OXFORD AQA

INTERNATIONAL QUALIFICATIONS

# INTERNATIONAL AS

# PHYSICS

# PH01

## Unit 1 Mechanics, materials and atoms

Mark scheme

June 2025

Version: 0.1 Pre-Standardisation

256XPH01/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.

Further copies of this mark scheme are available from www.oxfordaqa.com

# 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 material is permanently deformed / does not return to its original length (when force is removed) ✓ | | 1 | AO1 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **01.2** | Idea that the material undergoes little or no plastic deformation before failure ✓ | | 1 | AO1 |

| | | | |
|---|---|---|---|
| **Total** | | | **2** |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **02** | Idea that they are equal in magnitude and opposite in direction ✓<br>They are separated by a perpendicular distance and are coplanar ✓ | | 2 | AO1 |

| | | | | |
|---|---|---|---|---|
| **Total** | | | **2** | |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **03.1** | $kg\ s^{-2}$ ✓ | | 1 | AO2 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **03.2** | Attempts to calculate area under graph ✓<br>30 to 33.5 (J) ✓<br>31 to 32.5 (J) ✓✓ | | 3 | 1 × AO1<br>2 × AO3 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **03.3** | The stiffness of **S** increases as compression increases ✓<br>because the gradient of the line increases ✓ | Condone spring constant for stiffness | 2 | AO3 |

| | | | |
|---|---|---|---|
| **Total** | | | **6** |

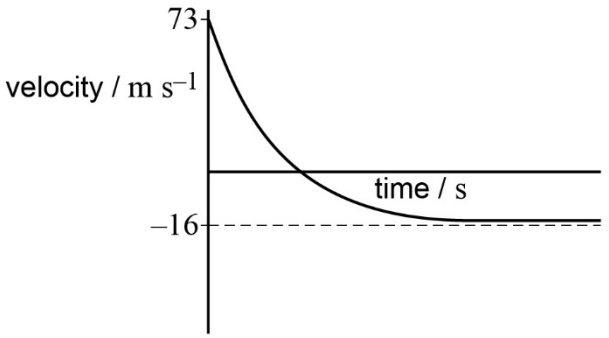
| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **04.1** | proton, electron and antineutrino ✓ | | 1 | AO1 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **04.2** | annihilation ✓<br>releasing two gamma photons only ✓ | | 2 | AO1 |

| | | | |
|---|---|---|---|
| **Total** | | | **3** |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **05** | Attempt to use conservation of momentum ✓<br><br>$v = 3.6(3)$ seen ✓<br>Their final kinetic energy correctly calculated ✓<br>Initial and calculated final kinetic energy compared and a consistent conclusion given ✓ | eg<br>$(8.4 \times 4.1) + (6.3 \times 2.7) = (8.4 \times 3.4) + 6.3v$<br><br>final = 90.1 J | 4 | 1 × AO1<br>2 × AO2<br>1 × AO3 |

| | | | | |
|---|---|---|---|---|
| **Total** | | | **4** | |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **06.1** | Starts at 73 (m s$^{-1}$) and decreases with correct shape above the $x$-axis ✓<br>Same continuous shaped curve below the $x$-axis ✓<br>Becomes constant at $-16$ (m s$^{-1}$) ✓ |  | 3 | AO3 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **06.2** | Resolves vertically or uses $s = vt$ ✓<br>$t = 29$ (s) ✓ | | 2 | AO2 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **06.3** | Tangent drawn at $t = 5.0$ s ✓<br>Attempts to calculate gradient with a sufficiently large triangle ✓<br>Uses $mg - R = ma$ ✓<br>600 (N) ✓ | expect to see answer in range 2.50–3.00<br><br>allow 575 to 620 | 4 | 1 × AO1<br>2 × AO2<br>1 × AO3 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **06.4** | Gradient initially steep as the acceleration is $g$ ✓<br>Due to $mg >$ air resistance / drag or large resultant force ✓<br>Gradient decreases due to drag increasing / resultant force decreasing so acceleration decreases ✓<br>When drag = weight, jumper reaches constant speed so gradient is zero ✓ | Allow air resistance is negligible | 4 | AO3 |

| | | | |
|---|---|---|---|
| **Total** | | | **13** |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **07.1** | Uses $2 \times 1.6 \times 10^{-19}$ **AND** divides by either $2m_p + 2m_n$ **OR** $4 \times 1.67 \times 10^{-27}$ ✓<br>Uses $\frac{\text{charge}}{\text{mass}}$ ✓<br>$4.79 \times 10^{7}$ (C kg$^{-1}$) ✓ | Allow use of $4 \times 1.66(1) \times 10^{-27}$ leading to $4.82 \times 10^{7}$ (C kg$^{-1}$) | 3 | 2 × AO1<br>1 × AO2 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **07.2** | Idea that the activity will not drop to the level where it needs to be replaced<br>**OR**<br>Will not alter count rate during demonstration ✓ | Condone activity will be low so risk will be low | 1 | AO3 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **07.3** | Idea that collisions with air particles reduces velocity / momentum / kinetic energy ✓ | | 1 | AO2 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **07.4** | Any **two** from: ✓✓<br>• measure the count rate with no source present<br>• for a length of time<br>• subtract from the reading when the source is present | | 2 | AO1 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **07.5** | Idea that some of the decay products of radium-226 are radioactive and emit beta and/or gamma ✓<br>beta and/or gamma with a range greater than alpha ✓ | | 2 | 1 × AO2<br>1 × AO3 |

