OXFORD

INTERNATIONAL
AQA EXAMINATIONS

# OXFORD AQA INTERNATIONAL AS Physics PH01

Unit 1

Mark scheme
January 2018

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1 8 1 A P H 0 1 / M S

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.

| Question | Marking guidance | Mark | Comments |
|---|---|---|---|
| 1 | $^{0}_{-1}e$ ✓<br><br>$^{42}_{20}Ca$ | 2 | Accept $e^-$, $\beta^-$ or β with the correct numbers. Not b or B |

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

| Question | Marking guidance | Mark | Comments |
|---|---|---|---|
| 02.1 | (Gravitational) attraction between the weight and the Earth ✓ | 1 | |
| 02.2 | Correct detail about what constitutes action–reaction pairs ✓ | 1 | eg (the two forces) must be of the same type OR co-linear OR in opposite directions OR of equal magnitude OR act on different objects. Any one correct attribute.<br>The second mark is NOT dependent on having a correct answer to 02.1 |
| **Total** | | **2** | |

| Question | Marking guidance | Mark | Comments |
|---|---|---|---|
| 03.1 | The energy equivalent of the mass of the particle… ✓<br>Rest mass **OR** when the particle has zero momentum or velocity<br>**OR** Reference to $E = mc^2$ ✓ | 2 | Not just "at rest".<br>"Energy equivalent of the rest mass (of the particle)" gets 2 marks |
| 03.2 | $1.5(1) \times 10^{-10}$ (J) ✓ | 1 | Correct answer only |
| **Total** | | **3** | |

| Question | Marking guidance | Mark | Comments |
|---|---|---|---|
| 04 | Vertical lift force labeled $\boldsymbol{L}$ of the same length as $\boldsymbol{W}$ ✓<br>Horizontal drag force labeled $\boldsymbol{D}$ of the same length as $\boldsymbol{T}$ ✓<br>The pairs of forces are co-linear OR are in positions to suggest that there is no net moment. ✓ | 3 | Allow one mark only for freehand sketches if the lengths and directions are approximately correct by eye |
| **Total** | | **3** | |

| Question | Marking guidance | Mark | Comments |
|---|---|---|---|
| 05.1 | Draws gradient as a tangent to the curve on the graph ✓<br>Extracts at least one piece of data from the graph that is used to find a gradient or the gradient of a chord (condoning powers of ten) ✓<br>15 to 20 m $s^{-2}$ ✓ | 3 | Candidates who use a small triangle can access the second and third marks only.<br>Candidates who use 2 widely spaced points on the curve can access the 2nd mark only |
| 05.2 | Evidence of determining the area under the graph ✓<br>1 square is equivalent to $2.5 \times 10^{-4}$ (m) **OR** 9 to 11 squares ✓<br>$2.3 \times 10^{-3}$ to $2.7 \times 10^{-3}$ (m) ✓ | 3 | Stated or seen on the graph |
| **Total** | | **6** | |

| Question | Marking guidance | Mark | Comments |
|---|---|---|---|
| 06.1 | Uses $s = \frac{1}{2}gt^2$ ✓<br>0.585 (s) to at least 2 sf ✓ | 2 | Substitution or rearrangement seen<br>Accept 0.58 |
| 06.2 | 20(.3) (m $s^{-1}$) **OR** 19.8 (m $s^{-1}$) when using 0.6 s ✓ | 1 | |
| 06.3 | Uses Pythagoras ✓<br>49(.4) (m $s^{-1}$) ✓<br>Uses appropriate trig relationship<br>32° to the horizontal<br>**OR**<br>Correct scale diagram seen<br>Scale given 0.1 or 0.2 cm per m $s^{-1}$<br>48 to 50 m $s^{-1}$<br>30° to 34° to the horizontal | 4 | Angle must be shown on diagram or clearly stated "to the horizontal" 58° to vertical acceptable<br><br>Candidates who show an incorrect direction in their vector diagram lose the final mark |
| **Total** | | **7** | |

| Question | Marking guidance | Mark | Comments |
|---|---|---|---|
| 07.1 | 2.5 y to 2.8 y ✓<br>Construction seen on graph ✓<br>Repeat and average seen ✓ | 3 | |
| 07.2 | Paper moves between source and detector ✓<br>Count rate **OR** reduction of count rate **OR** absorption measured ✓<br>If count rate too high, rollers separate **OR** if count rate too low, rollers move together ✓<br>Either beta suitable because will pass through paper with some absorption **OR** half-life suitable because activity will not change quickly **OR** long half-life so does not need frequent replacement ✓ | 4 | |
| **Total** | | **7** | |

| Question | Marking guidance | Mark | Comments |
|---|---|---|---|
| 08.1 | $T\sin 40$ or $T\cos 50$ seen in numbers or symbols ✓<br>$1.5(4) \times 10^8$ (N) ✓ | 2 | Condone lack of factor of 2 for 1st mark |
| 08.2 | Converts mass of tower into weight ✓<br>$2.2(4) \times 10^8$ (N) OR Adds correctly weight of tower to their **08.1** ✓ | 2 | eg $7.1 \times 10^6$g seen |
| 08.3 | $E = \frac{\sigma}{\epsilon}$ used ✓<br>$\sigma = \frac{F}{A}$ and $\epsilon = \frac{e}{l}$ used ✓<br>$0.41(3)$ (m) | 3 | Use of $E = \frac{Fl}{eA}$ gets both of the first two marks |
| 08.4 | Breaking stress – force per unit area (when the cable breaks) ✓<br>Plastic deformation – idea that change in shape is permanent **OR** extension is unrecoverable ✓ | 2 | Not simply inelastic |
| 08.5 | Allows margin for error **OR** yield occurs at lower stresses **OR** can cope with unexpectedly large loads | 1 | Accept to prevent going into the plastic deformation region (of the stress-strain graph) |
| **Total** | | **10** | |

