GCSE
PHYSICS
8463/1F

Paper 1 Foundation Tier

Mark scheme

June 2024

Version: 1.0 Final

2 4 6 G 8 4 6 3 / 1 F / 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 do not form 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.

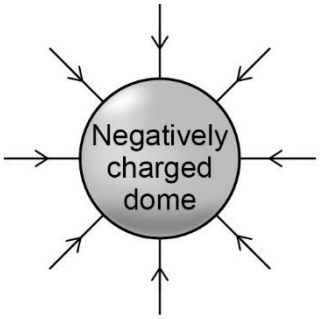
You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

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	negative		1	AO1 4.2.5.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	repulsion		1	AO1 4.2.5.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3			1	AO1 4.2.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	resistance		1	AO1 4.2.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	ionised		1	AO1 4.2.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	electrons		1	AO1 4.2.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	energy transferred = 0.000 002 × 300 000 energy transferred = 0.6 (J)		1 1	AO2 4.2.4.2

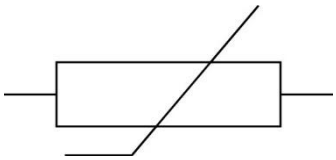
Total Question 1	**8**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	50 hertz		1	AO1 4.2.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	230 volts		1	AO1 4.2.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	resistance = $\frac{0.45}{0.75}$ resistance = 0.60 (Ω)		1 1	AO2 4.2.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4			1	AO1 4.2.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	pd across battery - pd across thermistor		1	AO3 4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	1.5 V (thermistor has the) same resistance as resistor **or** both (components) have a resistance of 200 (Ω)	 MP2 dependent on scoring MP1 allow pd shared equally (between components of equal resistance) allow pd will be half (of the total pd)	1 1	AO3 4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	resistance at 15 °C = 200 (Ω) change in resistance = 400 (Ω)	 allow a correct change in resistance from a misread resistance within the range 180 to 220 Ω	1 1	AO2 4.2.1.4

Total Question 2	**10**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	stretched length – original length		1	AO2 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	$E_e = 0.5 \times 800 \times 7.5^2$ $E_e = 22\,500$ (J)		1 1	AO2 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	kinetic energy = $0.5 \times 240 \times 15^2$ kinetic energy = 27 000 (J)		1 1	AO2 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	$E_p = m \times g \times h$		1	AO1 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	$24\,000 = 240 \times 9.8 \times h$ $h = \frac{24\,000}{(240 \times 9.8)}$ $h = 10.2$ (m)	 allow 10 (m) allow a correct answer given to more than 3 s.f.	1 1 1	AO2 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	energy is transferred to the surroundings work is done against air resistance		1 1	AO1 4.1.2.1

Total Question 3	**11**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	0.0 to 10.0 cm^3		1	AO3 4.3.1.1 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	the measured volume would be larger		1	AO3 4.3.1.1 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	0.4 (cm^3)		1	AO2 4.3.1.1 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	the results are repeatable		1	AO3 4.3.1.1 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	subtract 0.02 from the measurement		1	AO3 4.3.1.1 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	density = $\frac{\text{mass}}{\text{volume}}$ **or** $\rho = \frac{m}{V}$		1	AO1 4.3.1.1 RPA5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	$22 = \frac{m}{0.3}$ $m = 22 \times 0.3$ $m = 6.6$ (g)		1 1 1	AO2 4.3.1.1 RPA5

Total Question 4	**9**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	the volume decreased		1	AO1 4.3.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	the distance decreased		1	AO1 4.3.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	the frequency of collisions increased		1	AO1 4.3.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	the air pressure increased		1	AO1 4.3.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	the mean speed of the particles increases		1	AO1 4.3.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	$0.0130 = 2.60\times10^{-8} \times 1010 \times \Delta\theta$ $\Delta\theta = \dfrac{0.0130}{(2.60 \times 10^{-8} \times 1010)}$ $\Delta\theta = 495$ (°C)	 allow a correct answer given to more than 3 s.f.	1 1 1	AO2 4.1.1.3 4.3.2.2

Total Question 5	8

Question 6

<table>
<tr><th>Question</th><th>Answers</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>06.1</td><td>2 marks for 4 correct answers
1 mark for 2 or 3 correct answers

<table>
<tr><th>Source of background radiation</th><th>Natural</th><th>Man-made</th></tr>
<tr><td>Cosmic rays</td><td>✓</td><td></td></tr>
<tr><td>Medical X-rays</td><td></td><td>✓</td></tr>
<tr><td>Nuclear accidents</td><td></td><td>✓</td></tr>
<tr><td>Radon gas</td><td>✓</td><td></td></tr>
</table>
</td><td>2</td><td>AO1
4.4.3.1</td></tr>
</table>

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	rock **C** (because) alpha is stopped by (one sheet of) paper **or** (one sheet of) paper significantly decreased the radiation detected	 MP2 dependent on scoring MP1 allow alpha is the least penetrating	1 1	AO1 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	rock **A** (because) beta radiation is stopped by (a thick) aluminium (sheet) **or** the (thick) aluminium (sheet) significantly decreased the radiation detected	 MP2 dependent on scoring MP1	1 1	AO1 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	wearing protective gloves		1	AO3 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	the activity is half the original activity		1	AO3 4.4.2.3

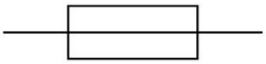
Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	the greater the activity, the greater the risk of harm		1	AO1 4.4.3.3

