AQA

GCSE
Combined Science: Synergy

8465/4H – Paper 4 – Physical Sciences – Higher Tier

Mark scheme

8465

June 2018

Version/Stage: 1.1 Final

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 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.

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 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.

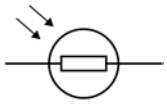
The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine 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.

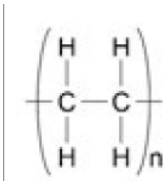
You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1			1	AO1 4.7.2.4
01.2	in series with LDR in parallel with LDR		1	AO1 4.7.2.2 4.7.2.3
01.3	(graph shows) direct proportion (because) it is a straight line through the origin	 allow inverse proportion would show a curve with a negative gradient	1 1	AO3 4.7.2.2
01.4	straight line through the origin with a positive gradient current is always of smaller magnitude than line already plotted for a given potential difference	 this mark only scores if first mark is awarded allow for **2** marks a straight horizontal line along the *x*-axis	1 1	AO2 4.7.2.2
01.5	potential difference = current × resistance	allow $V = IR$	1	AO1 4.7.2.2

01.6		an answer of 440 (Ω) scores **4** marks an answer of 0.44 (Ω) scores **3** marks		AO2 4.7.2.2
	12.5 mA = 0.0125 A		1	
	5.50 = 0.0125 × R	this mark may be awarded if current is incorrectly / not converted	1	
	(R =) $\frac{5.50}{0.0125}$	this mark may be awarded if current is incorrectly / not converted	1	
	(R =) 440 (Ω)	allow an answer consistent with incorrectly / not converted current	1	

Total			**11**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	five single bonds inside the brackets (1 C–C bond and 4 C–H bonds) two single bonds extending from the carbons	allow **2** marks for an answer of: 	1 1	AO1 4.6.2.4
02.2	HD (poly(ethene) polymer chains) have no side chains chains are closer together in HD (poly(ethene) than LD poly(ethene))	allow LD (poly(ethene) polymer chains) have side chains ignore cross links	1 1	AO2 4.6.2.4 AO3 4.6.2.4
02.3	**Level 2:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.		3-4	AO3 4.6.1.6
	Level 1: The method would not necessarily lead to a valid outcome. Some relevant steps are identified, but links are not made clear.		1–2	
	No relevant content		0	
	Indicative content • suspend a poly(ethene) strip / bag • (use a ruler) to measure length **or** to locate starting position • add (known) mass / weight to the strip / bag **or** pull with a newtonmeter • determine extension • repeat using different forces (by adding further masses / weights **or** pulling harder) • control variables: size / thickness of strip • repeat and calculate a mean			

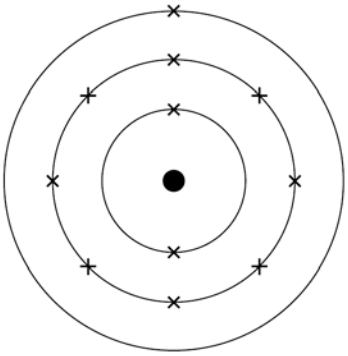
Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	any **two** from: • both have increasing extension with increasing force • both extend non-linearly • HD poly(ethene) has a smaller extension (than LD poly(ethene)) for a given force • HD poly(ethene) has a smaller maximum extension (than LD poly(ethene))	allow LD poly(ethene) stretches more for a given force allow correct readings of extension for a given force for both polymers allow HD poly(ethene) breaks at a greater (maximum) force ignore references to strong / weak	2	AO3 4.6.1.6
02.5	$\frac{85}{100}$ × 8.0 (billion) **or** 6.8 (billion) (8 billion − 6.8 billion =) 1.2 billion **or** 1200 000 000 **or** 1.2×10^9	an answer of 1.2 billion scores **2** marks an answer of 1.2 scores **1** mark allow $\frac{15}{100}$ × 8.0 (billion) allow **1** mark for an answer consistent with an incorrect conversion of billion	1 1	AO2 4.8.2.9

Question	Answers	Mark	AO / Spec. Ref.
02.6	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	5–6	AO3 4.4.1.4 4.8.1.2 4.8.2.8 4.8.2.9
	Level 2: Some logically linked reasons are given. There may also be a simple judgement.	3–4	
	Level 1: Relevant points are made. They are not logically linked.	1–2	
	No relevant content	0	
	Indicative content **similarities** • both made from crude oil • crude oil is a finite resource • production and transport of both cause emissions of carbon dioxide • carbon dioxide contributes to global warming • both can be disposed of in the same ways **disadvantages of disposable bags** • each disposable bag generates more waste (than one bag for life) • each disposable bag generates approximately 2.5 times more waste **or** 0.25 g more waste (than one bag for life) • if 6 disposable bags used they generate approximately 15 times more waste **or** 2.35 g more waste (than one bag for life) • if 6 disposable bags used it causes more CO_2 to be emitted (than one bag for life) • if 6 disposable bags used 2.7 g more CO_2 emitted **or** approximately 1.4 times more (than one bag for life) **advantages of disposable bags** • a disposable bag causes less CO_2 to be emitted (than one bag for life) • a disposable bag emits 5.3 g less CO_2 (than one bag for life) • if disposable bags used more than once less CO_2 emitted (than one bag for life) • if bag for life is used fewer than 5 times, it results in more CO_2 being emitted (than one disposable bag) • disposable bags extend less as made from HD poly(ethene)		