| | | | | |
|---|---|---|---|---|
| **Total** | | | **9** | |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **08.1** | Uses $\rho = \frac{m}{V}$ to calculate volume ✓<br>Uses $V = \pi r^2 h$ to calculate radius ✓<br>Doubles to give $76\ \text{mm}$ ✓ | | 3 | 1 × AO1<br>2 × AO2 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **08.2** | Uses equation of motion to determine $a$ ✓<br>$mg\sin\theta$ seen ✓<br>Uses $F = ma$ ✓<br>$\theta = 33°$ ✓<br>**OR**<br>Uses $E_k = \frac{1}{2}mv^2$ ✓<br>Uses $W =$ friction $\times s$ ✓<br>Uses $E_p = E_k + W$ ✓<br>Uses trig to determine $\theta = 33°$ ✓ | Expect to see $a = 2.9(0)\ (\text{m s}^{-2})$<br><br>Expect to see $\theta = \sin^{-1}\left(\frac{ma+R}{mg}\right)$ | 4 | AO2 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **08.3** | Uses equation of motion ✓<br>to get $t = 4.6(4)$ (s) ✓ | | 2 | 1 × AO1<br>1 × AO2 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **08.4** | (repeated) to minimise the effect of random errors ✓<br>(done in different locations) to take account of any lack of uniformity ✓ | Allow 'the ground may not be uniform / horizontal' | 2 | AO4 |

| | | | |
|---|---|---|---|
| **Total** | | | **11** |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **09.1** | Removes variation in reaction time ✓<br>Time too short to measure with a stopwatch without getting a large uncertainty in the measurement ✓ | | 2 | AO4 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **09.2** | Any **two** from: ✓✓<br>• repeat and average<br>• use a greater range of data<br>• use smaller intervals<br>• obtain more data sets | | 2 | AO4 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **09.3** | $t^2$ should be to 3 sf / should not be recorded to 2 sf ✓ | | 1 | AO1 |

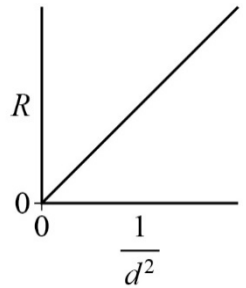
| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **09.4** | Use $s = \frac{1}{2}gt^2$ and compare with $y = mx + c$ ✓<br>Plot $s$ against $t^2$ or $2s$ against $t^2$ ✓<br>Determine gradient and multiply by $2$ ✓ | Accept if axes reversed | 3 | AO2 |
| **Total** | | | **8** | |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **10.1** | Max **two** from: ✓✓<br>• calculates area in $\mathrm{m}^2$<br>• use of stress $= \frac{\text{force}}{\text{area}}$<br>• uses Young modulus $= \frac{\text{stress}}{\text{strain}}$<br>$2.96\ \mathrm{GPa}$ ✓ | $2.1 \times 10^{-6}\ \mathrm{m}^2$<br><br>correct power of ten must be seen | 3 | 2 × AO1<br>1 × AO2 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **10.2** | Uses trig to determine $\theta = 65°$ ✓<br><br>Uses $F = 2T\cos 65$ to determine $F$ ✓ | <br><br>expect to see $790\ (\mathrm{N})$ | 2 | 1 × AO2<br><br>1 × AO3 |

| Question | Answers | Additional comments/Guidelines | Mark | AO |
|---|---|---|---|---|
| **10.3** | Any **three** from: ✓✓✓<br>• because $2T\cos\theta = ma$, acceleration decreases from an initial maximum<br>• force decreases as extension/strain decreases<br>• rate of decrease in extension/strain/force decreases<br>• acceleration due to the tension is zero when the length is $1.48\ \text{m}$ because the horizontal component of the tension is zero | | 3 | 1 × AO2<br>2 × AO3 |

| | | | |
|---|---|---|---|
| **Total** | | | **8** |

| Question | Key | Answer | AO |
|---|---|---|---|
| **11** | **C** | 17 000 years | AO3 |
| **12** | **A** | $9.8 \times 10^4$ | AO2 |
| **13** | **C** | displacement, force, momentum | AO1 |
| **14** | **D** | $1.2 \times 10^{-2}$ kg m s$^{-1}$ | AO2 |
| **15** | **D** | 0.51 N | AO2 |
| **16** | **B** | 2.7 MJ | AO2 |
| **17** | **C** | 206 \| 82 | AO3 |
| **18** | **C** | positron | AO2 |
| **19** | **D** | velocity | AO1 |
| **20** | **C** | 12 N \| 16 N \| 20 N | AO2 |
| **21** | **D** |   | AO3 |

| | | | |
|---|---|---|---|
| **22** | **B** | downwards with an increasing speed | AO1 |
| **23** | **B** | momentum. | AO1 |
| **24** | **B** | $\frac{mgv}{\eta}$ | AO3 |

**Total 14 marks**