GCSE
PHYSICS
8463/2H

Paper 2 Higher Tier

Mark scheme

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Version: 1.1 Final 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 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.

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

Level of response marking instructions

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 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. 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 and not look to pick holes in 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 and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 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.

An answer which contains nothing of relevance to the question must be awarded no marks.

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 <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, 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	Move the wooden block to the left.		1	AO3 4.5.6.2.2 RPA7
01.2	use a pulley (on the edge of the bench)	allow any feasible method to stop the string from rubbing	1	AO3 4.5.6.2.2 RPA7
01.3	suitable scale points plotted correctly line of best fit	 allow 5 correctly plotted for **2** marks **OR** 3–4 correctly plotted for **1** mark	1 2 1	AO2 4.5.6.2.2 RPA7
01.4	(directly) proportional	allow a correct description of direct proportionality ignore positive correlation allow weight (added to mass holder) for force allow f = ma for **1** mark	1	AO3 4.5.6.2.2 RPA7
01.5	repeat the measurements/investigation ignore anomalies **and** calculate the mean / average		1 1	AO3 4.5.6.2.2 RPA7
01.6	resultant force = mass × acceleration **or** F = m a		1	AO1 4.5.6.2.2 RPA7

01.7	0.375 = 0.60 × a $a = \frac{0.375}{0.60}$ a = 0.625 (m/s^2) a = 0.63 (m/s^2)		1 1 1 1	AO2 4.5.6.2.2 RPA7
Total			**14**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(force of) gravity fusion	do **not** allow weight	1 1	AO1 4.8.1.1
02.2	distance = speed × time **or** s = vt	allow a correct re-arrangement do **not** allow d = st	1	AO1 4.5.6.1.2
02.3	$1.5 \times 10^{11} = 3.0 \times 10^8 \times t$ $t = \frac{1.5 \times 10^{11}}{3.0 \times 10^8}$ t = 500 (s)		1 1 1	AO2 4.5.6.1.2

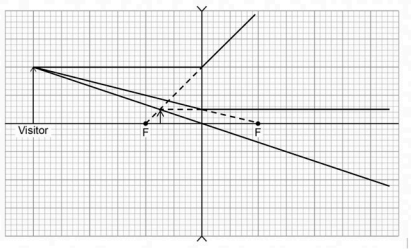
02.4	**Level 3**: Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.		5–6	AO1 4.8.1.2
	Level 2: Scientifically relevant facts, events or processes are identified and their relevance is clear. The account is not fully accurate.		3–4	
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.		1–2	
	No relevant content		0	
	Indicative content: • fusion (processes in stars) produce new elements • cloud of gas / hydrogen **and** dust **OR** nebula • pulled together by gravity • causing increasing temperature (to start the fusion process) • (to become a) protostar • hydrogen nuclei fuse to form helium nuclei • and the star becomes main sequence • hydrogen begins to run out • helium nuclei fuse to make heavier elements • up to iron • the star expands (to become a) • red super giant • (the star collapses rapidly) and <u>explodes</u> • called a supernova • creating elements heavier than iron • and distributing them throughout the universe • leaving behind a neutron star • or a black hole.			
02.5	Temperature		1	AO1 4.6.3.2
Total			**13**	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	it is harder to judge where the centre of a wider ray is		1	AO3 4.6.1.3 RPA9
	causing a larger uncertainty (in the measurements)	allow increasing <u>random</u> errors (in the measurements)	1	
03.2	line of best fit drawn and extrapolated to 80 degrees		1	AO3 4.6.1.3 RPA9
	41 (degrees)	allow 40 to 43 (degrees)	1	
03.3	**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 4.6.1.3 RPA9
	Level 2: The design/plan 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 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: • 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 70 degrees. allow use of optical pins instead of a ray box			

03.4	$\frac{(28 + 25 + 22)}{3} = 25$ 3 (degrees)	 allow alternative method 28 – 22 = 6 (1) = 3 (degrees) (1)	1 1	AO3 4.6.1.3
03.5	Velocity		1	AO1 4.6.2.2
Total			**13**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	any **two** correct lines drawn from the top of the visitor and passing through the lens image drawn at the correct position and with the correct orientation	allow construction lines that are not dashed mark only scores if first two marks scored. a convex lens diagram scores **0** marks 	2 1	AO2 4.6.2.5
04.2	Decreases		1	AO3 4.6.2.5
04.3	Iron		1	AO1 4.7.2.1
04.4	there is a current in the solenoid / circuit creating a magnetic field attracting the bolt	allow a charge flows through the solenoid / circuit allow the solenoid / coil is magnetised	1 1 1	AO1 4.7.2.1

04.5	1.50 cm = 0.015 m 2.88 = k × 0.015 k = 2.88 / 0.015 k = 192 (N/m)	 this mark may be awarded if distance is incorrectly/not converted this mark may be awarded if distance is incorrectly/not converted allow a correctly calculated answer using an incorrectly/not converted distance	1 1 1 1	AO2 4.5.3

