GCSE
COMBINED SCIENCE: TRILOGY
8464/P/2H

Physics Paper 2H

Mark scheme

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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, 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 not 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.	ID
01.1	(4 - 0) + (10 - 7) **or** 4 + 3 **or** 10 - 3 7 (s)	an answer of 7 (s) gains **2** marks	1 1	AO2 6.5.4.1.5	E
01.2	gradient = $\frac{0-2}{24-14}$ (-)0.2 (m/s^2)	an answer of 0.2 (m/s^2) gains **2** marks allow readings from any two points correctly substituted allow correct use of $a = \frac{\Delta v}{t}$	1 1	AO2 6.5.4.1.5	E
01.3	(there are no wires) to get tangled / disconnected	allow easier to move arms allow wires are inconvenient allow easier to transfer data	1	AO3 6.6.2.4	E
01.4	wave speed = frequency × wavelength	allow v = f λ allow any correct re-arrangement	1	AO1 6.6.1.2	E
01.5	300 000 000 = 2 400 000 000 × λ λ = $\frac{300\ 000\ 000}{2\ 400\ 000\ 000}$ λ = 0.125 (m)	an answer of 0.125 (m) or 0.13 (m) scores **3** marks allow λ = 0.13 (m)	1 1 1	AO2 6.6.1.2	E
01.6	range is far enough (for most uses) power is not too great so the battery will not drain quickly	allow power not too great so the phone will not overheat allow the range per milliwatt is greatest or 4 metres	1 1	AO3 6.6.2.4	E

Total			**11**		

Question	Answers	Mark	AO / Spec. Ref.	ID
02.1	**Level 3:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 6.6.1.2	E
	Level 2: The design/plan 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 design/plan 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 • If two quantities have been determined, v = f λ can be used to find the third. **Frequency** • use a stopclock • count the number of waves passing a point in a fixed time period • divide the time by the number of waves to determine the time for one wave, T • f = 1/T • read the frequency off the oscillator **Wavelength** • use a camera to freeze the image • use a metre rule to measure the distance between two wavefronts • count the number of waves between the wavefronts • divide distance by the number of waves to determine λ **Velocity** • determine a mean value of frequency • determine a mean value of wavelength • measure the time it takes one wavefront to travel the length of the screen • measure the length of the screen • speed = distance / time to access Level 3 there must be a description of how frequency, wavelength and velocity can be determined			

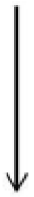
02.2	(the duck) moves perpendicular to the direction of wave travel	duck moves up and down is insufficient	1	AO2 6.6.1.1	E

02.3		an answer of 5.5 gains **3** (mm) marks		AO2 6.6.1.2	E
	mean maximum height = 511 **and** mean minimum height = 500		1		
	511 – 500 = 11	allow a calculated difference from incorrect means	1		
	11 / 2 = 5.5 (mm)	allow their difference divided by 2	1		
		any correct method of determining the mean amplitude can score **3** marks			

Total			**10**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	distance speed		1 1	AO1 6.5.4.1.3	A
03.2	(both have magnitude) only a vector has direction	allow scalar does not have a direction	1	AO1 6.5.1.1	E
03.3	any **two** from: • mass • velocity • friction • power of the motor	 allow weight allow speed or direction allow air resistance or drag	2	AO1 6.5.5.2	E

03.4	total momentum is zero after the collision (because the bumper cars are stationary) because the momentum of each car before the collision was equal (in magnitude) and opposite (in direction) so the total momentum of the bumper cars was zero before the collision and momentum is conserved **OR** total momentum is zero after the collision (because the bumper cars are stationary) (1) because the momentum of each car before the collision was equal (in magnitude) and opposite (in direction) (1) both cars exert an equal and opposite force on each other (for equal periods of time) (1) so the cars accelerate (in opposite directions) (1)		1 1 1 1	AO3 5.5.5.2	E
Total			**9**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1			1	AO1 6.7.2.2	A
04.2	reverse the direction of the current reverse the direction of the magnetic field		1 1	AO1 6.7.2.2	E
04.3	B = 0.360 (T) 0.072 = 0.360 × I × 0.050 $I = \frac{0.072}{(0.360 \times 0.050)}$ I = 4.0 (A)	an answer of 4.0 (A) scores **4** marks allow a correct substitution using an incorrectly / not converted value of B allow a correct rearrangement using an incorrectly / not converted value of B allow a correct calculation using an incorrectly / not converted value of B	 1 1 1 1	AO2 6.7.2.2	E