Total			18

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	scalars have magnitude only vectors have magnitude and direction	allow size for magnitude	1 1	AO1 4.6.1.1
03.2	any **three** from: • arrow pointing vertically downwards originating in the block, labelled weight • arrow pointing left along the surface labelled friction; part of the arrow must be between the block and the carpet • arrow pointing to the left touching block labelled air resistance **or** drag • arrow pointing vertically upwards from bottom surface of block, labelled (normal) contact force	allow gravity allow reaction (force) for contact (force) judge horizontal and vertical by eye allow **1** mark for three correctly labelled arrows, in correct directions but in incorrect positions	3	AO2 4.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	clear attempt to draw horizontal **and** vertical components horizontal component: 2.6 (N) vertical component: 1.7 (N)	horizontal line should extend beyond dashed line on diagram allow a range from 2.5 to 2.7 allow a range from 1.6 to 1.8 if 2nd and 3rd marking points not awarded, allow **1** mark for clear measurements of **both** 5.2 ± 0.2 cm and 3.4 ± 0.2 cm	1 1 1	AO2 4.6.1.2
03.4	$\frac{5.2 + X + 5.3}{3} = 5.4$ (X =) 5.7 (N)	an answer of 5.7 (N) scores **2** marks allow 5.6 (N) or 5.8 (N) for **2** marks	1 1	AO2 4.6.1.1
03.5	any **three** from: • angle (of string) • speed (at which block is pulled) • area of block in contact with surface • mass / weight of block	allow velocity (at which block is pulled) ignore same block	3	AO3 4.6.1.1
Total			**13**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1		allow dot, cross, or e to show electrons	1	AO1 4.5.1.1
04.2	any **two** from: • use tongs / tweezers to handle metal • use a (safety) screen • use a small piece of metal • use a large volume of water • keep a safe distance between teacher / students and apparatus	ignore store metal under oil	2	AO3 4.5.1.4
04.3	OH^-		1	AO1 4.5.1.4 4.7.3.4
04.4	as diameter increases, reactivity increases (because as diameter increases) outer electron is further from the nucleus (so) outer electron is less attracted to the nucleus (so) outer electron is lost (more) easily	 allow (because as diameter increases) outer shell is further from nucleus allow (so there is) increased shielding	1 1 1 1	AO3 4.5.1.4 AO1 4.5.1.4 AO1 4.5.1.4 AO1 4.5.1.4
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	oxygen		1	AO1 4.7.5.3
05.2		any order of components		AO1 4.7.2.4
	correct symbol for cell / battery with positive terminal connected to anode	ignore + and − symbols on cell / battery do **not** accept voltmeter if connected in series	1	4.7.5.3
	correct symbol for ammeter connected in series		1	
	correct symbol for variable resistor connected in series	allow variable power supply in place of variable resistor ignore additional components that would not affect the circuit working	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	calculation / statement including data to show effect of doubling current on mass of copper deposited **or** calculation of **two** quotients, eg $\frac{0.24}{0.047} = 5.11$ $\frac{0.48}{0.095} = 5.05$	allow **1** mark for recognising that comparing doubling of one quantity to doubling of another is needed **or** allow **1** mark for recognising that a scaling factor needs to be applied could be opposite way round (giving around 0.2)	2	AO3 4.7.5.3
	(therefore) results support student **A** **or** results show direct proportionality	this mark must be supported by relevant calculations / statements	1	
	(however) there is an anomalous result at 0.36 A, 0.057 g	allow in terms of quotient (6.32 instead of ~5 or 0.16 instead of ~0.2)	1	
05.4	$\frac{0.142}{63.5}$ $= 2.24 \times 10^{-3}$	an answer of 2.24×10^{-3} scores **2** marks an answer of 0.00224 scores **1** mark allow an answer that rounds to 0.00224 allow an answer that rounds to 2.2×10^{-3}	 1 1	AO2 4.5.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	increase the time the circuit is switched on for		1	AO3 4.7.5.3
Total			**11**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	place thumb and first two fingers (of left hand) at right angles to each other		1	AO1 4.6.3.5
	first / index finger indicates (direction of) magnetic field	allow forefinger for first/index finger do **not** accept electric field	1	
	second / middle finger indicates (direction of) current		1	
	thumb (then) shows (direction of) force	allow motion / thrust	1	
		a clearly labelled diagram can score up to **4** marks		
06.2	there is a downwards force on the magnets		1	AO2 4.6.3.5
	(because when there is a current in the wire) there is a magnetic field around the wire		1	
	which interacts with the magnetic field of the (permanent) magnets		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3		an answer of 0.14 (T) scores **4** marks an answer of 140 scores **3** marks		AO2 4.6.3.5
	$0.00214 = B \times 0.32 \times 0.048$	this mark may be awarded if F is incorrectly / not converted	1	
	$B = \frac{0.00214}{0.32 \times 0.048}$	this mark may be awarded if F is incorrectly / not converted	1	
	0.1393 (T)	an answer that rounds to 0.14 (T) scores **3** marks	1	
	0.14 (T)	allow answer consistent with their incorrectly / not converted F to 2 significant figures allow an answer from an incorrect calculation to 2 significant figures	1	
Total			**11**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	(in circular motion) the direction is (constantly) changing		1	AO1 4.7.1.3 4.7.1.4
	(so) velocity is (constantly) changing		1	
	(and) acceleration is rate of change of velocity	allow acceleration = $\frac{\text{change in velocity}}{\text{time}}$	1	
07.2	$s = \frac{2.6^2 - 1.4^2}{2 \times 0.31}$		1	AO2 4.7.1.4
07.3		an answer of 29 (A) scores **6** marks		AO2 4.7.2.7 4.8.2.7
	$0.72 = \frac{190}{P_{input}}$	allow $\frac{72}{100} = \frac{190}{P_{input}}$	1	
	$P_{input} = \frac{190}{0.72}$		1	
	$P_{input} = 264$ (W)	allow an answer that rounds to 264 (W)	1	
	$264 = 36 \times I$	allow their calculated $P_{input} = 36 \times I$	1	
	$I = 7.33$ (A)		1	
	$I = 29$ (A)	allow an answer that rounds to 29 (A) allow their value for I × 4 correctly calculated	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	old theory suggests Moon rocks would be different from Earth rocks		1	AO3 key ideas
	(but) new evidence shows they are similar	this mark is dependent on scoring the first mark allow **1** mark for new evidence (from studying Moon rocks) could not be explained by the old theory	1	
Total			**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	$C_{16}H_{34}$		1	AO1 4.8.1.2
08.2	heat to vaporise the hydrocarbons / (crude) oil	allow heat to evaporate the hydrocarbons / (crude) oil allow alkanes for hydrocarbons ignore boil	1	AO1 4.8.1.3
	temperature (of column) decreases from bottom to top		1	
	as gases / vapours rise up the column, they condense		1	
	at different points according to their boiling point		1	
08.3		an answer of 2057 (kJ/mol) or −2057 (kJ/mol) scores **3** marks		AO2 4.7.4.5 4.8.1.2
	(energy required to break bonds = (2 × 347) + (8 × 413) + (5 × 495) =) 6473 (kJ/mol)		1	
	(energy released when bonds formed = (6 × 799) + (8 × 467) =) 8530 (kJ/mol)		1	
	(overall energy change = 6473 − 8530 =) −2057 (kJ/mol)	allow calculation of difference between their values from step 1 and step 2 ignore order / sign	1	

