GCSE
PHYSICS
8463/2F

Paper 2 Foundation Tier

Mark scheme

June 2022

Version: 1.0 Final Mark Scheme

226G8463/2F/MS

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.

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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 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.

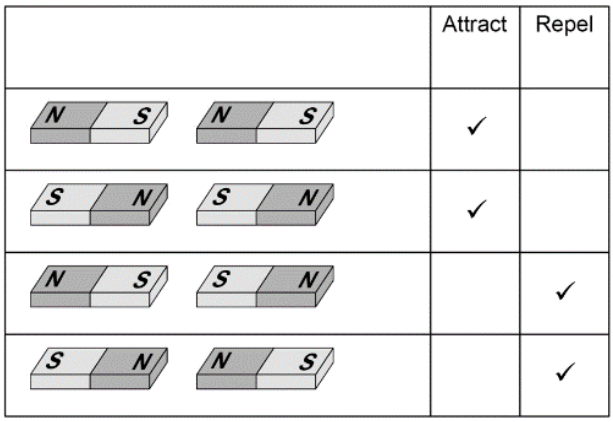
You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

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	all ticks correct  allow **1** mark for 3 correct ticks		2	AO2 4.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	the magnetic field gets weaker further from the magnet the magnetic field is strongest at the poles		1 1	AO1 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	iron		1	AO1 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	coil		1	AO1 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	the magnetic field would be stronger		1	AO1 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	the magnetic field would be weaker		1	AO1 4.7.2.1

Total Question 1		**8**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	gravitational force		1	AO1 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	air resistance		1	AO1 4.5.6.15

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	the resultant force on the hailstones is zero		1	AO1 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	line extrapolated to 80 mm 46 (m/s)	allow a straight line allow 44 – 48 but not if inconsistent with their extrapolated line	1 1	AO3 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	it has a greater weight		1	AO3 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	0.48 (N)		1	AO2 4.5.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	upwards	allow up ignore north	1	AO2 4.5.1.4

Total Question 2		**8**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	a star		1	AO1 4.8.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	Milky Way		1	AO1 4.8.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	natural satellite (that orbits a planet)		1	AO1 4.8.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	Charon is smaller than the (largest) dwarf planet Ganymede / Titan is larger than the (smallest) planet	allow **1** mark for some are bigger than the smallest planet **or** some are smaller than dwarf planets	1 1	AO3 4.8.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	similarity: circular (orbit) difference: (orbital) period **or** (orbital) height	 allow (orbital) speed	 1 1	AO1 4.8.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	expensive **or** dangerous	allow difficult to get to allow few opportunities allow only trained astronauts can go	1	AO3 4.8.1.3

Total Question 3		**8**

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	centre of mass		1	AO1 4.5.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	weight is directly proportional to mass		1	AO1 4.5.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	reading from balance = 1.1 kg mass = $\frac{1.1}{5}$ = 0.22 kg	 allow correct calculation using incorrectly read value from the balance	1 1	AO2 4.5.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	weight = 0.22 × 9.8 2.156 (N)	allow ecf from question **04.3** allow correct answer to 2 or 3 sig figs	1 1	AO2 4.5.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	0.015 m		1	AO2 4.5.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	spring constant = $\frac{6.0}{0.015}$ 400 (N/m)	allow ecf from question **04.5**	1 1	AO2 4.5.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	returns to its original length/shape	allow returns to 3.5 cm	1	AO3 4.5.3

Total Question 4		**10**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	ultraviolet travels at the same speed as visible light		1	AO1 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	D C	this order only	1 1	AO1 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	A 400 – 315 = 85 (nm) B 315 – 280 = 35 (nm) C 280 – 100 = 180 (nm) (ultraviolet) C (UVC)	three calculations correct 2 marks one or two calculations correct 1 mark mark dependent on all three calculations being made	2 1	AO2 4.6.2.1

Question	Answers	Mark	AO / Spec. Ref.
05.4	**Level 2:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	3–4	AO3 4.6.2.3
	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: • ozone absorbs all of the UVC • UVC is the most dangerous • ozone absorbs nearly all (95%) of the UVB • UVB has a medium risk • ozone does not absorb any UVA • ozone does not reduce risk from UVA • UVA is the least dangerous • the greater the ionising power the greater the absorption by ozone • the greater the ionising power the greater the risk • UV damages skin cells • can lead to skin cancer • can cause sunburn • UV can damage eyes • leads to problems with eyesight		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	our eyes detect visible light	allow it would be dark all the time allow specific effect ie plants couldn't grow	1	AO1 4.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	transmitted absorbed	this order only	1 1	AO1 4.6.2.6

