GCSE
COMBINED SCIENCE: TRILOGY
8464/P/1H

Physics Paper 1H

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 / ; e.g. 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 examples 1 and 2) 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	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, i.e. 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	ammeter in series with the resistor, voltmeter in parallel with the resistor		1	AO1/1 6.2.1.4 RP 16 WS 2.4	A
01.2	current decreased	ignore slows down	1	AO1/1 6.2.1.3 RP 16 WS 3.6	E
01.3	reverse the connections to the cell	allow battery for cell allow reverse the cell	1	AO1/2 6.2.1.3 RP 16 WS 2.2	E
01.4	(directly) proportional	do not allow inversely proportional do not allow indirectly proportional	1	AO1/2 6.2.1.3 RP 16 WS 3.5	G
01.5	potential difference = current × resistance **or** V=IR	allow voltage for potential difference allow any correct re-arrangement	1	AO1/1 6.2.1.3 RP 16 WS 3.3	E
01.6	$3.0 = 0.12 \times R$ $R = \frac{3.0}{0.12}$ R = 25 (Ω)	an answer of 25 (Ω) scores **3** marks	 1 1 1	AO2/1 6.2.1.3 RP 16 WS 3.3	E
Total			**8**		

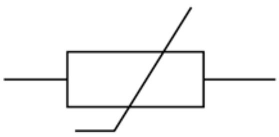
Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
02.1	pressure decreased because molecules have less (kinetic) energy so fewer collisions (with the wall/container each second)	 allow less speed/velocity allow collide with less force allow less force on the walls	1 1 1	AO2.1 6.3.3.1	E
02.2	$0.70 = m \times 330$ **or** $700 = m \times 330\,000$ $m = \frac{0.70}{330}$ **or** $m = \frac{700}{330\,000}$ m = 0.0021 (kg)	an answer of 0.0021(212121…) scores **3** marks allow correct rearrangement using converted value(s) of E to J and/or L to J/kg allow 0.0021(212121…) allow correct calculation using converted value(s) of E and/or L 3 marks can only be awarded for m = 0.0021(212121…) (kg)	1 1 1	AO2.1 6.3.2.2 6.1.1.3	E
02.3	see table below 2 correct answers scores **1** mark. if more than one tick in a row, neither tick can score a mark		2	AO3/2b 6.3.1.1	E

Substance	Solid	Liquid	Gas
Oxygen		✓	
Nitrogen			✓
Carbon dioxide	✓		

02.4	**Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1.1 6.3.1.2	E
	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 cooling • as the argon cools the particles slow down • particles in a liquid move slower than particles in a gas • particles in a solid move slower than particles in a liquid • as the liquid/solid cools the particles get closer together • as the liquid/solid cools the density increases gas to liquid • particles change from being spread apart to touching each other • particles will (collide with other particles more often and) change direction more often liquid to solid • particles change from a random arrangement to a regular pattern • particles change from moving freely to fixed positions • particles change from moving freely/randomly to vibrating explanation • (internal) energy (of the argon) decreases • (kinetic) energy (of the particles) decreases with temperature • (potential) energy (of the particles) changes with change of state (of the argon) • forces between particles in a gas are negligible/zero • attractive forces act between atoms when they are close to each other • attractive forces between particles are stronger in a solid than in a liquid to access level 3 there must be an explanation of changes to arrangement and movement of particles during either cooling or a change of state			

Total			**14**

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	an energy resource that cannot be replenished as it is used	allow an energy resource that will run out ignore cannot be re-used	1	AO1.1 AO1 in isolation 6.1.3	E
03.2		an answer of 30 (A) scores **4** marks		AO2.1 6.2.4.1	E
	6.9 k(W) = 6900 (W)		1		
	6900 = 230 × I	allow correct substitution of an incorrectly/not converted value for power	1		
	$I = \frac{6900}{230}$	allow a correct transformation using an incorrectly/not converted value for power	1		
	I = 30 (A)	allow a correct calculation using an incorrectly/not converted value for power	1		
03.3	direct potential difference is always in the same direction	allow direct current is always in the same direction	1	AO1.1 6.2.3.1	E
	alternating potential difference changes direction	allow alternating current changes direction	1		
03.4	lower potential difference across the cable	allow lower power/energy dissipation	1	AO1.1 6.1.2.2 6.2.4.1	E
	it is more efficient **OR** (lower resistance gives) a greater current (for the same potential difference) (1) so the car battery can charge faster (1)	allow it won't get as hot	1		
Total			**9**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1	less than 20 Ω		1	AO2/1 6.2.2	A
04.2	the resistance of the lamp is added to the total resistance of the resistors in parallel	allow resistors in series add up	1	AO3/1a 6.2.2	E
	the resistors in parallel have a total resistance of less than 10 ohms	allow resistors in parallel have a smaller resistance than the lowest value resistor	1		E
04.3			1	AO1.1 AO1 in isolation 6.2.1.1	E
04.4	the current increased		1	AO1.1 AO1 in isolation 6.2.1.4 6.2.1.3	E
	(because) the resistance (of the thermistor) decreased	allow because the resistance of the circuit decreased	1		

04.5	**the resistor** the potential difference across the resistor becomes 0V because there is a short circuit across the resistor	 allow because there is no current in the resistor allow switch has no resistance If neither of the first two marking points awarded, allow **1** mark for p.d. decreases because there is less current in the resistor **or** p.d. decreases because components in parallel have less resistance **or** p.d. decreases because there is an alternative route for the current	 1 1	AO2.2 6.2.2 6.2.1.1 6.2.1.3 WS 3.6	E
	the lamp the potential difference across the lamp increases because the current increases	 allow the potential difference across the lamp will be the same as the battery allow because the resistance of the circuit decreases allow because there is less p.d. across the resistor	 1 1		

