GCSE
PHYSICS
8463/2H

Higher Tier Paper 2

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

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.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1.1	focal length	this answer only	1	AO1/1 4.6.2.5
1.2	one correct line drawn from the top of the object, passing through the lens and crossing or meeting given line inverted image drawn at the correct position and length	ignore any arrow drawn on the line if two lines are drawn, both must be correct arrowhead required	1 1	AO2/2 4.6.2.5
1.3	similarity (both are) diminished difference concave is <u>virtual</u> and convex is <u>real</u> **or** concave is upright and convex is inverted	 allow smaller for diminished a comparison must be made ignore reference to positions of images	1 1	AO3/2a 4.6.2.5
1.4	$6.0 = \frac{9.0}{\text{object height}}$ $\text{object height} = \frac{9.0}{6.0}$ object height = 1.5 (mm)	an answer of 1.5 (mm) scores **3** marks provided working can be seen, an attempt to convert 9.0 mm to cm or m with all other steps correct scores **2** marks	 1 1 1	AO2/1 4.6.2.5
Total			**8**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2.1	metre rule	allow metre ruler allow tape measure do not accept ruler do not accept metre stick	1	AO1/2 4.6.1.2 RPA8
2.2	(wave) speed = frequency × wavelength	allow v = f λ	1	AO1/1 4.6.1.2 RPA8
2.3	 80cm = 0.8m v = 55 × 0.8 v = 44 (m/s)	an answer of 44 (m/s) scores **3** marks this mark may be awarded if wavelength is incorrectly or not converted allow correct calculation using an incorrectly or not converted wavelength an answer of 4400 (m/s) scores **2** marks	 1 1 1	AO2/1 4.6.1.2 RPA8
2.4	move the (wooden) bridge to the right OR change the mass/weight (on the string) scores **1** mark add more masses/weights (to the string) scores both marks	 dependent on 1st mp being scored	1 1	AO2/2 4.6.1.2 RPA8

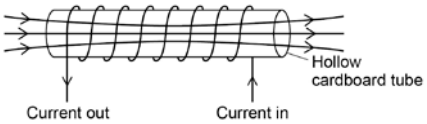
2.5	**Level 2:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	3–4	AO3/3a 4.6.1.2 RPA8
	Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content add or take away masses from the string (ignore any stated values) adjust frequency using the signal generator and/or move the wooden bridge observe a steady / stationary pattern measure the wavelength calculate wave speed from frequency and wavelength a Level 1 answer should include a way of changing tension a complete Level 2 answer would include either changing frequency and/or moving the bridge		
Total		**11**	

Question 3

Question	Answers	Mark	AO/ Spec. Ref
3.1	**Level 3**: Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1/1 AO2/1 4.5.6.3.2 4.5.6.3.3
	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 • reaction time explained in terms of longer reaction times increase thinking distance (from a given speed) • taking drugs • drinking alcohol • tiredness • age • distractions explained in terms of the effect on driver's reaction time • speed explained in terms of the faster the vehicle the greater the distance travelled in the driver's reaction time (or converse) **OR** explained in terms of increased speed increases KE so increases work done to stop the vehicle • condition of the tyres • condition of road surface • wet/icy roads explained in terms of condition of tyres and road surface (including weather considerations) affecting <u>friction</u> (between tyres and road) • condition of brakes explained in terms of effect on braking force (applied to the wheels) or reduced <u>friction</u>		

