OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL AS
Physics

PH03-Unit 3 Fields and their consequences
Mark scheme

June 2018

Version/Stage: 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 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
01.1	(motion in which) The acceleration (or force) is (directly) proportional to the displacement … ✓ … (and is) directed towards the equilibrium position or centre of the oscillation ✓	2	Accept acceleration in opposite direction to displacement
01.2	Uses $T = 2\pi\sqrt{\frac{l}{g}}$ ✓ $T = 3.01$ (s) ✓	2	2 or more sig figs
01.3	Uses $v_{max} = A\omega$ **or** uses $\omega = \frac{2\pi}{T}$ ✓ Uses $E_k = \frac{1}{2}mv^2$ or $E_k = \frac{1}{2}m\omega^2A^2$ or $v_{max} = 2.5(1)$ (m s^{-1}) or $\omega = 2.1$ (rad s^{-1}) ✓ 56.7 (J) ✓	3	Answer could be 2 or 3 sf Accept answers between 56.3 and 57.0
01.4	Displacement–time: Acceptable cosine or –cosine curve covering 2 oscillations ✓ Correct scales showing amplitude of 1.2 m and period of 3 s ✓ Velocity–time: Acceptable sine or –sine curve appropriate to the 1st graph (and registered with it) ✓ Correct scales showing max velocity of 2.5 m s^{-1} or their velocity from 01.3 and period of 3 s ✓	4	Condone candidates attempting to use 3.01 s period Candidates who have drawn cos fro the 1st graph should have –sin for the 2nd and vice versa. Candidates who erroneously draw sin for 1st graph – allow cos for the 2nd. Those who drew –sin for the 1st get a mark for –cos in the 2nd Condone lack of registration between 1st and 2nd graphs if scales are adequately labelled
Total		**11**	

Question	Marking guidance	Mark	Comments
02.1	1.45 N to 2 or 3 sf **cao** ✓	1	
02.2	Potential is zero at infinity ✓ Potential is lower (than zero) (at the point in the field) since work needs to be done to move (unit) mass from the point to infinity (against gravitational attraction) wtte ✓	2	
02.3	1050 or 1045 J **cao**	1	Accept 1000 (J) if it is stated to be 2 sf
02.4	Equates $\frac{mv^2}{r}$ or $mr\omega^2$ with $\frac{GMm}{r^2}$ ✓ Uses $T = \frac{2\pi}{\omega}$ ✓ Clear and convincing manipulation ✓	3	
02.5	Correct rearrangement or substitution ✓ 9.75×10^6 (m) ✓	2	Expect to see $24x3600 = \sqrt{\frac{4\pi^2 r^3}{6.67x1o^{-11}7.35x10^{22}}}$ Or $r = \sqrt[3]{\frac{GMT^2}{4\pi^2}}$ for the 1st mark Condone wrong value of *t* in the substitution for the 1st mark
Total		**9**	

Question	Marking guidance	Mark	Comments
03.1	Use of $E_{max} = BAN\omega$ ✓ Use of $\omega = 2\pi f$ ✓ 2.26 (V)✓	3	
03.2	1.6(0) (V) **ecf from 03.1** ✓	1	$\frac{\text{candidate's 03.1}}{1.414}$
03.3	Use of $P = \frac{V^2}{R}$ ✓ 0.38 (W) **ecf from 3.2** ✓	2	Allow symbols or numbers including use of peak voltage for 1st mark $\frac{(\text{candidate's 03.2})^2}{6.8}$
03.4	Doubling B doubles emf ✓ Doubling ω doubles emf ✓ Either or both increases power by a factor of 4 ✓ Doubling ω doubles the frequency of the o/p ✓ MAX 3	MAX 3	
Total		**9**	

Question	Marking guidance	Mark	Comments
04.1	Probability of decay per unit time	1	Condone ratio of activity to number of nuclei present
04.2	Uses $\lambda = \frac{\ln 2}{t_{\frac{1}{2}}}$ or 3.79×10^{-3} seen Uses $N = N_0 e^{-\lambda t}$ or $1.4(3) \times 10^{20}$ seen 5.1 or 5.07×10^{20}	3	
04.3	Correct general shape starting at origin and appearing to become asymptotic ✓ 1 correct data point and smooth curve that is asymptotic at 6.5 ✓	2	Points to look for: (0, 0) (183, 3.25) (366, 4.88) (400, 5.07) (549, 5.69)
Total		**6**	

Question	Marking guidance	Mark	Comments
05.1	Charge stored per unit pd or per unit volt is $80\ \mu C$ wtte ✓	1	
05.2	Increases the permittivity **or** has a greater permittivity than vacuum ✓ Reduces the electric field strength... ✓ ... because polarised molecules rotate (to align with field) ✓ ... so reduces the pd across the plates **or** more charge can be stored for the same pd ✓ Any three	3	
05.3	Uses $Q=CV$ at some point in the calculation ✓ Uses $E = \frac{1}{2}CV^2$ or $E = \frac{1}{2}QV$ or $E = \frac{1}{2}\frac{Q^2}{C}$ at some point in the calculation ✓ Calculates initial energy stored ($1000\ \mu J$) or final energy stored ($490\ \mu J$) ✓ 51 (%) **cao** ✓	4	
Total		**8**	

Question	Marking guidance	Mark	Comments
06.1	Both curve to the right – apparently circular arcs ✓ **P** has smaller radius than **Q** ✓	2	
06.2	Equates Bqv and $\frac{mv^2}{r}$ ✓ Correct substitution of data for one calculation ✓ Either radius correct: **P** is 0.366 m; **Q** is 0.390 m ✓ 0.047 (m) ✓	4	Look for $r = \frac{2.66\ x\ 10^{-26} x\ 4.1\ x\ 10^{6}}{0.93\ x\ 3.2\ x\ 10^{-19}}$ but accept in other arrangements
06.3	Force acting is always at right angles to velocity **or** circular motion so direction changes but speed stays the same	1	
Total		**7**	

Question	Key
7	C
8	C
9	B
10	A
11	D
12	D
13	A
14	C
15	D
16	C
17	B
18	A
19	C
20	D
21	B
22	A

Question	Key
23	D
24	C
25	A
26	B
27	A
28	B
29	A
30	B
31	D
32	C
33	B
34	A
35	A
36	B