AS PHYSICS 7407/2

Paper 2

Mark scheme

June 2025

Version: 1.0 Final

256A7407/2/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.

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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Physics - Mark scheme instructions 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 and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

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

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.

3. Marking points

3.1 Marking of lists
This applies to questions requiring a set number of responses, but for which candidates 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 (often prefaced by 'Ignore' in the mark scheme) are not penalised.

3.2 Marking procedure for calculations

Full marks can usually be given for a correct numerical answer without working shown unless the question states 'Show your working'. However, if a correct numerical answer can be evaluated from incorrect physics then working will be required. The mark scheme will indicate both this and the credit (if any) that can be allowed for the incorrect approach.
However, if the answer is incorrect, mark(s) can usually be gained by correct substitution/working and this is shown in the 'extra information' column or by each stage of a longer calculation.

A calculation must be followed through to answer in decimal form. An answer in surd form is never acceptable for the final (evaluation) mark in a calculation and will therefore generally be denied one mark.

3.3 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.

3.4 Errors carried forward, consequential marking and arithmetic errors

Allowances for errors carried forward are likely to be restricted to calculation questions and should be shown by the abbreviation ECF or *conseq* in the marking scheme.

An arithmetic error should be penalised for one mark only unless otherwise amplified in the marking scheme. Arithmetic errors may arise from a slip in a calculation or from an incorrect transfer of a numerical value from data given in a question.

3.5 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited (eg fizix) **unless** there is a possible confusion (eg defraction/refraction) with another technical term.

3.6 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.

3.7 Ignore / Insufficient / Do <u>not</u> allow

'Ignore' or 'insufficient' 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.

'Do **not** allow' means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

3.8 Significant figure penalties

Answers to questions in the practical sections (7407/2 – Section A and 7408/3A) should display an appropriate number of significant figures. For non-practical sections, an A-level paper may contain up to 2 marks (1 mark for AS) that are contingent on the candidate quoting the **final** answer in a calculation to a specified number of significant figures (sf). This will generally be assessed to be the number of sf of the datum with the least number of sf from which the answer is determined. The mark scheme will give the range of sf that are acceptable but this will normally be the sf of the datum (or this sf −1).

An answer in surd form cannot gain the sf mark. An incorrect calculation **following some working** can gain the sf mark. For a question beginning with the command word 'Show that…', the answer should be quoted to **one more** sf than the sf quoted in the question eg 'Show that X is equal to about 2.1 cm' – answer should be quoted to 3 sf. An answer to 1 sf will not normally be acceptable, unless the answer is an integer eg a number of objects. In non-practical sections, the need for a consideration will be indicated in the question by the use of 'Give your answer to an appropriate number of significant figures'.

3.9 Unit penalties

An A-level paper may contain up to 2 marks (1 mark for AS) that are contingent on the candidate quoting the correct unit for the answer to a calculation. The need for a unit to be quoted will be indicated in the question by the use of 'State an appropriate SI unit for your answer'. Unit answers will be expected to appear in the most commonly agreed form for the calculation concerned; strings of fundamental (base) units would not. For example, 1 tesla and 1 Wb m^{-2} would both be acceptable units for magnetic flux density but 1 kg m^2 s^{-2} A^{-1} would not.

3.10 Level of response marking instructions

Level of response mark schemes are broken down into three 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.

Determining 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 2 with a small amount of level 3 material it would be placed in level 2.

The exemplar materials used during standardisation will help you to determine the appropriate level. 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.

Question	Answers	Additional comments/Guidance	Mark	AO
01.1	sensible relevant precaution ✓	e.g. stand behind laser when in use; avoid looking directly at the beam or at reflections put up a warning sign; turn off when not in use ensure laser is secure when in use; operate above (or below) eye level avoid shining at reflective surfaces allow 'laser safety glasses/goggles' Reject 'wear safety glasses/goggles'. Reject 'don't point laser at other people's eyes' OWTTE.	1	AO1

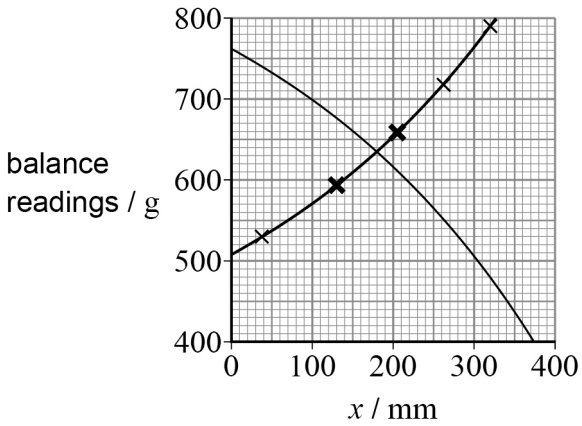
Question	Answers	Additional comments/Guidance	Mark	AO
01.2	(Δx =) 553 – 60 = 493 mm $_1$✓ $\frac{10}{their\ \Delta x} \times 100$ (%) $_2$✓	For $_1$✓ and $_2$✓ evidence needs to be seen. For $_2$✓ 1 or 2 sf only. For $_2$✓ expect 2.0% from 493 mm	2	1 × AO1 1 × AO3