| Question | Marking guidance | Mark | Comments |
|---|---|---|---|
| 09.1 | Acceleration increases with time or distance ✓ | 1 | |
| 09.2 | Uses $a = \frac{F}{m}$ ✓<br><br>$0.143\ (\text{m s}^{-2})$ ✓ | 2 | Substitution into the equation gets the mark – condone power of ten |
| 09.3 | Work done is area under graph – stated or used ✓<br><br>Evidence of correct calculation eg $\frac{(0.2+4.4)\times10^3)}{2}.90$ ✓<br><br>$2.07 \times 10^5$ ✓ | 3 | Alternative method: Work done = average force x distance<br><br>Condone powers of ten error in 2nd mark.<br><br>Must have convincing manipulation of powers of ten and must be at least 2 sf in 3rd mark |
| 09.4 | Use of $E_k = \frac{1}{2}mv^2$ ✓<br><br>$17(.2)\ (\text{m s}^{-1})$ **ecf** from 09.3 ✓ | 2 | Alternative method: calculates average acceleration and uses appropriate equation of motion.<br><br>Acceptable answer $16.9\ (\text{m s}^{-1})$ for candidates that use $2 \times 10^5$ |
| 09.5 | Friction (or rolling friction)(between wheels and road) remains constant ✓<br>Air resistance increases (with time or distance travelled) ✓ | 2 | Just mentioning air resistance and friction without correctly describing the expected changes (or lack of change) gets 1 mark<br><br>Accept (overall) resistive forces increase for 1 mark |
| **Total** | | **10** | |

| Question | Marking guidance | Mark | Comments |
|---|---|---|---|
| 10.1 | Well-drawn line, labelled *s*, indicating the distance between the top ball and the bottom ball ✓ | 1 | *s* should be from the top of the 1st ball to the top of the last ball or from the bottom of the 1st ball to the bottom of the last ball |
| 10.2 | largest distance gives smallest (percentage) uncertainty ✓ | 1 | Accept smaller (percentage) error |
| 10.3 | 198 ± 1 (mm) ✓<br>**ecf** | 1 | Accept answer in m or cm.<br>Must have value and unit correct and consistent<br>If the candidate has marked *s* between a different pair of balls they can still have the mark. The other acceptable distances are:<br>1st to 2nd = 8 (mm)<br>1st to 3rd = 32 (mm)<br>1st to 4th = 71 (mm)<br>1st to 5th = 127 (mm)<br>2nd to 3rd = 24 (mm)<br>2nd to 4th = 63 (mm)<br>2nd to 5th = 118 (mm)<br>2nd to 6th = 190 (mm)<br>3rd to 4th = 39 (mm)<br>3rd to 5th = 94 (mm)<br>3rd to 6th = 162 (mm)<br>4th to 5th = 56 (mm)<br>4th to 6th = 121 (mm)<br>5th to 6th = 71 (mm)<br>The same uncertainties and requirement for correct unit apply to the ecf |

| Question | Marking guidance | Mark | Comments |
|---|---|---|---|
| 10.4 | Use of $s = ½ gt^2$ with candidate's value for $s$ leading to 9.6 to 10.1 ($m\ s^{-2}$) to 2 or 3 sf ✓ | 1 | Candidates who do not measure $s$ from the 1st ball will have to do a lot of maths to access the 2nd mark<br>Look for use of $s = ut + ½ gt^2$ |
| 10.5 | $\frac{1}{198} \times 100$<br>leading to 0.5 % ✓ | 1 | Accept appropriate value for candidate's 10.1 and 10.3<br>Ignore sf |
| 10.6 | Adds some percentage uncertainties ✓<br>2 × 0.8(%) + candidate's 10.5 ✓<br>(±) 0.2 or 0.21 **ecf** ✓ | 3 | Can access the 3rd mark for correctly calculating the absolute uncertainty from their own (incorrect) percentage uncertainty |
| **Total** | | **8** | |

| Question | Marking guidance | Mark | Comments |
|---|---|---|---|
| 11.1 | Change of momentum ✓ | 1 | Accept integral of force wrtt time or area under force time graph |
| 11.2 | Area under graph used ✓<br>Uses area of parallelogram **OR** triangle plus rectangle with correct data (condone powers of ten for this mark) ✓<br>Clear correct powers of ten leading to 73.5 (N s) ✓ | 3 | Look for $\frac{(240+180)x10^{-3}}{2} x\ 350$ OR $\left(\frac{1}{2}0.6x350\right)+(0.18x350)$ |
| 11.3 | Uses their 11.2 = mv – mu OR 75 = mv – mu ✓<br>15(.3) (m $s^{-1}$) ✓ **ecf** | 2 | Use of 7.5 give an answer of 15.6 (m $s^{-1}$) |
| 11.4 | Crumple zone increases duration of the impact (wtte) (therefore force is smaller) ✓<br>Car **A** (or passengers in car **A**) have greater change in momentum (therefore force is larger) ✓ | 2 | Accept car or passengers in A have greater impulse |
| **Total** | | **8** | |

| Question | Key |
|---|---|
| 12 | B |
| 13 | D |
| 14 | C |
| 15 | D |
| 16 | B |
| 17 | A |
| 18 | D |
| 19 | B |
| 20 | B |
| 21 | B |
| 22 | B |
| 23 | A |
| 24 | C |
| 25 | C |