AQA

GCSE
Combined Science: Trilogy

8464/P/2H – Physics Paper 2 – Higher Tier

Mark scheme

8464

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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	its acceleration would decrease to zero the resultant force on it would decrease to zero		1 1	AO3 6.5.4.2.2
01.2	any **one** from: • move the second light gate closer to the first • shorten the string length	allow use a taller table	1	AO3 6.5.4.2.2
01.3		each mistake and its correction may be given in any order		AO3 6.5.4.2.2
	1.26667 (m/s^2) (is wrong)	allow (mean value calculated at) 0.20 (N)	1	
	give value to 2 significant figures	allow give value to 1 decimal place allow 1.3 (m/s^2)	1	
	6.7 (m/s^2) (is wrong)	allow (mean value calculated at) 0.98 (N) allow test 2 for 0.98 (N) or 7.2 is an anomaly	1	
	discard the anomalous result and recalculate the mean	allow repeat the anomalous test result and re-calculate the mean allow 6.4 (m/s^2)	1	
01.4	(resultant) force is directly proportional to acceleration	allow the larger the (resultant) force, the greater the acceleration allow positive correlation between (resultant) force and acceleration allow mass / weight (of the holder) for (resultant) force	1	AO3 6.5.4.2.2

Question	Answers	Extra information	Mark	AO / Spec Ref.
01.5	all points correctly plotted within ½ small square curved line of best fit	allow **1** mark for 3 or 4 points correctly plotted	2 1	AO2 6.5.4.2.2
01.6	inversely proportional	allow as mass increases, acceleration decreases	1	AO3 6.5.4.2.2
Total			**12**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	1st box ticked		1	AO1 6.7.1.2
02.2	(permanent magnet) has no effect on the aluminium iron is attracted (to the permanent magnet) (only) the (permanent) magnet can be repelled (by the permanent magnet)		1 1 1	AO2 6.7.1.1 6.7.1.2

Question	Answers	Mark	AO / Spec. Ref.
02.3	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to give a clear account.	5–6	AO2
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logically linking. The resulting account is not fully clear.	3–4	AO2
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	AO1
	No relevant content	0	
	Indicative content • completing the circuit • turns the electromagnet on • there is a current in the coil • a magnetic field is produced around the coil • the iron core becomes magnetised • move electromagnet towards the blocks • the block is attracted to the electromagnet • moving the crane moves the block • switching off the current switches off the electromagnet • releasing the block		6.7.2.1
Total		**10**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	momentum = mass × velocity	allow p = mv	1	AO1 6.5.5.1
03.2		an answer of 63 (kg) scores **3** marks		AO2 6.5.5.1
	200 = m × 3.2		1	
	$m = \frac{200}{3.2}$		1	
	m = 63 (kg)	allow 62.5 (kg)	1	
03.3	(total) momentum before (collision) = (total) momentum after (collision)		1	AO1 6.5.5.2
	either momentum of skater A decreases and momentum of skater B increases	allow (total) momentum is shared between skater A and skater B	1	
	velocity of skater A decreases and velocity of Skater B increases		1	
	or momentum of skater A decreases and so velocity of skater A decreases (1) momentum of skater B increases and so velocity of skater B increases (1)			
Total			**7**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	D needs the greatest force to extend the spring the same amount	allow 20 (N) allow fourth (newtonmeter) reason only scores if correct newtonmeter selected	1 1	AO1 6.5.3
04.2	zero (error) any **one** from: • record the value and subtract from readings taken • adjust the newtonmeter to zero	allow systematic (error) allow subtract 1 from all readings	1 1	AO3 6.5.3