Question	Answers	Additional comments/Guidance	Mark	AO
01.3	Max 2 from set of cognitive steps: $_1$✓ $_2$✓ determines tan θ **OR** θ **OR** sin θ $_a$✓ $d = \frac{10^{-3}}{300}$ or 3.33×10^{-6} (m) $_b$✓ use of $n\lambda$ = their d × their sin θ $_c$✓ attempts to use two determinations of λ (for accuracy) $_d$✓ λ in range 6.2 to 6.4 × 10^{-7} (m) $_3$✓	Only the $_b$✓ mark is permissible for use of 2-source equation. For $_a$✓: $n = 1$ $\tan\theta_1 = \frac{0.232}{1.20}$ **OR** 0.193; $\theta_1 = 10.9(°)$; $\sin\theta_1 = \frac{0.232}{\sqrt{0.232^2 + 1.20^2}}$ **OR** 0.190 $n = 2$ $\tan\theta_2 = \frac{0.493}{1.20}$ **OR** 0.411; $\theta_2 = 22.3(°)$; $\sin\theta_2 = \frac{0.493}{\sqrt{0.493^2 + 1.20^2}}$ **OR** 0.380 For $_b$✓ do not condone POT error or omission; condone '*s*' for '*d*'. For $_c$✓ condone POT omission for d or substitution of $\frac{1}{300}$ for $_c$✓ 'use of' means full substitution with λ as only unknown; condone mismatch of their θ for with n. For $_3$✓ allow ecf for their Δx from **01.2**	3	2 × AO2 1 × AO3

Question	Answers	Additional comments/Guidance	Mark	AO
01.4	valid method to determine distance from grating to screen $_1$✓	$_2$✓ depends on $_1$✓ Zero marks for use of 2-source equation. For $_1$✓ accept a similar triangles approach, e.g. $L = 1.20 \times \frac{(0.)400}{(0.)232}$ with one substitution error. **OR** Use of tan $\theta = \frac{0.400}{L}$ (= 0.193) with one substitution error. Allow use of their □ **OR** Uses Pythagoras theorem from a determination of a hypotenuse.	2	AO3
	value that rounds to 2.1 (m) $_2$✓	For $_2$✓ allow ecf if θ is calculated from their wavelength in **01.3**		
Total			**8**	

Question	Answers	Additional comments/Guidance	Mark	AO
02.1	all correct ✓	*b* = (vernier) calipers / travelling microscope *c* = (metre) ruler *d* = micrometer (screw gauge) / screw gauge / <u>digital</u> (vernier) calipers	1	AO1

Question	Answers	Additional comments/Guidance	Mark	AO
02.2	Max 2 from: $_1$✓ $_2$✓ use set square against the bench to make metre ruler vertical $_a$✓ measure the vertical distance between the bench and the line at (two) different points $_b$✓ check that these distances are the same/equal $_c$✓	For $_a$✓ condone tee square (for set square); allow 'ground/floor' for 'bench'. For $_b$✓ insist on 'vertical' if $_a$✓ not scored. For $_b$✓ allow measure 'height' for 'vertical distance'.	2	AO1

Question	Answers	Additional comments/Guidance	Mark	AO
02.3	either point plotted in their correct minor grid square **AND** smooth curve of increasing gradient **OR** both points plotted in their correct minor grid squares $_1$✓ both points plotted in their correct grid squares **AND** smooth curve of increasing gradient $_2$✓  	The line must pass through all 5 points. Withhold 1 mark for: either point thick / faint / a blob **OR** a thick / faint / discontinuous line For $_1$✓ allow a best-fit line consistent with their incorrect plot(s).	2	AO2

Question	Answers	Additional comments/Guidance	Mark	AO
02.4	determines beam mass by adding one reading of m_1 and of m_2 at a common value of x $_1$✓ determines beam mass from at least two pairs of values of m_1 and m_2 $_2$✓	For $_1$✓ allow missing best-fit line from **02.3** For $_2$✓ may see mean average determined, or a comparison of two identical values. Theory gives beam mass = 1270 (g)	2	AO3

