OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL A-LEVEL

PHYSICS

PH03

Unit 3 Fields and their consequences

Mark scheme

January 2020

Version: 1.0 Final

20IXPH03/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 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	Additional comments/guidelines	Mark
01.1	Two from: ✓ ✓ measure from equilibrium position time for ≥10 s time for ≥10 oscillations repeat timings and find mean		2
01.2	(resultant) force acts in opposite direction to displacement/x owtte ✓	Allow 'to the left'	1
01.3	ma =(–)kx ✓ Use of a = (–) $\omega^2 x$ ✓ Use of $\omega = 2\pi f$ and $T = \frac{1}{f}$ ✓ Correct handling of negative signs and power to give $T = 2\pi\sqrt{\frac{m}{k}}$ ✓	Don't allow $a = \omega^2 r$	4
Total			**7**

Question	Marking guidance	Additional comments/guidelines	Mark
02.1	Reads off graph (-7.4) and takes exponential to get Q_0 6.1×10^{-4} (C) ✓		2
02.2	Uses $C = \frac{Q}{V}$ to produce 1.22×10^{-4} (F) ✓		1
02.3	Extracts data correctly from the graph ✓ Correct use of data ✓ 79 (s) ✓	Methods may use gradient (1.27×10^{-2}), $T_{½}$ (55 s), time when Q=$0.37Q_0$, or a pair of readings from the graph and substitution into $Q = Q_0e^{-\frac{t}{RC}}$. Gradient method must use t≥150 s.	3
02.4	Uses time constant = RC (expect 0.66 MΩ) ✓ Uses parallel resistor formula ✓ 0.84 (MΩ) ✓	Allow any answer that rounds to 0.8 (MQ) from different intermediate values for C or time constant.	3
02.5	R is greater (in Fig 4) ✓ States time constant is larger, or calculates larger time contant **OR** References $V = IR$ with same V ✓ Lower (initial) rate of discharge or smaller (initial) current, from some reasoning ✓	Allow MP1 and MP2 for correct calculations of both initial currents. (Fig 3: 7 μA; Fig 4: 2 μA)	3
Total			**12**

Question	Marking guidance	Additional comments/guidelines	Mark
03.1	1.1×10^{4} (N) ✓		1
03.2	Vector addition of L and W ✓ Horizontal arrow drawn pointing right ✓	Allow parallelogram. W must be vertical.	2
03.3	Vertical component of lift = weight **OR** Lcos25 (= W) seen ✓ 2 sf value that rounds to 1.2×10^{3} (N) ✓	Allow Lsin65 or Lcosθ ecf from 03.1	2
03.4	Horizontal component of lift = centripetal force or Lsinθ = F_c **OR** uses $R^2 = L^2 - W^2$ ✓ Evaluates F_c (5070 N) **OR** uses centripetal force formula ✓ Allow range of 63 to 66 (m s^{-1}) ✓	Condone use of L in centripetal force equation for MP2 Allow 2 marks for 99 (m s^{-1}) and ecf for their 03.3.	3
03.5	(Aircraft) decreases height/altitude or gains vertical speed downwards or accelerates downwards ✓ (Because) vertical component of lift < weight ✓ (Aircraft) moves in smaller (arc) radius ✓ (Because horizontal component of lift increases, so) centripetal force increases ✓	Don't credit "L increases" Don't credit "L increases". Allow reference to centripetal force equation.	4
Total			**12**

Question	Marking guidance	Additional comments/guidelines	Mark
04.1	Uses $\omega = 2\pi f$ with $f = \frac{1}{T}$ or uses $\omega = \frac{2\pi}{T}$ directly ✓ 2.66×10^{-6} (rad s^{-1}) ✓	$T = 2.36 \times 10^{6}$ s	2
04.2	Uses $g = \frac{Gm}{r^2}$ for Earth ✓ 2.0×10^{-3} (N kg^{-1}) ✓	Condone POT in r	2
04.3	Uses $a = \omega^2 r$ ✓ 3.3×10^{-3} (m s^{-2}) ✓	Accept 3.2×10^{-3} (m s^{-2}). Allow 3.3×10^{-6} if failure to convert km to m already penalised in 04.2.	2
04.4	Two from: ✓ ✓ Idea that satellite's orbital period is lower than expected for this orbit or should be greater (at that distance/in absence of Moon) Idea that orbit requires greater centripetal force than that provided by Earth alone Idea that field strengths/forces of Earth and Moon will add (to provide required centripetal acceleration) Idea that effective mass (in Newton's gravitational law) or gravitational/centripetal force is larger	Orbital speed may be referenced instead of orbital period. Effective mass is combined mass of Earth and Moon	2
04.5	Line passing at right angles to all equipotential lines ✓	Condone 1 out of 5 crossings not at a right angle. Ignore any arrows.	1
Total			**9**

Question	Marking guidance	Additional comments/guidelines	Mark
05.1	0.86 (Wb s^{-1}) ✓	Allow 0.85 or 0.87	1
05.2	Induced emf caused by change in flux linkage ✓ Zero emf (between 1.90 and 1.95 s) because no change in flux linkage **OR** equal magnitudes of emf because (trolley at) constant speed ✓ And one from: ✓ Explains emf increases or decrease in terms of <u>rate of</u> change of flux linkage Explains change in sign in terms of Lenz's Law	Condone "flux" for "flux linkage" Condone reference to 'peak(s)'. If no mark given, allow 1 mark for idea that induced emf is caused by a change in magnetic field with coil	3
05.3	Uses $v = s/t$ with either 1.5, 2.5, 4.0 or 5.5 cm or with a duration taken from the graph ✓ 0.5 (m s^{-1}) ✓		2
05.4	Larger emf (for either peak) ✓ Narrower waveform (for either peak) ✓ Any two from: ✓ ✓ 2nd peak higher than 1st 2nd peak narrower than 1st Shorter separation between peaks	Sketch must start at 1.42 s for full marks	4
Total			**10**

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

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