

INTERNATIONAL AS PHYSICS

PH01

Unit 1 Mechanics, materials and atoms

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	The maximum force a material can withstand before it begins to undergo plastic deformation ✓	Allow stress for force. Allow a named force e.g. tension. Allow strain or extension. Allow correct description of plastic deformation.	1	AO1

Question	Answers	Additional comments/Guidelines	Mark	AO
01.2	The maximum point / force / extension / stress / strain at which a material obeys Hooke's law ✓	Condone the last point at which a (stress-strain/force-extension) graph is a straight line. Allow explanation in terms of equation if all terms named	1	AO1

Total			2	
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Question	Answers	Additional comments/Guidelines	Mark	AO
02	${}^{13}_{7}\text{N} \rightarrow {}^{13}_{6}\text{C} + {}^0_1\beta^+ + {}^0_0\nu$ <p>All symbols correct ✓</p> <p>All numbers correct ✓</p>	<p>Allow e^+ for β^+</p> <p>Allow ν_e for ν</p>	2	AO1

Total			2	
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Question	Answers	Additional comments/Guidelines	Mark	AO
03	<p>Correct substitution into $\rho = \frac{m}{V}$ for copper or zinc ✓</p> <p>Divides their total mass by their total volume ✓</p> <p>8300 (kg m⁻³) ✓</p>	<p>Expect to see:</p> <p>0.2937 kg</p> <p>0.1207 kg</p> <p>Total mass = 0.4144 kg</p> <p>(5.0×10^{-5} m³)</p> <p>Allow POT errors in mp1 and mp2</p> <p>8288 kg m⁻³</p>	3	AO2

Total			3	
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Question	Answers	Additional comments/Guidelines	Mark	AO
04	Between A and B : GPE $\rightarrow$ KE $\checkmark_1$ Between B and C : KE $\rightarrow$ EPE $\checkmark_{23}$ Between B and C : KE + GPE $\rightarrow$ EPE $\checkmark_2 \checkmark_3$	Ignore references to work done by air resistance and friction. Allow for MP1 between A and B : GPE decreasing and KE increasing Allow for MP2 between B and C : KE (increasing then) decreasing and EPE increasing Allow for MP3 between B and C : KE (increasing then) decreasing AND GPE decreasing AND EPE increasing. MP3 implies MP2 Penalise missing “potential” only once Do not allow “potential energy” or “PE” for GPE or EPE	3	2 $\times$ AO2 1 $\times$ AO3
Total			3	

Question	Answers	Additional comments/Guidelines	Mark	AO
05	<p>Uses $F = mg \sin 26^\circ$ ✓</p> <p>F correctly calculated (22 (N) from $g = 9.81 \text{ (m s}^{-2}\text{)})$ and compared with 25 (N) AND states NO the block will not slide ✓</p>	<p>Expect to see $49 \sin 26$</p> <p>Condone $g = 9.8 \text{ (m s}^{-2}\text{)}$ leading to 21.48 N if compared correctly with 25 N</p>	2	<p>1 × AO2</p> <p>1 × AO3</p>

Total			2	
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Question	Answers	Additional comments/Guidelines	Mark	AO
06.1	<p>Any one from: ✓</p> <ul style="list-style-type: none"> • 2×0.511 • 1.022 • converts an energy from MeV to J <p>$1.64 \times 10^{-13} \text{ (J)}$ ✓</p>	<p>Allow $E = mc^2$ route</p>	2	<p>1 × AO1</p> <p>1 × AO2</p>

Question	Answers	Additional comments/Guidelines	Mark	AO
06.2	<p>the force that the electron exerts on the positron is the same magnitude and in the opposite direction to the force exerted on the electron by the positron according to Newton's 3rd law ✓</p> <p>unbalanced / resultant force (on each particle) so the particle(s) accelerate according to Newton's 1st or 2nd law ✓</p>	<p>MAX 1 if law(s) are stated without references to the particles</p> <p>Allow does not travel at constant speed for accelerates</p>	2	AO1

