

INTERNATIONAL A-LEVEL PHYSICS

PH05

Unit 5 Physics in practice

Mark scheme

June 2026

Version: 1.0 Final

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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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.

Question	Answers	Additional comments/Guidelines	Mark	AO
01.1	<p>h measured using a micrometer/digital callipers ✓</p> <p>w measured with vernier/digital callipers (condone micrometer) ✓</p> <p>L is 0.305 – reading on L from where the ruler meets the clamp ✓</p> <p>For h OR w repeat at different positions along the ruler and average ✓</p>	<p>In MP4: Ignore references to parallax error. Allow a description of how to remove zero error.</p>	4	<p>2 × AO3</p> <p>2 × AO4</p>

Question	Answers	Additional comments/Guidelines	Mark	AO
01.2	<p>Any one from: ✓</p> <ul style="list-style-type: none"> • correct determination of either reading (38.3 or 38.8) • subtract their two values. <p>0.5 (mm) ✓</p>	<p>Allow PoT error in MP1.</p> <p>Allow full marks for 0.5 mm alone</p> <p>1SF only</p>	2	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
01.3	Gradient calculation ✓ ₁ With $\Delta m \geq 0.5 \text{ kg}$ ✓ ₂ Use of $E = \frac{4gL^3}{wh^3 \times \text{gradient}}$ ✓ ₃ $1.90 \times 10^{11} \text{ to } 1.99 \times 10^{11} \text{ (Pa)}$ ✓ ₄	Condone minor misreads in points Condone for use of a single point max 2 $m \geq 0.5 \text{ kg}$ ✓ ₁₂ $1.83 \times 10^{11} \text{ to } 1.92 \times 10^{11} \text{ (Pa)}$ ✓ ₃₄ $\geq 3 \text{ SF required.}$	4	AO3

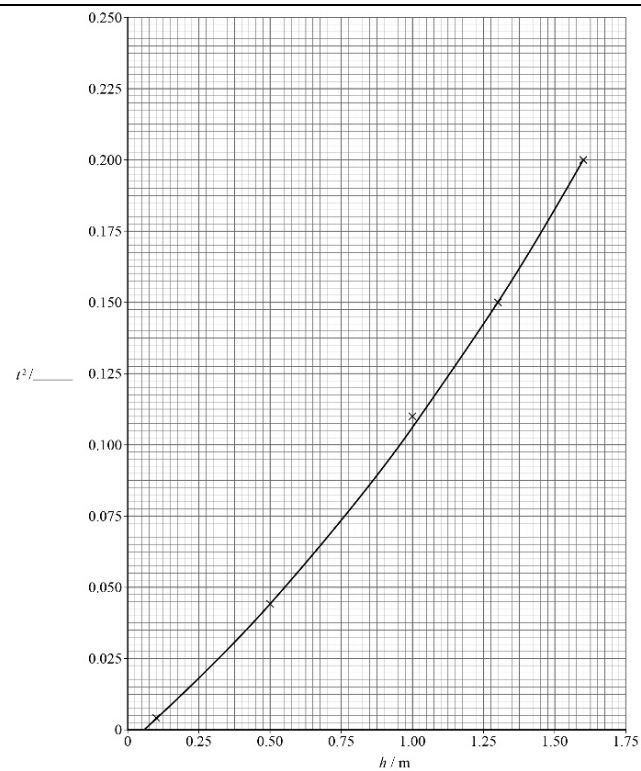
Question	Answers	Additional comments/Guidelines	Mark	AO
01.4	Any three from: ✓✓✓ • use of time base with their number of boxes for nT for integer n • determine T from nT for integer $n \geq 2$ (expect $4T$) • use of $f = \frac{1}{T}$ for their T • use of $f = k \sqrt{\frac{E_2}{\mu L_2^4}}$ for their f $2.0 \times 10^{11} \text{ to } 2.3 \times 10^{11} \text{ (Pa)}$ ✓	In bp1 and mp4 assume whole number of T unless their number of boxes is divided by a non-integer or $T = 80 \text{ ms}$ is used. For bp1 condone any one of: • T in range 17 to 18 ms • $2T$ in range 34 to 36 ms • $3T$ in range 52 to 54 ms • $4T$ in range 70 to 72 ms	4	AO3

Total			14	
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Question	Answers	Additional comments/Guidelines	Mark	AO
02.1	s^2 ✓	Do not allow different units in Table 1 and Figure 1	1	AO1

Question	Answers	Additional comments/Guidelines	Mark	AO
02.2	Correct value and SF for both values: 0.004, 0.044✓		1	AO3