	• mass / weight of vehicle explained in terms of deceleration force or kinetic energy or change in momentum answers do not need to reference thinking / braking distance a Level 1 answer would list factors only **or** one factor with one linked explanation a Level 2 answer lists at least three factors with one linked explanation **or** two factors with two linked but different explanations a Level 3 answer lists at least three factors with at least two linked but different explanations			
3.2	work (done) = force x distance	allow W = F s	1	AO1/1 4.5.2
3.3	900 000 = 60 000 × distance distance = $\frac{900\ 000}{60\ 000}$ distance = 15 (m)	an answer 15 (m) scores **3** marks	1 1 1	AO2/1 4.5.2
3.4	brakes overheating **or** brakes locking (causing) loss of control **or** (causing) a skid	allow brake fade allow wheels locking allow increasing the stopping / braking distance **ONLY** if the first marking point is scored ignore any effects on passengers or possible accidents	1 1	AO1/1 4.5.6.3.4
Total			**12**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4.1	field lines going in, (through) and out of the solenoid arrow(s) in correct direction	 allow field lines only visible outside the cardboard tube allow a bar magnet shaped field with lines above and below the solenoid	1 1	AO1/1 4.7.2.1
4.2	the rods become (induced) magnets with the same polarity (at each end)	allow the rods are (temporarily) magnetised ignore rods repel do not accept rods become charged	1 1	AO1/1 4.7.1.1
4.3	changed two (independent) variables (at the same time) so it is not possible to know the effect of one (independent) variable or the other	allow need to keep current or number of turns constant allow should only change one variable (at a time) allow current and number of turns both changed ignore fair test	1 1	AO3/1b 4.7.2.1 WS2.7
4.4	(increasing the current) increases the strength until the strength reaches a maximum value	allow weight (held) for strength of electromagnet ignore a given current value for when maximum strength happens	1	AO3/2b 4.7.2.1 WS3.5
4.5	increasing the number of turns from 10 to 20 increases the strength more than increasing from 20 to 30	a general trend is required	1	AO3/2b 4.7.2.1 WS3.5
Total			**8**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5.1	wavelength	this answer only	1	AO1 4.8.2 iso
5.2	(extremely) hot and dense	ignore very small	1	AO1/1 4.8.2 iso
5.3	(directly) proportional	allow a correct description of direct proportionality ignore positive correlation	1	AO3/2b 4.8.2
5.4	6×10^{24}		1	AO2/2 4.8.2 WS4.4
5.5	the furthest galaxies are moving the fastest (this suggests) the universe is expanding (from a very small region)		1 1	AO1/1 4.8.2
5.6	expanding at (an ever) greater rate	allow expanding faster	1	AO3/1a 4.8.2
5.7	any **one** from: • detects false claims • detects inaccurate data • detects bias • verifies new data • provides a consensus (of opinion)	 allow provides credibility allow detects mistakes allow removes bias allow checks validity ignore shows data is accurate ignore proves a theory	1	AO1/1 4.8.2 WS 1.6
5.8	wavelength (seems to have) decreased frequency (seems to have) increased		1 1	AO2/1 4.8.2
Total			**10**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
6.1	the tendency of an object to continue in its state of rest or motion	allow how difficult it is to change the velocity of an object	1	AO1/1 4.5.6.2.1 iso
6.2	(soft foam) increases the time taken to stop or increases the time taken to decrease momentum	allow increases impact/contact time allow increases the time of the collision do not accept slows down time	1	AO1/1 4.5.7.3
	decreases the rate of change in momentum	allow reduces acceleration/deceleration reduces momentum is insufficient allow increases the time to reduce the momentum to zero for **2** marks	1	
	reducing the force (on the egg)	allow impact for force	1	

6.3		an answer 4.5 (m/s) scores **4** marks an answer 4500 scores **3** marks		AO2/1 4.5.7.3
	180 ms = 0.18 s	if incorrectly or not converted, subsequent marks may still be awarded for correct method and calculations	1	
	$800 = \frac{32 \times v}{0.18}$		1	
	$v = \frac{800 \times 0.18}{32}$		1	
	v = 4.5 (m/s)		1	
	Alternative method 180 ms = 0.18 s (1) Δmv = 144 (kgm/s) (1) Δv = 144 ÷ 32 (1) v = 4.5 (m/s) (1)			
	Alternative method 180 ms = 0.18 s (1) a = 25 (m/s^2) (1) 25 = Δv ÷ 0.18 (1) v = 4.5 (m/s) (1)			
Total			**8**	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7.1	The frequency increases and the wave speed in air stays the same		1	AO1/1 4.6.2.1 iso
7.2	pass through soft tissue (but) absorbed by bone	allow penetrate for pass through allow skin/muscle/etc… for soft tissue pass through tissue is insufficient allow do not pass through bone do not accept reflected by bone	1 1	AO1/1 4.6.2.4
7.3	accept a sensible practical suggestion eg • complete the investigation standing up • use (slightly) cooler water • do not touch the hot cube	do not accept use cold water pour water in carefully is insufficient ignore wear safety goggles or gloves	1	AO2/2 4.6.2.2 WS2.4
7.4	distance between each side (of the cube) and the (infrared) detector	allow distance between cube and detector	1	AO1/2 4.6.2.2 WS2.2
7.5	measurements (for each surface) have not been repeated (to show that they cluster closely)	do not accept any answer for measurement should be repeated for any reason other than to show they cluster eg to show accuracy / average / anomalies would be wrong	1	AO3/3b 4.6.2.2 WS3.7
7.6	(the student) could not conclude that black surfaces always emit more (infrared) than a white surface (as) the reading for the matt white and shiny black would both be 66 (°C)	a (matt) white surface (appears to) emit(s) the same amount (of infrared) as a (shiny) black surface the conclusion is wrong is insufficient allow (as) the reading for the matt white and shiny black would be the same	1 1	AO3/1a/2b 4.6.2.2 WS2.2
7.7	0.0	allow 0 allow zero	1	AO1/1 4.6.3.1