Question	Answers	Additional comments/Guidelines	Mark	AO
06.3	<p>To conserve momentum ✓</p> <p>Idea that photons (must) travel at the speed of light OR idea that at least two photons are required to cancel momentum OR two photons with opposite direction and same (magnitude) of momentum / speed ✓</p>	<p>condone net momentum is 0 or photons cannot be at rest or photons have nonzero momentum</p> <p>Allow momentum of photon is not equal to the total momentum of the electron and positron for both marks</p>	2	AO1

Total			6	
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Question	Answers	Additional comments/Guidelines	Mark	AO
07.1	<p>Use of suvat ($u = \sqrt{2as}$) OR conservation of energy $\left(\frac{1}{2}mv^2 = mg\Delta h; \Delta h = \frac{v^2}{2g}\right) \checkmark$</p> <p>0.74 (m) $\checkmark$</p>	<p>If MP1 is awarded for a substitution directly into $v^2 = u^2 + 2as$ one of u or a must be negative. Condone for MP2.</p> <p>Use of $g = 9.81$ gives 0.73598</p> <p>Use of $g = 9.8$ give 0.73673</p>	2	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
07.2	Idea that kinetic energy is not conserved $\checkmark$	Do not allow a reference to momentum is not conserved	1	AO1

Question	Answers	Additional comments/Guidelines	Mark	AO
07.3	<p>Calculation to find horizontal velocity OR use of $2.4(1) \text{ (m s}^{-1}\text{)}$ ✓</p> <p>Use of conservation of momentum equation with either LHS or RHS correct for their initial horizontal velocity ✓</p> <p>Conservation of momentum equation with both sides correct for their initial horizontal velocity ✓</p> <p>1.7 (g) ✓</p>	<p>$2.2(m + 0.16) = 2.41m$</p> <p>Do not allow 4.5 as their initial horizontal velocity in MP2 and MP3. This does not prevent the award of MP2 for $2.2(m+0.16)$</p> <p>For MP4 condone 0.153 (g) for their use of 4.5 for initial velocity.</p>	4	<p>$2 \times \text{AO2}$</p> <p>$2 \times \text{AO3}$</p>

Question	Answers	Additional comments/Guidelines	Mark	AO
07.4	<p>Use of $F = \frac{\Delta mv}{\Delta t}$ OR $F = ma$ OR $a = \frac{\Delta v}{\Delta t}$ OR $v = u + at$ ✓</p> <p>$7.0 \text{ or } 7.1 \times 10^{-3} \text{ (N)}$ ✓</p>	<p>Expect $\frac{0.16 \times 10^{-3} \times 2.2}{50 \times 10^{-3}}$</p> <p>Other appropriate methods followed by a correct answer get full credit</p> <p>Allow ecf from 7.3</p> <p>Expect $a = 44 \text{ m s}^{-2}$</p>	2	AO2

Total			9	
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Question	Answers	Additional comments/Guidelines	Mark	AO
08.1	Charge is $43 \times 1.60 \times 10^{-19}$ OR mass is $99 \times 1.67 \times 10^{-27}$ ✓ Specific charge = 4.16×10^7 (C kg ⁻¹) ✓	Allow mass is $43 \times 1.673 \times 10^{-27} + 56 \times 1.675 \times 10^{-27}$ leading to 4.15×10^7 C kg ⁻¹ Allow use of 99u leading to 4.18×10^7 (C kg ⁻¹)	2	AO1