Question	Answers	Additional comments/Guidelines		Mark	AO												
02.3	Suitable scales ✓				4	AO4											
	Accurate points plotted																
	Check 2 nd and 3 rd points and any that obviously wrong ✓✓																
	Curved line of best fit ✓																
	<table><tr><th><i>h</i> / m</th><th><i>t</i>² / s²</th></tr><tr><td>0.100</td><td>0.004</td></tr><tr><td>0.500</td><td>0.044</td></tr><tr><td>1.000</td><td>0.11</td></tr><tr><td>1.300</td><td>0.15</td></tr><tr><td>1.600</td><td>0.20</td></tr></table>	<i>h</i> / m	<i>t</i> ² / s ²	0.100	0.004	0.500	0.044	1.000	0.11	1.300	0.15	1.600	0.20				
<i>h</i> / m	<i>t</i> ² / s ²																
0.100	0.004																
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1.000	0.11																
1.300	0.15																
1.600	0.20																



Question	Answers	Additional comments/Guidelines	Mark	AO
02.4	Any three from: ✓✓✓ • the graph is not a straight line / is a curve (and $h = \frac{1}{2}gt^2$ suggests it should be a straight line) • the line does not pass through the origin (and $h = \frac{1}{2}gt^2$ suggests it should pass through the origin) • the initial speed / speed through light gate (1) is not 0 • dropped from a small distance above the top light gate • correct reference to $h = ut + \frac{1}{2}at^2$	If answers states the graph does support the equation $h = \frac{1}{2}gt^2$ MAX 2. Condone calculating gradient and stating it is not equal to $\frac{2}{9.81} = 0.20$. Allow s for h . If no other marks awarded, allow MAX 1 for the graph should be a straight line that passes through the origin. Ignore references to friction and air resistance.	3	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
02.5	Set square placed against floor and ruler OR use of a plumb line, ruler should be (close to and) parallel to plumb line ✓ Along 2 sides ✓	Answer may come from diagram or text. Condone correct description of how to use a spirit level or protractor.	2	AO4

Question	Answers	Additional comments/Guidelines	Mark	AO
02.6	<p>Any three from: ✓✓✓</p> <ul style="list-style-type: none"> distance s_1 fallen between Figure 12a and Figure 12b $s_1 = \text{their Figure 12b top} - \text{their Figure 12a top}$ $(= 81.4 - 2.2 = 79.2 \text{ cm})$ OR $s_1 = \text{their Fig 12b bottom} - \text{their Fig 12a bottom}$ $(= 88.3 - 6.5 = 81.8 \text{ cm})$ OR $s_1 = \text{their mean Figure 12b} - \text{their mean Figure 12a}$ $(= \frac{88.3+81.4}{2} - \frac{6.5+2.2}{2} = 80.5 \text{ cm})$ distance s_2 fallen during Figure 12b $s_2 = (\text{Figure 12b: their bottom} - \text{their top})$ $- (\text{Figure 12a: their bottom} - \text{their top})$ $(= (88.3 - 81.4) - (6.5 - 2.2) = 6.9 - 4.3 = 2.6 \text{ cm})$ speed at start u or end v or mean $\bar{v}$ of Figure 12b use of $v = \sqrt{2gs_1}$ for their s_1 or equivalent $(u = 3.94 \text{ m s}^{-1} \text{ or } v = 4.01 \text{ m s}^{-1} \text{ or } \bar{v} = 3.97 \text{ m s}^{-1})$ calculation of time Δt during Figure 12b use of $s_2 = u\Delta t + \frac{1}{2}g\Delta t^2$ with their s_2 and their speed OR use of $s_2 = v\Delta t - \frac{1}{2}g\Delta t^2$ with their s_2 and their speed OR use of $v = \frac{s}{t}$ with their s_2 and their speed <p>$6.5 \times 10^{-3} \text{ (s)}$ or $6.6 \times 10^{-3} \text{ (s)}$ ✓</p>	<p>Condone minor reading errors and rounding errors in the bullet points.</p> <p>Readings: Figure 12a top = 2.2 cm Figure 12a bottom = 6.5 cm Figure 12b top = 81.4 cm Figure 12b bottom = 88.3 cm</p> <p>Alternative 1 Any three from: ✓✓✓</p> <ul style="list-style-type: none"> distance from top of Fig 12a to top of Fig 12b $s_3 = 81.4 - 2.2 (= 79.2 \text{ cm})$ distance from bottom of Fig 12a to bottom of Fig 12b $s_4 = 88.3 - 6.5 (= 81.8 \text{ cm})$ time from top of Fig 12a to top of Fig 12b $t_3 = \sqrt{\frac{2 \text{ their } s_3}{g}} \left(= \sqrt{\frac{2 \times 79.2}{9.81}} = 0.40183 \text{ s} \right)$ time from bottom of Fig 12a to bottom of Fig 12b $t_4 = \sqrt{\frac{2 \text{ their } s_4}{g}} \left(= \sqrt{\frac{2 \times 79.2}{9.81}} = 0.40837 \text{ s} \right)$ <p>$\Delta t (= t_4 - t_3) = 6.5 \times 10^{-3} \text{ (s)}$ or $6.6 \times 10^{-3} \text{ (s)}$ ✓(s) ✓</p> <p>Alternative 2 bp1 and bp2 as alternative 1</p> <ul style="list-style-type: none"> speed u at start of Fig 12b $u = \sqrt{2g \text{ their } s_3} (= \sqrt{2 \times 9.81 \times 79.2} = 3.94 \text{ s})$ or equivalent speed v at end of Fig 12b $v = \sqrt{2g \text{ their } s_4} (= \sqrt{2 \times 9.81 \times 81.8} = 4.01 \text{ s})$ or equivalent <p>$\Delta t \left(= \frac{v-u}{a} \right) = 6.5 \times 10^{-3} \text{ or } 6.6 \times 10^{-3} \text{ (s)}$ ✓</p>	4	1 × AO1 1 × AO2 2 × AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
02.7	<p>The distance will be larger because and any one of: ✓</p> <ul style="list-style-type: none"> Idea that the smartphone, the ball and (the marking on) the ruler will not be (close to) horizontal (in at least one image) Idea that (in at least one image) smartphone will not be perpendicular to ball and ruler marking Idea that the ball will cover more of the ruler (as it too close to the smartphone) 		1	AO4
Total			16	