04.4	there is a magnetic field (due to the permanent magnet) **and** current in a wire causes a magnetic field current is in opposite directions in each side of the coil so forces act in opposite directions on either side of the coil (the split ring ensures that) the current in the left / right side of the coil is always in the same direction	allow (the split ring ensures that) the force in the left / right side of the coil is always in the same direction allow the current reverses each half rotation	1 1 1 1	AO1 6.7.2.3	E

Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	force ∝ extension		1	AO1 6.5.3	A
05.2		an answer of 60 (kg) scores **4** marks		AO2 6.5.1.3	E
	$F = 0.49 \times 1\ 200$ **or** $F = 588$ (N)		1		
	$588 = m \times 9.8$	allow a correct substitution using an incorrectly calculated value of F	1		
	$m = \frac{588}{9.8}$	allow a correct rearrangement using an incorrectly calculated value of F	1		
	$m = 60$ (kg)	allow a correct calculation using an incorrectly calculated value of F	1		
	OR 0.49 = mean mass per spring × 9.8 (1) mean mass per spring = $\frac{0.49}{9.8}$ (1) mean mass per spring = 0.050 (1) $m = 0.050 \times 1200 = 60$ (kg) (1)				
05.3		an answer of 140 scores **3** calculation marks		3 x AO2 1 x AO1 6.5.3	E
	$0.49 = k \times 3.5 \times 10^{-3}$		1		
	$k = \frac{0.49}{3.5 \times 10^{-3}}$		1		
	140		1		
	N/m		1		

05.4	springs with a low spring constant because they can compress by a larger amount (for a given force)	 allow they can compress by the same amount for a smaller force allow low stiffness	1 1	AO3 6.5.3	E

Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	thrust decreases	allow air resistance or drag increases ignore air resistance decreases as speed decreases	1	1xAO1 1xAO2 2xAO3 6.5.4.2.1	E
	so there is a resultant force in opposite direction	allow so air resistance or drag is greater than thrust	1		
	lift must decrease (because weight stays the same)		1		
	so there is a resultant downwards force	allow so weight is greater than lift the last two marking points cannot be awarded if there is a reference to the weight increasing	1		
06.2		an answer of 300 000 (kg) scores **5** marks		AO2 6.5.4.1.5 6.5.4.2.2	E
	$a = \frac{(10-80)}{28}$	allow $a = \frac{(80-10)}{28}$	1		
	a = (–)2.5 (m/s^2)	a valid equation must have been used to calculate a to score subsequent marks	1		
	(–) 750 000 = m × (–)2.5	allow a correct substitution using their calculated value of a	1		
	$m = \frac{(-)750\ 000}{(-)2.5}$	allow a correct rearrangement using their calculated value of a	1		
	m = 300 000 (kg)	allow a correct calculation using their calculated value of a	1		
Total			**9**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
7.1	speed / velocity in the glass is lower	speed / velocity changes is insufficient allow the refractive index of glass is higher than that of air allow glass has a higher optical density than air	1	AO1 6.6.2.2	E
	so the edge of the wave(front) entering the glass slows down		1		
	but the part of the wave(front) in the air continues at the higher speed / velocity (causing a change in direction)		1		
7.2	correct ray in the prism bent towards the normal		1	AO1 6.2.2.2	E
	second normal at 90° at the point the ray emerges		1		
	correct emergent ray bent away from the normal	this mark can be awarded without a normal line drawn	1		
7.3	violet has the shortest wavelength (400 nm)		1	AO3 6.2.2.2	E
	violet light travels the slowest in water		1		
	violet light undergoes the greatest change in speed (and direction)		1		
Total			**9**		