Question	Answers	Additional comments/Guidelines	Mark	AO
08.2	12 hours ✓		1	AO1

Question	Answers	Additional comments/Guidelines	Mark	AO
08.3	The mark scheme gives some guidance as to what statements are expected to be seen in a 1- or 2-mark (L1), 3- or 4-mark (L2) and 5- or 6-mark (L3) answer. Guidance provided in section 3.10 of the ‘Mark Scheme Instructions’ document should be used to assist in marking this question.		6	2 × AO1 1 × AO2 3 × AO3
	Mark	Criteria		
	6	All three areas covered in some detail. 6 marks can be awarded even if there is an error and/or parts of one aspect missing.		
	5	All three areas covered, at least two in detail. Whilst there will be gaps, there should only be an occasional error.		
	4	Two areas successfully discussed, or one discussed and two others covered partially. Whilst there will be several gaps, there should only be an occasional error.		
	3	One area discussed and one discussed partially, or all three covered partially. There are likely to be several errors and omissions in the discussion.		
	2	Only one area discussed or makes a partial attempt at two areas.		
	1	None of the three areas covered without significant error.		
	0	No relevant analysis.		
		A) How gamma is emitted by technetium-99m (Partial is 1/4. Full is 3/4) <ul style="list-style-type: none">• (Nucleus) is in an excited state (after emission of beta particle)• (Nucleus) de-excites• To release a photon• With energy equivalent to the change in energy from excited state to ground state B) Why gamma is the most suitable type of radiation for this scan (Partial is 1 of first 2 bullet points. Full any 3/4) <ul style="list-style-type: none">• Gamma radiation can be detected outside the body• Gamma radiation is low ionising so is therefore the least harmful to the patient• Alpha cannot pass through the body• Beta is more ionising than gamma so causes more damage to the patient C) Why technetium-99 is suitable for this scan <ul style="list-style-type: none">• Half-life should be short enough to not stay in the body too long• Idea that it must be long enough for the procedure to take place/for data to be collected		
Total			9	

Question	Answers	Additional comments/Guidelines	Mark	AO
09.1	<p>Idea that force is bigger at A than at B ✓</p> <p>Idea that the component of the weight perpendicular to the lid (and therefore the distance between the line of action of the weight and the hinge) decreases (from A to B) or the perpendicular distance between the line of action of the weight and the hinge decreases (from A to B)</p> <p>AND</p> <p>the idea of the principle of moments used ✓</p>		2	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
09.2	<p>Statement that $\cos 55^\circ$ cancels or</p> <p>One side of the moment equation correct ✓₁</p> <p>Both sides of moments equation correct:</p> <p>$(\cos 55^\circ) \frac{0.96}{2} W = (\cos 55^\circ) 0.76F$ ✓₂</p> <p>leading to 15(.49) (N) ✓₃</p>	<p>Use of $\cos 55^\circ$ in clockwise moment ✓₁</p> <p>Attempt to balance moments</p> <p>$(\cos 55^\circ) \frac{0.96}{2} W = 0.76F$ ✓₂</p> <p>Leading to 8.9 (N) ✓₃</p>	3	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
09.3	<p>Finds the height of the CoM of the lid ✓</p> <p>Use of $mgh = \text{GPE}$ (with their height) ✓</p> <p>Would not engage as $11 \text{ (J)} > 9.6 \text{ (J)}$ OWTTE ✓</p>	Expect $0.5 \times 0.96 \times \sin 55 = 0.393 \text{ m}$	3	AO3
Total			8	

Question	Answers	Additional comments/Guidelines	Mark	AO
10.1	Reaction time ✓	Accept idea that it takes time for sound to travel to the runners OWTTE	1	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
10.2	Draws a tangent at $t = 0.6$ (steepest part) ✓ $\Delta t > 0.2$ s AND a within range 11.1 to 17.5 ✓	MP2 is contingent on attempt at a tangent in MP1	2	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
10.3	Attempt to count squares or other valid area method ✓ Counts squares under A OR B AND multiples by the square value OR uses area of a triangle or trapezia ✓ Calculates both and subtracts them to get difference in distance, with corresponding conclusion of A ✓	1 big square = 0.2 m, 1 small square = 0.008 m Area under A is typically 4.1 m Area under B = 3.96 m Max 1 for ' A ' with some valid reasoning without full calculations Allow 1sf final answer Students can also gain full marks for calculating the area difference between the two lines only	3	2 × AO2 1 × AO3