Question	Answers	Additional comments/Guidelines	Mark	AO
03.1	Time nT and divide by n for $n \geq 10$ OR correct use of a fiducial marker ✓	Allow idea of recoding video and play back in slow motion or freeze frame.	1	AO4

Question	Answers	Additional comments/Guidelines	Mark	AO
03.2	<p>Any two from: ✓✓</p> <ul style="list-style-type: none"> determine correct percentage uncertainty for T or r $2 + 1 +$ their % uncertainty in $r + 2 \times$ their % uncertainty in T determines absolute uncertainty in g using their g or 9.81 and their % uncertainty in g. <p>$g = 10 \pm 1 \text{ (m s}^{-2}\text{)} \checkmark$</p>	<p>% uncertainty in $T = 5(.13) \%$ % uncertainty in $r = 0.7\% (0.67\%)$ Allow use of fractional uncertainties in BP1 and BP2.</p> <p>Alternative method</p> <p>Any two from: ✓✓</p> <ul style="list-style-type: none"> calculation of max g using max m and r and min M and T (11.2) calculation of max g using min m and r and max M and T (8.5) uncertainty = $\frac{\text{max } g - \text{min } g}{2}$ <p>Do not allow ≥ 3 SF Allow $g = 9.7 \pm 1.4 \text{ (m s}^{-2}\text{)}$</p>	3	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
03.3	<p>Friction adds to the weight in contributing to the centripetal force</p> <p>OR</p> <p>Friction increases the centripetal force</p> <p>OR</p> <p>weight + friction = centripetal in words or symbol form in any arrangement ✓</p> <p>Idea that the student is correct and one from: ✓</p> <ul style="list-style-type: none"> • period is smaller with some justification eg $T^2 = \frac{4\pi^2 mr}{Mg + \text{friction}}$ • calculated weight is larger than the weight of M. 	Allow tension for centripetal force in MP1.	2	AO4
Total			6	

Question	Answers	Additional comments/Guidelines	Mark	AO
04.1	<p>Any five from: ✓✓✓✓✓</p> <ul style="list-style-type: none"> • accelerated electrons collide with Xe / electrode atoms and give them energy • Xe atoms get excited • Idea that de-excitation emits photons • energy of photon = energy difference between levels • idea that many different paths / transitions so produce a mixture of different energies / wavelengths / frequencies • link between wavelength/frequency and energy, so a mixture of different wavelengths/frequency to produce white light. • electrons/ions decelerating due to collisions with xenon ions/electrodes releases photons/reference to Bremsstrahlung radiation • (allow idea that black body / thermal radiation due to high temperature plasma / hot electrodes) 	<p>Allow electrons in Xe atoms or Xe ions for bp2 and bp3</p> <p>Ignore references to a coating.</p> <p>Allow $hf = E_2 - E_1$ for bp4</p> <p>A reference to multiple energy levels is not enough for different paths / transitions in bp5</p>	5	AO1

