2 4.5.2.1 4.8.1.4
04.2	smaller molecule	allow shorter (hydrocarbon) chain allow smaller hydrocarbon if MP2 obtained	1	AO2
	(so) fewer intermolecular forces	do **not** accept fewer covalent bonds	1	AO1 4.6.2.5 4.8.1.4
04.3		allow converse argument		AO2 4.7.4.8 4.7.4.10
	yield increases as pressure increases		1	
	(because) fewer (gas) molecules as products		1	
	(so) equilibrium moves to right / products		1	
04.4	the yield increases when temperature is decreased	allow converse statements	1	AO2 4.7.4.8 4.7.4.10

04.5	reaction profile showing exothermic reaction		1	AO1
	labelling of activation energy	allow correct labelling of activation energy if endothermic reaction shown	1	AO1
	second profile drawn with different activation energy	in each profile reactants level and products level must be the same	1	AO2
	correct distinction between catalyst and no catalyst		1	AO1 4.7.4.4 4.7.4.6
04.6	increases the rate of the forward and reverse reaction	allow changes the rate of the forward and reverse reaction	1	AO3 4.7.4.6 4.7.4.9
	by the same amount		1	
Total			**13**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	correct symbols for thermistor, voltmeter and ammeter	ignore switches	1	AO1 4.7.2.2 4.7.2.4
	voltmeter in parallel with thermistor	do **not** accept ammeter in parallel with thermistor	1	
	battery in series with thermistor and ammeter	do **not** accept thermistor, ammeter and voltmeter in series	1	
		an answer of  scores **3** marks		
05.2		an answer of 40 (°C) scores **4** marks		3xAO2 1xAO2 4.7.2.2
	$5.60 = 0.04 \times R$		1	
	$R = \frac{5.60}{0.04}$		1	
	$R = 140\ (\Omega)$		1	
	40 (°C)	allow a value from the graph consistent with their incorrectly calculated value for resistance	1	

05.3	gradient is steepest (between 20 °C and 25 °C) (so) bigger change of resistance for same change in temperature	 ignore references to time	1 1	AO2 4.7.2.2
Total			**9**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	(gas) syringe	allow description of displacement of water in a measuring cylinder	1	AO1 4.7.4.1
06.2	(table headings + units) time in s(econds) **and** volume (of gas) in cm^3 values for times (from 0 to 120 seconds) values for volumes (from 0 to 79 cm^3)	 allow **1** mark if otherwise correct but 0,0 not included 	 1 1 1	AO2 4.7.4.1
06.3	 correctly drawn tangent at 30 s correct value for x step **and** y step from tangent (rate =) $\frac{\text{value for y step}}{\text{value for x step}}$ correctly calculated and rounded to 2 significant figures	an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps allow evidence of use of two points on tangent either on the graph or in the text allow correct expression using incorrectly determined values from tangent for x step and / or y step allow a correctly calculated answer to 2 significant figures from an incorrect attempt at rate determination	 1 1 1 1	AO2 4.7.4.1
06.4	particles have more energy (so) frequency of collisions increases (and) more particles have the necessary activation energy	allow particles move faster allow (so) more collisions per unit time allow more likelihood of collisions ignore more collisions 	1 1 1	AO1 4.7.4.3 4.7.4.4

Total			**11**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	atoms in the alloy are different sizes (so) structure / layers distorted (therefore) it is (more) difficult for layers / atoms to slide over each other		1 1 1	AO1 4.6.2.7
07.2	8.86 : 1.00		1	AO2 4.5.2.4
07.3	6.02×10^{23} per mole		1	AO1 4.5.2.4
07.4	$70 \times 10^{-9} \times 1000$ $= 7.0 \times 10^{-5}$ (g)	an answer of $7(.0) \times 10^{-5}$ (g) scores **2** marks an answer of 0.00007 **or** 7×10^{-8} (g) scores **1** mark allow 70×10^{-6}	1 1	AO2 4.5.2.4
07.5	SiO_2		1	AO2 4.6.2.4 4.6.2.5
07.6	any **three** from: • giant structure • covalent (bonds) • strong bonds • each silicon atom bonded to four oxygen atoms **or** each oxygen atom bonded to two silicon atoms	a maximum of **2** marks if reference made to incorrect bonding allow lattice ignore forces	3	AO1 4.6.2.4 4.6.2.5
Total			**11**	

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	to ensure all acid reacts		1	AO1 4.5.2.5 4.7.3.2
08.2	(improvement)			
	filter (after step 4 and before step 5)		1	AO3
	(explanation)			AO1
	(so) excess copper oxide is removed		1	
	(improvement)			AO3
	evaporate some of the water and then leave (to cool / crystallise)		1	
	(explanation)			AO2
	(so) crystals form rather than powder	ignore to form larger crystals	1	4.7.3.2

08.3		an answer of 0.0127 moles in excess scores **5** marks an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 4.5.2.4 4.5.2.5 4.5.2.6
	(moles CuO) $= \frac{2}{79.5}$		1	
	= 0.0252	allow 0.025157232	1	
	(moles sulfuric acid in 1 dm^3) $(= \frac{49}{98}) = 0.5$	allow (mass of sulfuric acid in 25 $cm^3 = \frac{49}{1\,000} \times 25$) = 1.225 g	1	
	$\left(\text{moles in 25 cm}^3 = \frac{0.5}{1\,000} \times 25\right)$ = 0.0125	allow (moles = $\frac{1.225}{98}$) = 0.0125	1	
	moles CuO in excess (= 0.0252 − 0.0125) = 0.0127	allow 0.012657232 correctly rounded to at least 2 significant figures allow correctly calculated and rounded answer using incorrectly calculated moles of CuO and / or moles of sulfuric acid	1	

Total			**10**

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	(when the switch is closed) the circuit is complete		1	AO1 4.6.3.4 4.6.3.5
	(so) there is a current in the wire		1	
	(so) a magnetic field forms around the wire		1	
	this magnetic field interacts with the permanent magnetic field		1	
	(so) a force then acts on the wire		1	
09.2	reverse / change the direction of the current	allow reverse the connections to the battery ignore turn the battery round	1	AO1 4.6.3.5
	reverse the direction of the magnetic field	allow reverse the positions of the magnetic poles	1	

09.3	(P = VI) P = 15.0 × 3.00 P = 45.0 (W) 0.81 MJ = 810 000 J (E = Pt) 810 000 = 45.0 × *t* $t = \frac{810\,000}{45.0}$ *t* = 18 000 (s)	an answer of 18 000 (s) scores **6** marks allow standard form allow full credit for alternative approach using E = QV and Q = It 0.81 MJ = 810 000 J (1) (E = QV) 810 000 = 15.0 × Q (1) $Q = \frac{810\,000}{15.0}$ (1) *Q* = 54 000 (C) (1) (Q = It) 54 000 = 3.00 × *t* (1) $\left(t = \frac{54\,000}{3.00} \right)$ *t* = 18 000 (s) (1) an incorrect answer for one step does **not** prevent allocation of marks for subsequent correct steps	 1 1 1 1 1 1	AO2 4.7.2.1 4.7.2.7 4.7.2.8
09.4	(potential difference of) 230 V (frequency of) 50 Hz		1 1	AO1 4.7.2.5
Total			**15**	