Total			**10**

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	electrons collide with particles in the heating element which increases the (kinetic) energy of the particles (in the heating element)	allow there is a current in the heating element allow internal store of energy increases allow the particles (in the heating element) vibrate more rapidly	1 1	AO1.1 6.2.4.2 6.3.2.1 WS 1.2	E
05.2	the starting temperature of the water	allow the starting temperature of the kettle	1	AO3.3a 6.2.4.2 WS 2.2	E
05.3	(the heating element of) the kettle took time to heat up		1	AO3.1a 6.2.4.2 WS 3.7	E
05.4	the (rate of) energy transfer (per kg of water) to the surroundings decreases as the mass of water increases **or** the efficiency of the kettle increases as the mass of water increases	allow the (rate of) energy transfer (per kg of water) to the surroundings changes as the mass of water changes allow the efficiency of the kettle changes as the mass of water changes	1	AO3.1b 6.2.4.2 WS 3.7	E

05.5		an answer of 4800 (J/kg °C) scores **6** marks a correct answer given to more than 2 s.f. scores **5** marks		AO2.1 6.3.2.2 6.1.1.3 6.1.1.4 WS 3.3	E
	E = 2600 × 120	allow a correct substitution of an incorrectly/not converted value of P and/or t.	1		
	E = 312 000 (J)	this answer only the equation E=Pt must have been used to score subsequent marks.	1		
	312 000 = 0.80 × c × (100-18) **or** 312 000 = 0.80 × c × (82)	allow use of their value of E calculated using E =Pt for this and subsequent steps	1		
	$c = \frac{312\ 000}{0.80 \times 82}$		1		
	c = 4 756		1		
	c = 4 800 (J/kg °C) (2 s.f.)	this mark can only be scored for a correct rounding of a value of c calculated using correct equations	1		

Total			**11**

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	mass number stays the same, charge stays the same		1	AO1.1 6.4.2.2	A
06.2	gamma radiation is only weakly ionising **or** most gamma radiation will pass through any detector	allow gamma radiation is very penetrating	1	AO1.1 6.4.2.1	E
06.3	any two from • the radiation spreads out in all directions • only some of the radiation goes into the G-M tube • only some of the radiation passing into the GM tube is detected	allow **2** marks for only some of the radiation passing into the GM tube is detected because gamma is weakly ionising	2	AO1.1 6.4.2.4	E
06.4	to reduce the amount of radiation received because radiation increases the risk of cancer or (genetic) mutation	allow to reduce irradiation (of the teacher) allow causes cancer or (genetic) mutation ignore references to contamination	1 1	AO1.1 6.4.2.1 WS 1.4	E

06.5	a calculation of the product of thickness and count rate a second calculation of the product of thickness and count rate a comparison of the calculated values and a recognition that they are different **OR** A calculation of half the count rate (1) A comparison with the count rate for double that thickness (1) A recognition that the values are different (1)	examples of calculations $0.5 \times 110 = 55$ $1.0 \times 60 = 60$ $1.5 \times 33 = 50$ $2.0 \times 18 = 36$ $2.5 \times 10 = 25$ e.g. $\frac{110}{2} = 55$ the first two marks may be scored for a count rate divided by 3, 4 or 5 compared with the corresponding count rate for 3, 4 or 5 times the thickness e.g. $55 \neq 60$	1 1 1	AO3.1b 6.4.2.1	E

06.6	${}^{140}_{57}\text{La} \longrightarrow {}^{0}_{-1}\text{e} + {}^{140}_{58}\text{Ce}$	allow **1** mark for correct numbers on electron allow **1** mark for correct numbers on Ce	2	AO1.1 AO1 in isolation AO1.2 6.4.2.2	E

06.7		an answer of $\frac{1}{32}$ or equivalent scores **4** marks		AO3.1a 6.4.2.3	E
	half-life = 50 seconds	this may be indicated on Figure 7	1		
	250 seconds difference in age = 5 half lives	allow 100 seconds = 2 half lives **and** 350 seconds = 7 half lives	1		
	ratio = $\left(\frac{1}{2}\right)^5$ **or** ratio = $\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}$	allow this mark if they have halved 1.25($\times 10^{23}$) five times to get 0.0390625($\times 10^{23}$) for example 1.25($\times 10^{23}$) → 0.625($\times 10^{23}$)→ 0.3125($\times 10^{23}$)→ 0.15625($\times 10^{23}$) → 0.078125($\times 10^{23}$)→0.0390625($\times 10^{23}$)	1		
	ratio = $\frac{1}{32}$ **or** ratio = 1:32	allow ratio = 0.031 allow 32:1 **or** 32	1		
06.8	tangent drawn on graph	do not allow a line drawn that crosses the graph line	1	AO2.2 6.4.2.1	E
	use of gradient = $\frac{(\Delta \text{ no. of atoms})}{\Delta \text{ time}}$	values must be taken from their tangent drawn at 20 seconds	1		
	gradient = 5.3 ($\times 10^{21}$) (Bq)	allow gradient = 0.053 ($\times 10^{23}$) (Bq) allow a range between 4.7 ($\times 10^{21}$) (Bq) and 5.9 ($\times 10^{21}$) (Bq)	1		
Total			**18**		