Total Question 5		**13**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	100 km		1	AO3 4.5.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	gas		1	AO1 4.5.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	90 000 (Pa)	allow 89 500 to 90 500	1	AO2 4.5.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	101 000 – 90 000 = 11 000 (Pa)	allow ecf from question **06.3**	1	AO2 4.5.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	the density of the air decreases the mass of air above the student decreases		1 1	AO2 4.5.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	$P = \frac{188\ 000\ 000}{2000}$ 94 000 (Pa)		1 1	AO2 4.5.5.1.1

Total Question 6		**8**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	wavelength frequency	this order only	1 1	AO1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	parallel		1	AO1 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	8000 Hz		1	AO2 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	period = $\frac{1}{8000}$ 0.000125 (s)	allow ecf from question **07.3**	1 1	AO2 4.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	$\lambda = \frac{330}{6600}$		1	AO2
	$\lambda = 0.050$	allow 0.05	1	AO2
	m		1	AO1 4.5.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	distance (travelled) = speed × time **or** $s = vt$	allow any correct rearrangement	1	AO2 4.5.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.7	$13.2 = 330 \times t$		1	AO2 4.5.6.1.2
	$t = \frac{13.2}{330}$		1	
	$t = 0.04$ (s)	allow 0.040 (s)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.8	loudspeaker **B** is further from the technician (than speaker **A**) so the sound would take more time to travel (to the technician) so the sound from each speaker arrives at the technician at the same time	'it' means speaker **B**	1 1 1	AO3 4.6.1.2

Total Question 7		**16**

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	any **two** from: • capacity of the battery • speed • mass / weight • uphill / downhill • stopping at traffic lights • condition of the road • (air) temperature • (incorrect) tyre pressure • streamlining of the car	 allow energy/charge stored in battery allow efficiency of battery ignore size of the battery allow terrain ignore 'the road' only ignore 'weather' only allow efficiency of engine allow anything that would use charge from the battery **or** anything that will reduce the energy stored	2	AO3 4.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	acceleration = change in velocity/time (taken) **or** $a = \frac{\Delta v}{t}$	allow any correct rearrangement allow $a = \frac{v - u}{t}$ do **not** accept $a = \frac{v}{t}$	1	AO1 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	$20 = \frac{28}{t}$ $t = \frac{28}{20}$ 1.4 (s)		1 1 1	AO2 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	$v^2 - 0^2 = 2 \times 10 \times 605$ $v^2 = 12\ 100$ $v = 110$ (m/s)		1 1 1	AO2 4.5.6.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	work done = force × distance **or** $W = Fs$	allow any correct rearrangement	1	AO1 4.5.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	*s* = 7500 (m)		1	AO2 4.5.2
	W = 4000 × 7500	allow correct substitution using incorrectly / not converted value of s	1	
	W = 30 000 000 (J)	allow correct calculation using incorrectly / not converted value of s	1	

Total Question 8		**13**

Question 9

Question	Answers	Mark	AO / Spec. Ref.
09.1	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 4.6.1.3
	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 Some indicative content could be indicated within a labelled diagram • place a glass block on a piece of paper • draw around the glass block • use the ray box to shine a ray of light through the glass block • mark the ray of light entering the glass block • mark the ray of light emerging from the glass block • join the points to show the path of the complete ray through the block • and draw a normal line at 90 degrees to the surface • use a protractor to measure the angle of incidence • use a protractor to measure the angle of refraction • use a ray box to shine a ray of light at a range of different angles (of incidence) • increase the angle of incidence in 10 degree intervals • from an angle of incidence of 10 degrees to an angle of incidence of 80 degrees Methods involving mirrors and reflection score zero		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	angle of incidence in degrees / ° on *x*-axis **and** angle of refraction in degrees / ° on *y*-axis		1	AO2 4.6.1.3
	all points plotted correctly	allow **1** mark if 3 or 4 points plotted correctly allow tolerance of half a small square	2	
	curved line of best fit	allow line of best fit from their incorrectly plotted points	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	normal drawn at 90° at the point where the incident ray strikes the mirror		1	AO2 4.6.1.3
	straight line drawn with a ruler **and** angle of incidence = angle of reflection	ignore any arrows	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	(the protractor drawn on the paper means you) do not have to move the mirror (to measure the angles)	allow do not have to mark the position of the rays of light allow protractor does not need to be repositioned	1	AO3 4.6.1.3
	(so) more likely to record the correct angle of incidence and/or reflection	allow reducing random error allow more accurate	1	
	ray in method A does not diverge	allow the ray in method A is thin(ner)	1	
	(making it) easier to judge the centre (position) of the ray	allow more accurate if not already awarded allow converse answers in terms of method B being worse than method A	1	

Total Question 9		**16**