Question	Answers	Additional comments/Guidance	Mark	AO
02.5	suitable evidence of working $_1$✓ e in range 350 to 370 (mm) $_2$✓	For $_1$✓ evidence of working is: use of c = 900 and their x (based on where their best-fit line intersects the curve on **Figure 5**). For $_1$✓ only allow readings of x to half-square resolution (i.e. 5 mm). For $_2$✓ theory gives e = 360 (mm). For $_2$✓ allow ecf from **02.3**	2	AO3

Question	Answers	Additional comments/Guidance	Mark	AO
02.6	idea that (all) values of m_1 in the graph will increase because mass of support now included ✓	Allow 'same gradient but greater y-intercept'. Reject references to change in gradient. Condone 'weight' for mass of support. May see reference to inclusion of mass of support in answer to **02.7**	1	AO1

Question	Answers	Additional comments/Guidance	Mark	AO
02.7	e is larger because x (when $m_1 = m_2$) is a smaller value $_1$✓ idea that the lines (for m_1 and m_2) intersect at a smaller value of x $_2$✓	Allow ecf for incorrect trend given in **02.6** For $_2$✓ allow mass of support shifts centre of mass of system to left OWTTE. Condone consistent conclusions based on a change in gradient. If no other mark, allow 1 mark for 'e is smaller because lines intersect at a larger value of x'.	2	AO3
Total			**12**	

Question	Answers	Additional comments/Guidance	Mark	AO
03.1	algebraic explanation of power for either battery or internal resistance $_1$✓ explanation of three terms with relevant statement about conservation of energy/power (in the circuit) $_2$✓	Allow 1 mark for identifying all 3 terms with the relevant components without equation(s) quoted. For $_1$✓ expect to see: 'power of battery/total power $= VI = 12I$' 'power of internal resistance $= I^2r = I^2 0.037$' For $_2$✓ expect to see: 'power of lamps $(= 2 \times 65) = 130$'	2	1 × AO1 1 × AO2

Question	Answers	Additional comments/Guidance	Mark	AO
03.2	full substitution into equation for quadratic solution **OR** rearranges the given quadratic equation to equal zero **and** states that $a = 0.037$; $b = -12$; $c = 130$ $_1$✓ 11.2 (A) $_2$✓	For $_1$✓ condone missing minus sign for b in substitution. For $_2$✓ calculator value = 11.2216 A	2	1 × AO1 1 × AO2

Question	Answers	Additional comments/Guidance	Mark	AO
03.3	uses $P = I^2R$ **OR** uses $P = \frac{V^2}{R}$ **OR** uses $\varepsilon = I(R + r)$ **OR** $V = IR$ $_1$✓ 2.1 or 2.2 (Ω) $_2$✓	For $_1$✓ expect V = 11.58 V (from 11.22 A) or 11.59 V (from 11 A) For $_1$✓ load resistance (of lamps) = 1.05 Ω For $_1$✓ if $V=IR$ used, at least one value must be correct. Expect V=11.6 V or I =5.5 or 5.6 A. 1 max for 2.2 Ω from incorrect method of $\frac{12^2}{65}$ For $_2$✓ expect 2.06 Ω when using 11.22 A or 2.15 Ω when using 11 A.	2	1 × AO1 1 × AO2

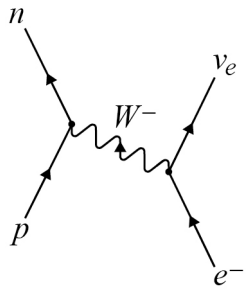
Question	Answers	Additional comments/Guidance	Mark	AO
03.4	$R_{\mathbf{X}}$ increases (due to diameter/area decrease) $_1$✓ effect of their change in $R_{\mathbf{X}}$: on the (total) current **OR** on the ratio of load resistance to internal resistance $_2$✓ effect on terminal pd in terms of: change in (total) current **OR** the division of emf between internal resistance and load resistance $_3$✓ effect of change in terminal pd on power of **Y** in terms of $P = \frac{V^2}{R}$ $_4$✓	$_2$✓ $_3$✓ and $_4$✓ may be awarded from an incorrect statement for $_1$✓, if accurate and consistent. e.g. for $_2$✓ 'load resistance increases so total current decreases'. Allow $_2$✓ if a reference to 'current' implies the 'total current'. e.g. for $_3$✓ 'decreased fraction of internal resistance means greater terminal pd'. For $_3$✓ allow reference to 'lost volts' when explaining effect on terminal pd.	4	AO3
Total			**10**	

