GCSE
COMBINED SCIENCE: TRILOGY
8464/P/1H

Physics Paper 1H

Mark scheme

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2 4 6 G 8 4 6 4 / P / 1 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.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

Further copies of this mark scheme are available from aqa.org.uk

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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 should be awarded for a correct numerical answer, without any working shown.
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	kinetic energy (of the beater / food) internal / thermal energy (of the surroundings / whisk / food)	ignore sound	1 1	AO1 6.2.4.2 6.1.2.1 6.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	power = $\frac{\text{work done}}{\text{time}}$ or $P = \frac{W}{t}$		1	AO1 6.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	$92 = \frac{23\,000}{\text{time}}$ $\text{time} = \frac{23\,000}{92}$ 250 (s)		1 1 1	AO2 6.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	$P = I^2 R$		1	AO1 6.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	I = 0.500 A		1	AO2 6.2.4.1
	$P = 0.500^2 \times 640$	allow a correct substitution of an incorrectly / not converted current	1	
	P = 160 (W)	allow a correct calculation using an incorrectly / not converted current	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	230 (V)		1	AO1 6.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	decreases		1	AO1 6.2.4.1

Total Question 1	**12**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	2 protons and 2 neutrons	ignore helium nucleus	1	AO1 6.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	118		1	AO1 6.4.1.2

Question	Answers	Mark	AO / Spec. Ref.
02.3	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	4–6	AO1 AO3 6.4.1.3
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1–3	
	No relevant content	0	
	Indicative content Plum pudding model • the atom is a ball of positive charge • electrons are embedded in the ball Reasons why the plum pudding model was replaced • the results were not correctly predicted by the plum pudding model • the plum pudding model did not predict that some particles would be deflected • the large angle deflections suggest that the atom contains a nucleus • all deflections suggest that the nucleus is charged • most alpha particles were not deflected suggesting that atoms are mostly empty space Nuclear model • mass is concentrated in the nucleus • the nucleus is charged • the atom is mostly empty space • electrons orbit the nucleus in the nuclear model		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	James Chadwick		1	AO1 6.4.1.3

Total Question 2	**9**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	correct symbol for voltmeter connected across LED correct symbol for ammeter in series with LED		1 1	AO1 6.2.1.4 6.2.1.1 RPA16

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	change the number of cells in the battery reverse the connections to the LED / battery	allow use batteries with different potential differences allow adjust the variable resistor allow adjust the potential difference across the power supply allow reverse the connections to the power supply	1 1	AO1 6.2.1.4 RPA16

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	4 points plotted correctly line of best fit	allow a tolerance of ± ½ small square allow **1** mark for 3 points plotted correctly ignore line before 1.8 V	2 1	AO2 6.2.1.4 RPA16

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	the current is zero because the LED / diode has a very high resistance (in the reverse direction)	allow the current stops allow because the LED / diode only allows current in one direction	1 1	AO1 6.2.1.4 RPA16

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	the investigation is reproducible		1	AO3 6.2.1.4 RPA16

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3.6	resistor at constant temperature		1	AO1 6.2.1.4

Total Question 3	**11**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	chemical store of energy decreases gravitational potential energy of the drone increases		1 1	AO2 6.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	$3920 = 2.5 \times 9.8 \times \Delta h$ $\Delta h = \frac{3920}{2.5 \times 9.8}$ $\Delta h = 160$ (m) $(840 - 160) = 680$ (m) **OR** Initial $E_p = 2.5 \times 9.8 \times 840$ (1) Final $E_p (= 20580 - 3920)$ $= 16660$ (1) $h = \frac{16660}{2.5 \times 9.8}$ (1) = 680 (m) (1)	 allow an answer consistent with their calculated value of Δh using the correct equation allow initial $E_p = 20580$ allow correct use of an incorrectly calculated value of E_p using the gravitational potential energy equation allow a correct substitution and rearrangement using their calculated value of E_p using the gravitational potential energy equation allow an answer consistent with their calculated value of E_p using the gravitational potential energy equation	1 1 1 1	AO2 6.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	max E_k = 3920 + 150 (= 4070 J)	allow max E_k = 4070 J	1	AO2 6.1.1.2
	$4070 = 0.5 \times 2.5 \times v^2$	allow a substitution using their value for kinetic energy	1	
	$v = \sqrt{\frac{4070}{0.5 \times 2.5}}$	allow a correct re-arrangement using their value for kinetic energy allow $v^2 = \frac{4070}{0.5 \times 2.5}$	1	
	v = 57.06… (m/s)	allow v = 57 (m/s)	1	
	v = 0.057… (km/s)	allow an answer consistent with their calculated value for v using the kinetic energy equation	1	

Total Question 4	**11**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1		allow risk for hazard throughout		AO1 6.4.2.4
	Irradiating			
	EITHER			
	radiation enters the water	allow alpha / beta / gamma enters the water allow the water does not become radioactive	1	
	(which) does not affect the hazard	dependent on MP1	1	
	OR			
	because radiation can kill pathogens (1)	allow named pathogens e.g. bacteria, viruses		
	(irradiating) decreases the hazard (1)	dependent on MP1		
	contaminating			
	because radioactive isotopes will enter the water / body		1	
	(contaminating) increases the hazard	dependent on MP3	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	$^{52}_{23}V \rightarrow {}^{52}_{24}Cr + {}^{0}_{-1}\beta$		1	AO2 6.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	**radon-222** activity remained (almost) the same	allow the radiation emitted (each second) decreased by a small amount	1	AO3 6.4.2.3
	because 7.4 minutes is only a very small fraction of 3.8 days	allow 7.4 minutes is much smaller than 3.8 days allow the time is much less than the half-life	1	
	vanadium-52 activity decreased by a factor of 4		1	
	because 2 half-lives had passed		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	<u>peer review</u>		1	AO1 6.4.2.4

Total Question 5	**10**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	efficiency = 0.72 × 0.86	allow use of percentages if % is seen	1	AO2 6.1.2.2
	efficiency = 0.61(92)		1	
	0.62		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	(at higher temperatures) the (average) speed of the particles is greater	allow the (average) kinetic energy of the particles is greater do **not** accept vibrations	1	AO3 6.1.1.1 6.1.1.4 6.3.2.1 6.3.3.1
	so the frequency of collisions (between particles and the turbine) increases		1	
	and the force of each collision (between a particle and the turbine) is greater		1	
	so more energy transferred (each second)	dependent on MP2 or MP3 ignore increases the power	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	$48 = \frac{\text{mass}}{5.0 \times 10^5}$		1	AO2 6.3.1.1
	mass = $48 \times 5.0 \times 10^5$		1	6.3.2.2 6.1.1.3
	mass = 24 000 000		1	
		the equation density $= \frac{\text{mass}}{\text{volume}}$ must have been used to score subsequent marks		
	E = 24 000 000 × 1100 × 15	allow a correct substitution using their calculated value for mass	1	
	E = 396 000 000 000	allow an answer consistent with their calculated value for mass	1	
	$E = 3.96 \times 10^{11}$(J)	allow a correctly converted answer consistent with their calculated value for energy using the equation $\Delta E = m\, c\, \Delta\theta$	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(efficient energy storage means) less energy is wasted		1	AO1 6.1.3
	(to reduce carbon dioxide emissions) less fossil fuel used / burned	allow named fossil fuel	1	
	the amount of energy generated from renewable resources will need to increase **or** (most) renewable resources do not generate electricity all the time	allow named renewable resources allow renewable resources are unreliable	1	
	(so) efficient energy storage will help to meet the demand for energy / electricity		1	

Total Question 6	**17**