Total Question 6	**9**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	brown		1	AO1 4.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	blue		1	AO1 4.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3			1	AO1 4.2.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	current = $\frac{2.0}{0.40}$ current = 5.0 (A)		1 1	AO2 4.2.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	m = 0.000016 (kg) **or** $m = 1.6 \times 10^{-5}$ (kg) E = 0.000016 × 60 000 E = 0.96 (J)	 allow a correct substitution using an incorrectly / not converted value of m allow an answer consistent with an incorrectly / not converted value of m	1 1 1	AO2 4.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	the total energy will be greater		1	AO3 4.1.2.1 4.3.2.3

Total Question 7	**9**

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	**X** = $\frac{0.26 + 0.21 + 0.25}{3}$ **X** = 0.24 (A)	 allow **X** = $\frac{0.26 + 0.25}{2}$ = 0.255 for 2 marks	1 1	AO2 4.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	current = 0.17 (A) power = 3.0 × 0.17 power = 0.51 (W)	 allow a correct substitution using a value of I in the range 0.16 to 0.18 A allow an answer consistent using a value of I in the range 0.16 to 0.18 A answers of 0.456, 5.1 or 51 score **2** marks	1 1 1	AO2 4.2.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	decreases		1	AO2 4.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	filament lamp		1	AO3 4.2.1.4

Total Question 8	**7**

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	thermal / internal (energy) **or** kinetic (energy of the water particles)	ignore heat allow E_k	1	AO1 4.1.1.1 4.3.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	gravitational potential (energy)	allow E_p / GPE allow kinetic / E_k	1	AO1 4.1.1.1

Question	Answers	Mark	AO / Spec. Ref.
09.3	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	3–4	AO3 4.1.1.1 4.3.2.1 4.1.1.2 4.1.2.2 4.1.3
	Level 1: Relevant features are identified and differences noted.	1–2	
	No relevant content	0	
	Indicative content **Method A:** • heated water needs insulating (to maintain high temperature) • energy stored by heating water is much greater (per 100 kg) • useful energy from heating 100 kg of water = 20 160 (kJ) • energy wasted (per 100 kg) = 13 440 (kJ) • efficiency = 60 % **Method B:** • suitable location needed to pump water uphill • pumping water efficiency is higher • useful energy from pumping 100 kg of water = 367.5 (kJ) • energy wasted (per 100kg) = 122.5 (kJ) • efficiency = 75 % A level 2 answer should use the data in a relevant calculation that compares the two methods.		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	**Transport examples:** don't use (petrol / diesel) cars (for transport) **or** don't burn petrol / diesel (for transport) (instead) use electric cars **or** (instead) use hydrogen-fuelled cars **or** (instead) use a bicycle **or** (instead) use public transport **or** (instead) walk **Generating Electricity examples:** don't use coal / oil / gas (to generate electricity) (instead) use renewable methods **or** (instead) use nuclear power **OR** don't use (electrical) appliances when not needed to reduce the demand for electricity (generated) using coal / oil / gas	allow don't use other transport methods e.g. (diesel) buses allow fossil fuels for petrol / diesel allow fossil fuels for coal / oil / gas allow specific examples of renewable energy resources allow specific examples e.g. lights allow fossil fuels for coal / oil / gas accept other reasonable changes with valid alternative for 2 marks each	1 1 1 1	AO3 4.1.3

Total Question 9	10

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	nuclei neutrons gamma rays	this order only	1 1 1	AO1 4.4.4.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	energy = power × time **or** $E = P \times t$		1	AO1 4.2.4.2 4.1.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	P = 500 000 000 (W) E = 500 000 000 × 3600 E = 1 800 000 000 000 (J) **or** $E = 1.8 \times 10^{12}$ (J)	 allow a correct substitution of an incorrectly / not converted value of P allow an answer consistent with an incorrectly / not converted value of P	1 1 1	AO2 4.2.4.2 4.1.1.4

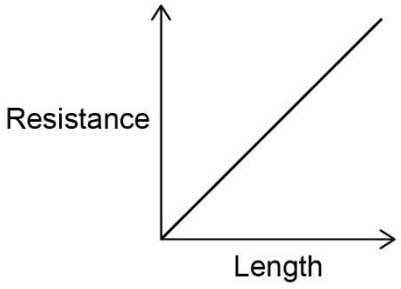
Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.4	any **one** from: • bury the radioactive waste • put the radioactive waste in cooling ponds • transport the radioactive waste in secure vessels • store the radioactive waste in metal containers • cover the radioactive waste in concrete	allow store it for (at least) one half-life ignore references to high / medium / low level waste ignore label the waste as hazardous	1	AO3 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.5	number of days = $\frac{92}{100} \times 365$		1	AO2 4.1.3
	number of days = 335.8	allow answers of 335 and 336 days allow an answer of 29.2 (days) for 1 mark	1	

Total Question 10	**10**

Question 11

Question	Answers	Mark	AO / Spec. Ref.
11.1	**Level 3**: The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.2.1.3 RPA3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method 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 • measure the length of the wire (between the crocodile clips) using the ruler • length varied by moving crocodile clips • current measured with ammeter • potential difference measured with voltmeter • calculate resistance for each length • use $V = IR$ to calculate resistance • record current and pd for different lengths • repeat readings of current and pd for each length and mean values calculated • remove any anomalous readings • ensure values of current are low to minimise heating of wire • ensure circuit is disconnected between readings **Level 2:** Varying the length of the wire. Measurements / equipment needed for pd and current.		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.2			1	AO1 4.2.1.3 4.2.1.4 RPA3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
11.3	potential difference is (very) low		1	AO1
	(so) no risk of electric shock **or** (so) no risk of electrocution	allow less risk of electric shock allow so wire won't melt allow so wire won't get hot	1	AO3 4.2.1.3 RPA3

Total Question 11	**9**