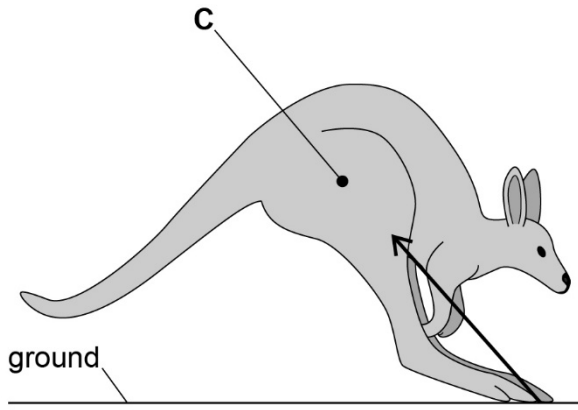
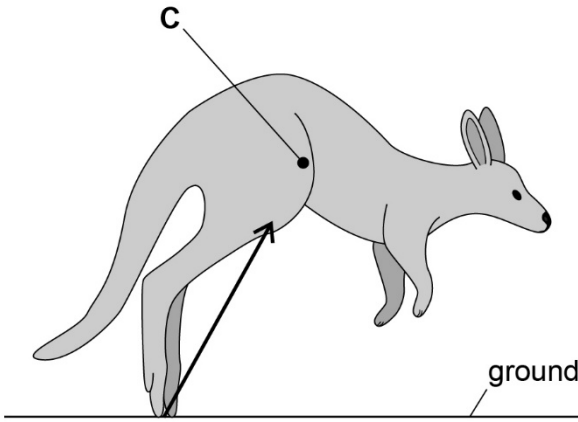
Question	Answers	Additional comments/Guidelines	Mark	AO
04.2	<p>Use of $\frac{A_1}{r_1^2} = \frac{A_2}{r_2^2}$ or equivalent ✓</p> <p>Use of $I = \frac{P}{A}$ for their A or $A = 432 \text{ (m}^2\text{)}$ ✓</p> <p>$I = 7(.0) \times 10^{-14} \text{ W m}^{-2} < 10^{-10}$ so no ✓</p>	<p>Expect illuminated A on moon</p> $= 432 \times \frac{(3.8 \times 10^8)^2}{27^2} = 8.56 \times 10^{16} \text{ m}^2$ <p>Use of $I \propto \frac{1}{r^2}$ gains mp1 and mp2.</p> $\frac{6000}{432} = 13.9 \frac{\text{W}}{\text{m}^2}$ <p>Allow 1SF or order of magnitude (from correct calculation) comparison</p>	3	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
04.3	Max one from: ✓ • heating power = $15 - 6$ (= 9 kW) • use of $Q = mc\Delta\theta$ for their Q $\Delta\theta \left(= \frac{9000 \times 60}{22 \times 4200} \right) = 5.8 \text{ (K)} \checkmark$		2	AO1

Question	Answers	Additional comments/Guidelines	Mark	AO
04.4	Any two from: ✓✓ • (polaroid filter in front of) lamp produces polarised light • only light aligned with polaroid filter in glasses makes it through to eye / only light from the projector whose filter aligns with the filter in the glasses makes it through to eye • (two) polaroid filters in front of lamps or in glasses are orientated at 90° to each other.	allow glasses filter that is perpendicular to projector filter / polarisation of light blocks light. Condone the idea that glasses filters are aligned to projector filters and so each eye can only see one screen.	2	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
04.5	Glasses polariser no longer aligned or perpendicular to projector/light polarisation (so lets some of both images through) ✓	Do not allow the idea that no light makes it through / no image can be seen.	1	AO2
Total			13	

Question	Answers	Additional comments/Guidelines	Mark	AO
05.1	Horizontal motion: $t = \frac{s}{v}$ with 6 m or 3 m ✓ Vertical motion: correct use of appropriate equation of motion with their t ✓ 0.93 (m) ✓	Expect 0.43 for 3 m (0.86 for 6 m) eg $s = vt - \frac{1}{2}at^2 = 0 - 0.5 \times (-9.81) \times 0.43^2$ or use of $v = u + at$ and $s = ut + \frac{1}{2}at^2$	3	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
05.2	<p>Both forces drawn with a ruler starting where the feet contact the ground, so that the line of action passes through C ✓</p> <p>Moment/torque has to be 0 ✓</p> <p>perpendicular distance between line of action of force to pivot/C = 0 ✓</p>	<p>Figure 18a</p>  <p>Figure 18b</p>  <p>Allow (line of action of) force must be through the pivot/C for MP3</p>	3	<p>1 × AO1</p> <p>1 × AO2</p> <p>1 × AO3</p>

