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INTERNATIONAL QUALIFICATIONS

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PHYSICS

PH01

Unit 1 Mechanics, materials and atoms

Mark scheme

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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 the 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 ✓ They are separated by a perpendicular distance ✓	Allow they are not co-linear Allow MP2 for a clear diagram	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 ✓ 30.5 to 33.5 (J) ✓ 31.5 to 32.5 (J) ✓✓	Expect to see 63 – 65 squares POT error prevents the awarding of one of MP2 or MP3.	3	1 × AO1 2 × AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
03.3	The stiffness of **S** increases (as compression increases) ✓ Because the ratio $\frac{F}{\Delta L}$ increases✓	Condone spring constant for stiffness Allow the gradient of the line increases	2	AO3

Total			**6**

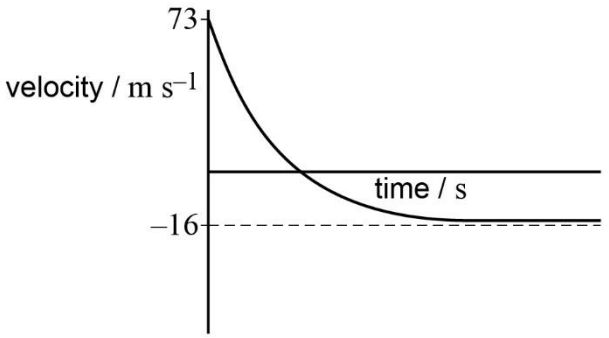
Question	Answers	Additional comments/Guidelines	Mark	AO
04.1	Proton **and** electron **and** antineutrino ✓	Allow β^- for electron Do not allow e^-	1	AO1

Question	Answers	Additional comments/Guidelines	Mark	AO
04.2	annihilation ✓ releasing (gamma) photon(s) ✓		2	AO1

Total			**3**

Question	Answers	Additional comments/Guidelines	Mark	AO
05	Use of conservation of momentum to calculate v ✓ $v = 3.6(3)$ ✓ Use of $E_k = \frac{1}{2}mv^2$ for final kinetic energy ✓ Initial and calculated final kinetic energy compared and a consistent conclusion given ✓	e.g. $(8.4 \times 4.1) + (6.3 \times 2.7) = (8.4 \times 3.4) + 6.3v$ Do not award MP4 if a circular argument is given	4	1 × AO1 2 × AO2 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 ✓ Continuous curve with correct shape below the x-axis ✓ Becomes constant at –16 (m s^{-1}) ✓		3	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
06.2	Resolves vertically or uses $s = vt$ with their vertical component of v✓ t = 29 (s) ✓		2	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
06.3	Tangent drawn at t = 5.0 s ✓ Calculates gradient with a sufficiently large triangle ✓ Uses their acceleration in $mg - R = ma$ ✓ 580 (N) ✓	Δv at least 20 ms^{-1} Expect to see answer in range 2.80 – 3.20 Allow 560 to 600	4	1 × AO1 2 × AO2 1 × AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
06.4	Gradient is acceleration ✓ Any **three** from: ✓✓✓ • Gradient / acceleration initially large either due to *mg* > drag or large resultant force • As velocity increases air resistance / drag increases • So resultant force decreases so gradient / acceleration decreases • When air resistance / drag = weight, jumper reaches constant speed so gradient / acceleration is zero	Allow gradient / acceleration is initially *g*	4	AO3

Total			**13**

Question	Answers	Additional comments/Guidelines	Mark	AO
07.1	Charge = $2 \times 1.60 \times 10^{-19}$ **or** mass = $(2 \times 1.67(3) \times 10^{-27}) + (2 \times 1.67(5) \times 10^{-27})$ ✓ Uses $\frac{\text{charge}}{\text{mass}}$ ✓ 4.79×10^{7} (C kg^{-1}) ✓	Allow use of 4*u* Allow 4.78×10^{7} or 4.82×10^{7} (C kg^{-1}) Max **1** mark if mass of electrons is included	3	2 × AO1 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 **OR** 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	Collisions with air particles (reduces velocity / momentum / kinetic energy) ✓	Do not accept air resistance	1	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
07.4	Measure the count rate with no source present **or** measure the background count for a long time ✓ Subtract the background count rate from the reading (when the source is present) ✓	Condone count / radiation for count rate in MP1 only	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 (with a range greater than alpha) ✓		2	1 × AO2 1 × AO3