Total			6	
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Question	Answers	Additional comments/Guidelines	Mark	AO
11.1	Weight arrow drawn downwards from the centre of mass AND Tension drawn upwards on the cable ✓	Both labels and arrows need to be drawn for the mark Lines must be straight	1	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
11.2	Attempts to use total mass to find acceleration = $2.18 \text{ (m s}^{-2}\text{)}$ ✓ Attempts to use mass of one carriage to determine tension ✓ 420 (N) ✓	$a = \frac{55 \text{ g} - 35 \text{ g}}{90}$ using their value of a Full marks can be awarded for suitable use of simultaneous equations with full and clear working Use of $g = 9.8$ gives 419 (N)	3	2 × AO2 1 × AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
11.3	<p>Use of $A = \frac{\pi d^2}{4}$ OR πr^2 ✓</p> <p>Use of Young modulus = $\frac{\text{stress}}{\text{strain}}$ ✓</p> <p>Use of stress = $\frac{F}{A}$ ✓</p> <p>Correct answer AND valid comparison and conclusion that it is not safe ✓</p>	<p>Area = $2.12 \times 10^{-5} \text{ m}^2$</p> <p>Tension = 7964 N</p> <p>For the given strain:</p> <p>Young's modulus maximum = $4.71 \times 10^{11} \text{ Pa} < 5.0 \times 10^{11} \text{ Pa}$, so no.</p> <p>maximum cable diameter = $5.05 \text{ mm} < 5.2 \text{ mm}$ so no</p> <p>For the given diameter:</p> <p>maximum strain = $7.06 \times 10^{-4} < 7.5 \times 10^{-4}$ so no.</p>	4	<p>2 × AO2</p> <p>2 × AO3</p>
Total			8	

Question	Answers	Additional comments/Guidelines	Mark	AO
12.1	Any accepted source of background radiation ✓	eg cosmic rays, rocks, building materials	1	AO1

Question	Answers	Additional comments/Guidelines	Mark	AO
12.2	Any safety measure that reduces radiation ✓ Idea that: decreases exposure OR increases distance to student ✓	Eg Move detector, reduce the time near the source Condone storing in a lead-lined box when not in use. Using long tongs	2	1 × AO2 1 × AO4

Question	Answers	Additional comments/Guidelines	Mark	AO
12.3	Both values correct ✓	Expect $x \quad \frac{1}{\sqrt{C}}$ 5.0 0.2200 10.0 0.390	1	AO4

Question	Answers	Additional comments/Guidelines	Mark	AO
12.4	Correct plotting of both points ✓ Best-fit line plotted ✓		2	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
12.5	<p>The line does not go through the origin (so does not show that $x = \frac{1}{\sqrt{C}}$) ✓</p> <p>Any one of: ✓</p> <ul style="list-style-type: none"> • x is an underestimate of the true distance • it is only measured from end of detector to gamma source housing • the point of detection is within the detector • the point of emission is within the source 		2	AO4
Total			8	

Question	Key	Answer	AO
13	C	12.4 m	AO2
14	B	4 kJ	AO2
15	C	56°	AO3
16	A	$2mv \rightarrow 0$	AO2
17	B	kg m s^{-1}	AO1
18	A	5.6 m s^{-2}	AO2
19	B	It can produce rotational motion.	AO1
20	B	70%	AO1
21	B	The distance travelled in 5.0 s is 25 m.	AO1
22	D	$\frac{\text{tensile stress}}{\text{tensile strain}}$ and tension	AO2
23	A	work done in stretching the spring	AO1
24	B	$2g \rightarrow g$	AO2
25	D	223 → 90	AO1
26	A	1 only	AO1

Total = 14 marks