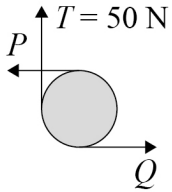
Question	Answers	Additional comments/Guidance	Mark	AO
04.1	attempt to determine horizontal component of velocity **OR** multiplies their speed by 1.7 (s) $_1$✓ 4.5 (m) $_2$✓	For $_1$✓, $\frac{8.7}{\tan 73°}$ or $8.7\tan 17°$ or 2.66 m s^{-1} seen. For $_1$✓: for their speeds accept only the horizontal component (2.66 m s^{-1}) or the initial speed ($\frac{8.7}{\sin 73°}$ or 9.0975 m s^{-1}). Condone $8.7\cos 73°$ (2.54 m s^{-1}). For $_2$✓ calculator value = 4.52176 (m)	2	AO2

Question	Answers	Additional comments/Guidance	Mark	AO
04.2	Max 2 from: $_1$✓$_2$✓ use of $s = ut + \frac{1}{2}at^2$ $_a$✓ consistent use of vector signs for u and a in above equation $_b$✓ correctly takes into account of 3.1 m (e.g. uses $s = 3.1 – h$) $_c$✓ 2.5 (m) $_3$✓	For $_a$✓ must see substitution of 1.7 for t and a value for u. Expect u = 8.7; condone $8.7\sin 73°$. Allow g/9.8/9.81 for a. Allow alternative method for $_a$✓ and $_b$✓: use of suvat equations to get time to max height (expect 0.887 s from 3.858 m) ✓ uses 1.7 – their calculated t to get distance from max height to basket (expect 3.243 m) ✓ 2.5 (m) with some relevant working gets all 3 marks	3	AO2

Question	Answers	Additional comments/Guidance	Mark	AO
04.3	(lower launch angle means) larger horizontal component of (initial) velocity **OR** smaller vertical component of (initial) velocity 1✓ (so) shorter time of flight, so fewer images 2✓	Condone 'speed' for 'velocity'.	2	AO3

Question	Answers	Additional comments/Guidance	Mark	AO
04.4	Max 3 from: 1✓ 2✓ 3✓ idea that (magnitude of) air resistance depends on speed **OR** that air resistance (always) acts against direction of motion a✓ idea that, when s_v is increasing, a_v is larger (than $g/9.81$) because air resistance acts downwards / same direction as weight b✓ idea that, when s_v is decreasing, a_v is smaller (than $g/9.81$) because air resistance acts upwards / in opposite direction to weight c✓ description of how a_v changes (because of air resistance) with speed during increasing s_v or decreasing s_v d✓	For b✓ or c✓ allow comparison that a_v during increasing s_v is greater than a_v during decreasing s_v e.g. for d✓ 'as s_v decreases, a_v decreases as the speed increases'	3	1 × AO1 2 × AO2
Total			**10**	

<table>
<tr><th>Question</th><th>Key</th><th>Answer</th><th>AO</th></tr>
<tr><td>5</td><td>C</td><td>730 Hz</td><td>AO2</td></tr>
<tr><td>6</td><td>D</td><td>10^3</td><td>AO1</td></tr>
<tr><td>7</td><td>A</td><td>N was replaced with a resistor of greater resistance.</td><td>AO2</td></tr>
<tr><td>8</td><td>D</td><td>
</td><td>AO1</td></tr>
<tr><td>9</td><td>C</td><td>64 m s^{-1}</td><td>AO1</td></tr>
<tr><td>10</td><td>D</td><td>1.6×10^{15} Hz</td><td>AO2</td></tr>
<tr><td>11</td><td>A</td><td>zero</td><td>AO2</td></tr>
<tr><td>12</td><td>A</td><td><table><tr><td>polarised</td><td>vertical</td></tr></table></td><td>AO1</td></tr>
<tr><td>13</td><td>D</td><td><table><tr><td>time for X > time for Y</td><td>upward force on X > upward force on Y</td></tr></table></td><td>AO2</td></tr>
</table>

14	**B**	421 nm	AO1
15	**A**	50 | towards centre	AO2
16	**B**	4	AO2
17	**C**	$\mathrm{W\ s^{-2}}$	AO1
18	**C**	**C**	AO2
19	**B**	the change in momentum of the object.	AO1
20	**A**	$v \propto \sqrt{x}$	AO2
21	**B**	X_{P}	AO1
22	**A**	They can be polarised.	AO1
23	**D**		AO2
24	**D**	$\frac{AEx^2}{2L}$	AO2

25	**D**	$mg\sin\theta = F\cos\theta$	AO2
26	**C**	5 A	AO1
27	**B**	6.8%	AO2
28	**B**	29 | 28	AO1
29	**C**	2ρ | $8m$	AO1
30	**C**	4.8 W	AO2
31	**A**	$10Fv$	AO2
32	**C**	7 | 8	AO1
33	**B**	3.0 kΩ	AO2
34	**C**	88 kW	AO2

Total – 30 marks