Question	Answers	Additional comments/Guidelines	Mark	AO
05.3	Identifies the area under the graph as the (horizontal) impulse or change in (horizontal) momentum ✓ Attempts to determine either area by calculation ✓ Determines both areas (by any suitable method) and comments they have the same magnitude (and opposite signs) OR subtracts the two areas = 0 ✓ Total change in momentum/impulse = 0 so no change in speed or equivalent ✓	Allow minor read-off errors in mp1 and mp2. Allow mp2 only to come from Question 05.4 Area does not have to be evaluated for mp2. Negative area $= 0.5 \times (0.025 - 0.005) \times 5400 = -54$ Positive area $= 0.5 \times (0.115 - 0.025) \times 1200 = 54$ Allow approximately zero in mp4.	4	1 × AO2 3 × AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
05.4	Uses $mv - mu =$ either area under graph OR Area under graph ÷ mass ✓ $v \left(= 6.9 - \frac{54}{52} \right) = 5.9 \text{ (m s}^{-1}\text{)} \checkmark$	ecf from Question 05.3 5.86	2	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
05.5	Any three from: ✓✓✓ • use of $\frac{1}{2}mv^2$ • use of $\Delta E_K = \frac{1}{2} \times 52 \times (8.1^2 - 5.9^2)$ • energy stored by spring = $0.3 \times \text{their } \Delta E_K$ • use of $E = \frac{1}{2} \frac{F^2}{k}$ or equivalent 8.1×10^4 or 8.3×10^4 ✓(N m ⁻¹)	Allow 6.9 or 0 as a velocity in bp2 as long as a subtraction is shown. Conde use of E_K rather than ΔE_K in bp3 Allow ecf from Question 05.4 Use of 6.0 leads to 86000 N m ⁻¹	4	3 × AO2 1 × AO3

Total			16	
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Question	Answers	Additional comments/Guidelines	Mark	AO
06.1	Use of $d = \frac{1}{200(\times 10^3)}$ OR Use of $n\lambda = d \sin \theta$ for their d ✓ A ✓	Allow PoT errors in MP1 MP2 does not imply MP1	2	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
06.2	(Use of $E = \frac{hc}{\lambda}$ leading to) B ✓		1	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
06.3	Use of $V = -\frac{GM}{r}$ OR $E_P = (-)\frac{GMm}{r}$ seen or used ✓ $\Delta V = \Delta\left(\frac{1}{2}v^2\right)$ seen or used OR $\Delta E_k = \Delta E_P$ seen or used OR $E_{kP} + E_{PP} = E_{kQ} + E_{PQ}$ seen or used ✓ $1.97 \times 10^4 \text{ (m s}^{-1}\text{)} \checkmark$	≥ 3 SF required Condone $1.98 \times 10^4 \text{ (m s}^{-1}\text{)}$	3	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
06.4	<p>Use of $I\omega$ with $I = mr^2$ and $\omega = \frac{v}{r}$ OR angular momentum = $mr v$ seen ✓</p> <p>Calculation of $(m)rv$ or $I\omega$ for one set of values ✓</p> <p>Calculation of $(m)rv$ for both sets of data and comparison to show that angular momentum is conserved ✓</p>	<p>Allow ecf from Question 06.3</p> <p>Allow use of their m, except do not allow use of $m = 1.9 \times 10^{27}$ for MP3, condone for MP2 and MP1.</p> <p>Allow inclusion of m eg $3.6 \times 10^{12}m$</p> <p>$6.99 \times 10^7 \times 5.12 \times 10^4 = 3.6 \times 10^{12}$ $1.82 \times 10^8 \times 2.0 \times 10^4 = 3.6 \times 10^{12}$</p>	3	2 × AO1 1 × AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
06.5	<p>Zero ✓</p> <p>No change in angular momentum, so no angular acceleration OR No change in angular momentum and torque = rate of change of angular momentum OR (line of action of) force acts through centre of rotation ✓</p>	<p>Ignore references to the comet (not) rotating.</p> <p>Condone centre of Jupiter or centre of orbit for centre of rotation.</p>	2	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
06.6	Use of $E_K = \frac{1}{2}mv^2$ with $v = 5.12 \times 10^4$ OR $\rho = \frac{m}{V}$ with their m and their V ✓ 540(kg m ⁻³) ✓	Allow 1SF Allow answers that round to 540 to 2SF	2	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
06.7	Idea that smaller area with (same area of) Earth leads to larger probability ✓ Idea that until Earth is outside the area ✓	Allow answers which refer to length or uncertainty instead of area	2	AO3

Total			15	
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