7.8	at night, more radiation is emitted from the Earth than absorbed from space cloud reflects radiation (towards the Earth) at A, (there is no cloud cover so) a larger proportion of radiation will be emitted into space	 allow solar radiation for radiation 	1 1 1	AO1/1 4.6.3.2
Total			**12**	

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
8.1	longer arrow pointing vertically downwards	one arrow only	1	AO2/1 4.5.1.4 4.5.6.1.5
	labelled weight	allow (force of) gravity	1	AO1/1 4.5.6.1.5
8.2	initially air resistance is less than weight / gravity so the skydiver accelerates	allow drag for air resistance allow increased velocity / speed for accelerates	1	AO3/1a AO1/1 AO2/1 4.5.6.1.4
	acceleration causes the air resistance to increase	acceleration **or** increased velocity / speed is not required here if given in the first mark point	1	4.5.6.1.5 4.5.6.2.1
	resultant force decreases to zero	allow air resistance becomes equal to weight / gravity	1	
	so the skydiver falls at terminal velocity	allow constant velocity/speed for terminal velocity ignore any mention of subsequent motion and use of parachute	1	
8.3		an answer of 50 (m/s) scores **3** marks		AO2 4.5.6.1.4
	distance at 7s = 200 (m) distance at 12s = 450 (m)	**both** distances required	1	
	speed = $\frac{450 - 200}{12 - 7}$ **or** $\frac{250}{5}$	allow correct use of their two distances divided by 5	1	
	50 (m/s)	allow an answer consistent with their two distances	1	

8.4	The higher the altitude the less dense the air so the air resistance on the skydiver (falling from 39000m) was less (at the same speed) so the skydiver was able to accelerate for longer before reaching (a higher) terminal velocity **or** so the skydiver was able to accelerate for longer before air resistance = weight / gravity	 allow constant velocity/speed for terminal velocity	1 1 1	AO1/1 4.5.5.2 AO1/1 AO2/1
Total			**12**	

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
9.1	chicken	allow a correct answer indicated in Table 3 provided the answer space in blank	1	AO3
9.2	2×10^{-6}		1	AO1/1 4.5.6.1.2 WS4.4
9.3		an answer 0.025 (m) scores **4** marks		AO2/1 4.6.1.5 4.5.6.1.2
	time = 8μs = 8×10^{-6} (s) or 4 × their answer to 9.2	subsequent marks may be scored if the number of squares is miscounted or t = 2μs is used	1	
	distance = ½ × 6300 × 8×10^{-6}	allow 8×10^{3} or 8×10^{-3} or 8×10^{-9} for 8×10^{-6}	1	
	distance = 0.0252 (m)	allow a correctly calculated answer using 8×10^{3} or 8×10^{-3} or 8×10^{-9}	1	
	distance = 0.025 (m)	allow a calculated value correctly rounded to 2 sig figs an answer 0.050 (m) scores **3** marks an answer 0.05 or 0.0504 (m) scores **2** marks	1	
9.4	to convert (the pressure variations in) sound (waves) into variations in current / p.d	allow electrical signal for variations in current / p.d. do not accept amplifies sound	1	AO1/1 4.7.3.3

9.5	sound (waves) cause the diaphragm to vibrate	diaphragm moves is insufficient	1	AO1/1 4.7.3.3
	the diaphragm causes the coil / wire to vibrate	do not accept moves the coil / wire up and down if m.p.1 and m.p.2 do not score, allow sound (waves) cause the coil / wire to vibrate for **1** mark	1	
	the coil / wire moves through the magnetic field **or** the coil / wire cuts magnetic field lines		1	
	a potential difference is <u>induced</u> (across the ends of the coil / wire)	allow <u>induced</u> current for <u>induced</u> p.d.	1	
Total			**11**	

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	the (perpendicular) distance from the pivot / hinge to (the line of action of) the force is greater	allow distance from the rope to the pivot / hinge is greater (than distance between handle and pivot / hinge)	1	AO2/1 4.5.4
	so a smaller force is required	this mark is dependent on scoring the 1st mark an answer a smaller force is required at the rope to produce the same moment scores **2** marks	1	
10.2		an answer of 770 scores **6** marks		AO2/1 4.5.4 4.5.3
	$924 = F \times 0.15$		1	
	$F = 6160$ (N)	allow use of $E = ½ F e$ instead of $k = F \div e$ and $E = ½ \times k \times e^2$	1	
	$6160 = k \times 0.25$	allow their calculated $F = k \times 0.25$	1	
	$k = \frac{6160}{0.25}$ **or** $k = 24640$ (N/m)	allow a value for k calculated using their calculated F	1	
	$E = \frac{½ \times 6160 \times 0.25 \times 0.25}{0.25}$	allow $E = ½ \times$ their calc. $k \times 0.25^2$	1	
	$E = 770$ (J)	allow an answer consistent with their calculated k	1	
Total			**8**	