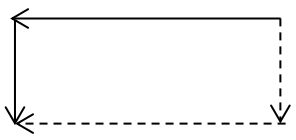
Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3		an answer of 0.02 (m) gains **6** marks		AO2 6.5.3
	$4.5 \times 10^{-2} = 0.5 \times 400 \times e^2$	this mark may be awarded if the standard form value is incorrectly converted	1	
	$e = \sqrt{\frac{4.5 \times 10^{-2}}{0.5 \times 400}}$	this mark may be awarded if the standard form value is incorrectly converted allow $e^2 = \frac{4.5 \times 10^{-2}}{0.5 \times 400}$	1	
	e = 0.015 (m)	this answer only	1	
	2.0 = 400 × e		1	
	e = 0.005 (m)	this answer only	1	
	0.015 + 0.005 = 0.02 (m)	allow their initial extension + their additional extension correctly calculated	1	
	or			
	$4.5 \times 10^{-2} = 0.5 \times 400 \times e^2$ (1)	this mark may be awarded if the standard form value is incorrectly converted		
	$e = \sqrt{\frac{4.5 \times 10^{-2}}{0.5 \times 400}}$ (1)	this mark may be awarded if the standard form value is incorrectly converted allow $e^2 = \frac{4.5 \times 10^{-2}}{0.5 \times 400}$		
	e = 0.015 (m) (1)	this answer only		
	F = 400 × 0.015 F = 6 (N) (1)	allow an answer of 400 × their calculated value of e		
	total force = 6 + 2 8 = 400 × e (1)	allow an answer that is consistent with their calculated value of e		
	e = 0.02 (m) (1)			
Total			**10**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	in a longitudinal wave, the oscillations / vibrations are parallel to the direction of energy transfer	allow direction of travel for energy transfer	1	AO1 6.6.1.1
	in a transverse wave, the oscillations / vibrations are perpendicular to the direction of energy transfer	allow direction of travel for energy transfer if no other mark scored allow **1** mark for (oscillations / vibrations of) longitudinal waves are parallel **and** (oscillations / vibrations of) transverse waves are perpendicular if no other mark scored allow **1** mark for transverse waves have peaks and troughs **and** longitudinal waves have compressions and rarefactions	1	
05.2		an answer of 0.063 (m) scores **3** marks		AO2 6.6.1.2
	$3.0 \times 10^8 = 4.8 \times 10^9 \times \lambda$	allow $\lambda = \frac{3.0 \times 10^8}{4.8 \times 10^9}$ this mark may be awarded if the standard form values are incorrectly converted	1	
	$\lambda = 0.0625$ (m)		1	
	$\lambda = 0.063$ (m) **or** $\lambda = 6.3 \times 10^{-2}$ (m)	allow an answer to 2 sig figs that is consistent with their calculated value of λ and has required rounding	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	any **three** from: • (the car aerial) absorbs radio waves or energy • electrons are made to vibrate (in the aerial) • creating an alternating current (in the aerial circuit) • the (signal) frequency is the same (as the radio wave)		3	AO1 6.6.2.3
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	either: 7.5 (m) **and** 12.3 (m) from the graph **or** 15 (m/s) × 0.32 (s) using speed extra distance = 4.8 (m)	an answer between 4.7 (m) and 4.9 (m) scores **2** marks allow 7.5 (m) and between 12.2 (m) and 12.4 (m)	 1 1	AO2 6.5.4.3
06.2	there is a decrease in kinetic energy of the car so this (causes) the internal / thermal energy store of the brakes to increase	allow work is done by friction (on the brakes)	1 1	AO1 6.1.1.1 6.5.4.3.4
06.3	$19^2 - u^2 = 2 \times 2 \times 84$ $u^2 = 19^2 - (2 \times 2 \times 84)$ u = 5 (m/s)	an answer of 5 (m/s) scores **3** marks $u = \sqrt{19^2 - (2 \times 2 \times 84)}$	 1 1 1	AO2 6.5.4.1.5

Question	Answers	Mark	AO / Spec. Ref.
06.4	**Level 3:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	5–6	AO3
	Level 2: Scientifically relevant facts, events or processes are identified and their relevance is clear. The account is not fully accurate.	3-4	AO1 AO3
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1–2	AO1
	No relevant content	0	
	Indicative content • use of drugs, alcohol, tiredness and distractions would increase the thinking distance • thinking distance increases with speed • thinking distance is directly proportional to speed • use of drugs, alcohol, tiredness and distractions would increase the gradient of thinking distance • poor brakes, poor tyres, wet / icy roads and mass would increase the braking distance • braking distance increases with speed • braking distance increases at an increasing (accept greater) rate (with speed) • poor brakes, poor tyres, wet/icy roads and mass would increase the gradient of braking distance • braking distance is directly proportional to speed squared • stopping distance = thinking distance + braking distance • factors that increase thinking and / or braking distance would increase the gradient of stopping distance • stopping distance increases at an increasing (accept greater) rate (with speed)		6.5.4.3.1
Total			**13**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	constant velocity	allow constant speed ignore references to stationary	1	AO1 6.5.4.2.1
07.2		allow drag for force B		AO1 6.5.4.2.1
	the man will accelerate		1	
	so force B increases		1	
	until force B equals force A	allow until resultant force is 0 (N)	1	
	the man moves at a higher constant velocity		1	
07.3	horizontal arrow pointing left (3000 N) and vertical arrow pointing down (1000 N) drawn to the same scale		1	AO2 6.5.1.4
	resultant force with a value in the range 3100 N–3200 N	allow and answer of 3000 N if a scale diagram has been drawn using the cm squares	1	
	direction in the range 251º–253º (clockwise from north)	allow 17º–19º (to the horizontal)	1	
07.4	the magnitude will increase	allow size	1	AO1 6.5.1.4
	direction will change towards the south	allow answers consistent with their response to question **07.3**	1	
Total			**10**	