Total			**9**

Question	Answers	Additional comments/Guidelines	Mark	AO
08.1	Uses $\rho = \frac{m}{V}$ to calculate volume ✓ Uses $V = \pi r^2 h$ to calculate radius or uses $V = \frac{\pi d^2 h}{4}$ to calculate diameter✓ 76 mm ✓	Ignore POT error in MP1 and MP2 only	3	1 × AO1 2 × AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
08.2	Uses equation of motion to determine a ✓ $mg\sin\theta$ seen ✓ Uses ma = their component of weight $- 0.41$✓ $\theta = 33°$ ✓ **OR** Uses $E_k = \frac{1}{2}mv^2$ ✓ Uses W = friction × s ✓ Uses $E_p = E_k + W$ ✓ Uses trig to determine $\theta = 33°$ ✓	Expect to see $a = 2.9(0)$ (m s^{-2}) Expect to see $\theta = \sin^{-1}\left(\frac{ma + R}{mg}\right)$	4	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
08.3	Uses an equation of motion ✓ to get $t = 5.5(2)$ (s) ✓	Condone use of $2.1\cos\theta$	2	1 × AO1 1 × AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
08.4	Repeated to minimise the effect of random errors ✓ Done in different locations to take account of any lack of uniformity ✓	Condone reduces random error(s) 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 ✓ Time too short to measure with a stopwatch without getting a large (percentage) uncertainty in the measurement ✓	Condone a reference to random error in place of variation Condone more precise if there is a reference to decimal places or significant figures	2	AO4

Question	Answers	Additional comments/Guidelines	Mark	AO
09.2	Any **two** from: ✓✓ • repeat and average • use a greater range of data • use larger values of s • obtain more data sets		2	AO4

Question	Answers	Additional comments/Guidelines	Mark	AO
09.3	t^2 should be to 3 sf ✓		1	AO1

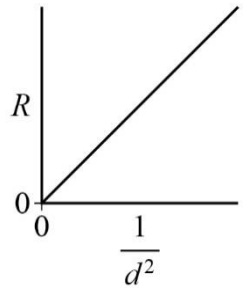
Question	Answers	Additional comments/Guidelines	Mark	AO
09.4	Use $s = \frac{1}{2} gt^2$ and compare with $y = mx + c$ ✓ Plot s against t^2 or $2s$ against t^2 ✓ g = 2 × gradient✓	 Accept any valid straight line plot Accept an answer consistent with their plot	3	AO2
Total			**8**	

Question	Answers	Additional comments/Guidelines	Mark	AO
10.1	Max **two** from: ✓✓ • calculates cross-sectional area • use of stress = $\frac{\text{force}}{\text{area}}$ • uses Young modulus = $\frac{\text{stress}}{\text{strain}}$ 2.96×10^9 Pa ✓	Correct power of ten must be seen Must be at least 3 sf	3	2 × AO1 1 × AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
10.2	Uses trig to determine $\theta = 65°$ or $\theta = 25°$ ✓ 790 (N)✓	Allow equivalent ratio Expect to see $F = 2T\cos 65$ or $F = 2T\sin 25$	2	1 × AO2 1 × AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
10.3	Because $F = ma$, acceleration decreases as F / tension decreases ✓ Any **two** from: ✓✓ • Force / tension decreases as extension/strain decreases • Force / tension decreases as θ increases because $\cos\theta$ / horizontal component decreases • Rate of decrease in extension / strain / force / acceleration decreases • Acceleration is zero when the length is $1.48\ \text{m}$ / string vertical because the horizontal component of the tension is zero	Allow because $2T\cos\theta = ma$, acceleration decreases F / tension decreases	3	1 × AO2 2 × AO3

Total			**8**

Question	Key	Answer	AO
11	**C**	17 000 years	AO3
12	**A**	9.8×10^4	AO2
13	**C**	displacement, force, momentum	AO1
14	**D**	1.2×10^{-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