04.6	Any **two** from: • increase the current (in the solenoid / circuit) • add more turns to the solenoid • use a spring with a lower spring constant	 allow any sensible suggestion for increasing the current such as increasing the p.d. / power of the battery **OR** using lower resistance wire in the solenoid do **not** allow increase the number of coils allow use a weaker spring	2	AO3 4.7.2.1
Total			**14**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	(total) momentum before = (total) momentum after	allow (total) momentum stays the same	1	AO1 4.5.7.2
05.2	momentum of player A = 585 (kg m/s) momentum of player B = –500.5 (kg m/s) $\frac{(-500.5 + 585)}{(78 + 91)}$ OR $\frac{84.5}{169}$ = 0.5 (m/s)	 allow $\frac{1085.5}{169}$ this answer only	1 1 1 1	AO2 4.5.7.1 4.5.7.2
05.3	(protective pads) increase the time taken to stop (during the collision) so the rate of change of momentum decreases reducing the force (on the ice hockey player)	allow increases impact / contact / collision time do **not** allow slows down time allow reduces acceleration/deceleration allow increases the time to reduce the momentum to zero for **2** marks allow impact for force do **not** allow if linked to an incorrect explanation	1 1 1	AO1 4.5.7.3
Total			**8**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	320 MHz = 3.2×10^8 Hz	allow 320 000 000	1	AO2
	$3.0 \times 10^8 = 3.2 \times 10^8 \times \lambda$	this mark may be awarded if frequency is incorrectly/not converted	1	AO2
	$\lambda = \frac{3.0 \times 10^8}{3.2 \times 10^8}$	this mark may be awarded if frequency is incorrectly/not converted	1	AO2
	wavelength = 0.9375	allow correct calculation using an incorrectly/not converted frequency allow an answer that rounds to 0.94	1	AO2
	metres **or** m		1	AO1 4.6.1.2
06.2	(alternating) current <u>induced</u> (in the electrical circuit)	allow <u>electrons</u> vibrate / oscillate (in the electrical circuit)	1	AO1 4.6.2.3
	with the same frequency as the radio wave		1	
06.3	Any **two** from: • (radio waves are) transverse • (radio waves) travel at a higher speed • (radio waves) don't need a medium • (radio waves are) electromagnetic	allow sound waves are longitudinal allow a description of transverse/longitudinal waves allow (only) radio waves travel through a vacuum allow sound waves are mechanical	2	AO1 4.6.1.1 4.6.1.2
06.4	accelerating	allow speeding up	1	AO3 4.5.6.1.4

06.5	appropriate tangent drawn correct reading from graph for change in distance and change in time (eg 5.6 (m) and 20 (s)) gradient of tangent shown (eg 5.6/20) 0.28 (m/s)	 allow correct reading from their tangent for change in distance and change in time allow correct gradient from their tangent this answer only allow 0.25 to 0.30 (m/s) if the tangent is appropriate allow 2.8 / 20 = 0.14 (m/s) for **1** mark	1 1 1 1	AO2 4.5.6.1.4
06.6	$0.52^2 - 0.12^2 = 2 \times 0.04 \times s$ $s = \frac{0.52^2 - 0.12^2}{2 \times 0.04}$ s = 3.2 (m) 0.48 = F x 3.2 $F = \frac{0.48}{3.2}$ F = 0.15 (N) **OR**	 this mark may be awarded if the displacement is incorrectly calculated this mark may be awarded if the displacement is incorrectly calculated allow a correctly calculated F using an incorrectly calculated displacement	1 1 1 1 1 1	AO2 4.5.2 4.5.6.1.5

	Alternative method 1 $t = \frac{0.52 - 0.12}{0.04}$ (1) t = 10 (s) (1) s = 0.32 × 10 = 3.2 (m) (1) 0.48 = F x 3.2 (1) $F = \frac{0.48}{3.2}$ (1) F = 0.15 (N) (1) **OR** Alternative method 2 $0.48 = (0.5 \times m \times 0.52^2) - (0.5 \times m \times 0.12^2)$ (1) 0.48 = 0.1352m – 0.0072m (1) 0.48 = 0.128m (1) m = 3.75 (1) F = 3.75 x 0.040 (1) F = 0.15 (N) (1)	allow a correctly calculated displacement from an incorrectly calculated t this mark may be awarded if the displacement is incorrectly calculated this mark may be awarded if the displacement is incorrectly calculated allow a correctly calculated F from incorrectly calculated values for displacement and / or t allow their calculated m allow correctly calculated F using an incorrectly calculated m		

06.7	there is a maximum forward force (provided by the motor) as the speed of the car increases air resistance increases until air resistance is equal in size to forward force so the car can no longer accelerate	allow driving force for forward force - throughout the car has a maximum acceleration is insufficient allow friction / drag for air resistance - throughout allow (until) the resultant force is zero allow forces are in equilibrium / balanced allow the car travels at terminal velocity	1 1 1 1	AO1 4.5.6.1.5
Total			**24**	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	to vary the (output) potential difference so that you don't need a different generator for each type of device	allow different devices require different potential differences allow so that it is compatible with different devices do **not** allow answers in terms of power	1 1	AO3 4.7.3.4
07.2	$\frac{1.5}{5.0} = \frac{150}{N_s}$ $N_s = \frac{150}{0.3}$ $N_s = 500$		1 1 1	AO2 4.7.3.4
07.3	the coil moves through the magnetic field **or** the coil cuts magnetic field lines a potential difference is <u>induced</u> (across the coil) there is a complete circuit, so a current is induced (in the coil) every half turn the potential difference reverses direction so (every half turn) the current changes direction		1 1 1 1 1	AO1 4.7.3.1 4.7.3.2
07.4	provides a continuous / moveable contact / connection (between the coil and the transformer / contacts / brushes) **or** stops the wires from twisting together		1	AO3 4.7.3.2

07.5	(after disconnection) there is no induced current so no magnetic field (produced around / by the coil) to oppose the movement of the coil		1 1 1	AO1 4.7.3.1
Total			**14**	