OXFORD

INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL A-LEVEL
PHYSICS
PH03

Unit 3 Fields and their consequences

Mark scheme

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I91XPH03/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 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 oxfordaqaexams.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	$T\sin\theta$ ✓	1	Accept $T\sin 35$ or $T\cos 55$
01.2	$T\cos\theta = \text{mg}$ seen ✓ 79(.3) (kg) ✓	2	
01.3	Evidence of $T\sin\theta = mr\omega^2$ being used or $F_{max} = mr\omega^2$ ✓ Divides $\frac{T\sin\theta}{T\cos\theta}$ or equivalent ✓ Evidence of correct rearrangement ✓	3	Changes subject to ω^2 and then takes square root.
01.4	$\omega = 0.98(0)$ OR $T = \frac{2\pi}{\omega}$ seen ✓ 6.4 (s)	2	
01.5	Recognizes that $\omega_A = \omega_B$ and that $r_A > r_B$ OR quotes a suitable expression for θ such as $\tan\theta = \frac{mr\omega^2}{mg}$ or $\omega^2 r = g\tan\theta$ ✓ Uses both parts of MP1to demonstrate that $\tan\theta$ α r ✓	2	

Question	Marking guidance	Mark	Comments
02.1	I_1 (starts high) and falls (exponentially) as the capacitor charges... ✓ ... because the pd across the pd across C grows (and opposes E) ✓ As the pd across C increases, the pd across R_1 decreases ✓ I_2 has a constant value ✓ $I = I_1 + I_2$ ✓ ANY 3	3	
02.2	$I_2 = \frac{0.7}{4000}$ OR $V_c = \frac{6000}{4000}.0.7$ OR $= \frac{3}{2}.0.7$ ✓ 1.05 (V) cao to 3 sf ✓	2	
02.3	Uses $V = V_0 e^{-\frac{t}{RC}}$ ✓ Takes logs correctly. Look for $t = RC \ln \frac{V_0}{V}$ ✓ Correct substitution into correct log formula eg $t = 13.2 \ln \frac{6}{1.05}$ Or calculates time constant . Accept 13.2 or 8.8 as the time constant for this MP ✓ $23(.0)$ (s) ✓	4	Accept substitution or rearrangement as evidence of use of formula. Condone incorrect value for resistance for 1st and 3rd mark. Use of $V = 1$ V instead of 1.05 V gives an answer of 23.7 s and gets full marks. Use of $R = 4000\ \Omega$ instead of $6000\ \Omega$ gives 15.3 s or 15.8 s and gets 3 marks. Students who use 1 V instead of 1.05 V get t = 23.7 s and receive full credit.

02.4	Increasing (the value of) $\mathbf{R_v}$ increases T wtte ✓ and explanation in terms of increasing time constant or resistance of discharge circuit or appropriate use of formula ✓	2	

Question	Marking guidance	Mark	Comments
03.1	Use of $\frac{N_s}{N_p} = \frac{V_s}{V_p}$ ✓ 8.1 or 8.05 (V) ✓	2	Either correct substitution or rearrangement
03.2	At least 2 cycles of ac shown with or without scales on axis ✓ Evidence of the use of $\sqrt{2}$ **or** $t = \frac{1}{f}$ ✓ Peaks at 11.3 (V) ✓ Time period 20 ms shown on graph or calculated✓	4	Must be even and with consistent peak values. Students who get either V_{max} or T correct get this mark also. Accept even if value of T on graph contradicts the calculated value
03.3	$V_s I_s = 0.9 V_p I_p$ seen in some form ✓ $93(.3)$ (mA) ✓ ecf from 03.1	2	For ecf answer should be $11.6 \times$ their 03.1
03.4	Magnitude of (peak) pd is **less** (because of pd dropped across diode) ✓ Only positive "humps" remain **or** negative is blocked Or the output is (half wave) rectified ✓	2	
03.5	Eddy currents or emf induced in the core… ✓ … because of varying magnetic field or flux ✓ Eddy currents dissipate energy wtte ✓ Core is laminated… ✓ …to reduce (magnitude of) eddy currents ✓ ANY 4	4	

Question	Marking guidance	Mark	Comments
04.1	At least 6 radial lines, straight and evenly spaced by eye with arrows away from the centre ✓	1	Accept lines not drawn with a ruler if they are straight and symmetrical Condone field shown within the drop
04.2	Work done moving <u>unit</u> charge from infinity (to the point in the field) ✓	1	Accept equation with terms defined
04.3	Substitution into $V = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$ ie $\frac{6.4 \times 10^{-19}}{4\pi x\ 8.85 \times 10^{-12} \times 5.8 \times 10^{-5}}$ ✓ 4.11×10^{-3} ✓	2	Condone use of $1.6 \text{ x } 10^{-19}$ for the 1st MP only
04.4	Up arrow labelled F_E or $\frac{Vq}{d}$ or similar **and** down arrow labelled weight, W, or mg or similar ✓	1	Condone difference in length of arrows. Accept if the upward pointing arrow is labelled F
04.5	Recognition that F_E is equal (and opposite) to weight ✓ New resultant force is 2 mg owtte ✓	2	2 x 9.81 or 19.62 seen gets only 1 mark if it is without acceptable explanation
04.6	(Drop moves downwards) (Weight and) electrostatic force remain constant ✓ Air resistance increases (with speed) ✓ Terminal speed reached **or** acceleration gets smaller ✓ ANY 2	max 2	

Question	Marking guidance	Mark	Comments
05.1	Uses $E_{\mathrm{k}} = \frac{1}{2}mv^2$ ✓ Uses $Bqv = \frac{mv^2}{r}$ ✓ Convincing manipulation ✓	3	Eg shows that $mv = \sqrt{2E_{\mathrm{k}}m}$ or $v = \sqrt{\frac{2E_k}{m}}$

05.2	$\frac{q_\alpha}{q_\beta}$ = (−)2 used or seen in calculation $\frac{E_\alpha}{E_\beta}$ = 6.7 OR $\frac{7.4}{1.1}$ used or seen in calculation $\frac{m_\alpha}{m_\beta}$ = 7360 OR $\frac{6.64 \times 10^{-27}}{9.11 \times 10^{-31}}$ used or seen in calculation max 2 110 or 111 ✓ OR Correctly converts 1 energy to Joule (1.18×10^{-12} or 1.76×10^{-13}) ✓ Correctly substituting into $r = \frac{1}{Bq}\sqrt{2E_k m}$ for one particle Or a correct value of r ($\frac{0.392}{B}$ *or* $\frac{3.54 \times 10^{-3}}{B}$) ✓ 110 or 111 ✓	3	All 3 marks for correct answer

Question	Key	Question	Key
06	**B**	22	**C**
07	**C**	23	**B**
08	**A**	24	**D**
09	**D**	25	**D**
10	**B**	26	**A**
11	**C**	27	**B**
12	**D**	28	**C**
13	**B**	29	**A**
14	**A**	30	**C**
15	**B**	31	**C**
16	**C**	32	**A**
17	**B**	33	**D**
18	**D**	34	**D**
19	**A**	35	**D**
20	**A**		
21	**D**		