Question	Answers	Mark	AO / Spec. Ref.
08.4	**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 • carbon dioxide is released by both (during combustion) • carbon dioxide emissions contribute to global warming • fuels from plants are carbon-neutral when taking into account the CO_2 taken in by the plants as they grow • combustion of crude oil-derived fuels causes sulfur dioxide emissions • sulfur dioxide emissions cause acid rain • transport of crude oil can lead to oil spills • transport of both releases carbon dioxide • fuel from plants require a large area of land to grow plants • fuel from plants may displace food crops • clearing land to grow plants for fuel may contribute to deforestation • growing plants for fuel can destroy habitats **or** reduce biodiversity • fuel from plants can be produced from recycled cooking oil so reduces waste		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5		an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		
	$\left(\text{moles } C_4H_{10} = \frac{14.5}{58} =\right)$ 0.25		1	AO2 4.5.2.5
	$\left(\text{moles } O_2 = \frac{72}{32} =\right)$ 2.25		1	AO2 4.5.2.5
	0.25 moles butane requires $\left(0.25 \times \frac{13}{2} =\right)$ 1.625 moles of oxygen		1	AO2 4.5.2.5
	1.625 is less than 2.25 moles (so oxygen is in excess) therefore butane is limiting		1	AO3 4.5.2.5
	or			
	2.25 moles oxygen requires $\left(2.25 \times \frac{2}{13} =\right)$ 0.346 moles of butane(1)			
	0.346 is greater than 0.25 moles therefore butane is limiting (1)			
	or			
	(0.25 : 2.25 =) 1 : 9 **or** 2 : 18 (1)			
	9 is greater than 6.5 **or** 18 is greater than 13			
	(therefore oxygen is in excess) so butane is limiting (1)			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5 cont.		**alternative approach:** 116 (g butane reacts with) 416 (g oxygen) (1) (14.5 g butane requires) $\frac{416}{116}$ × 14.5 (1) = 52 g oxygen (1) 52 is less than 72 so (oxygen is in excess) therefore butane is limiting (1) **or** 116 (g butane reacts with) 416 (g oxygen) (1) (72 g oxygen requires) $\frac{116}{416}$ × 72 (1) = 20.1g butane (1) 20.1 is greater than 14.5 so butane is limiting (1)		
Total			**16**	