OXFORD AQA
INTERNATIONAL QUALIFICATIONS

INTERNATIONAL A-LEVEL

PHYSICS

PH03

Unit 3 Fields and their consequences

Mark scheme

June 2025

Version: 0.1 Pre-Standardisation

256XPH03/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.

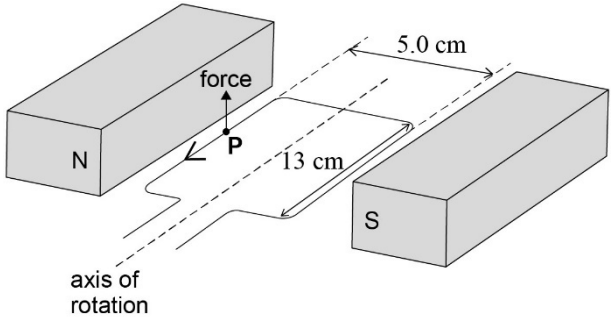
Step 2 Determine a mark

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	Current drawn as an arrow pointing along left-hand wire towards the front ✓		1	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
01.2	Any **two** from: ✓✓ • use of $F = BIL$ (with either distance) • use of couple $= Fs$ (with the other distance) • use of $66F$ couple $= 0.044$ (N m) ✓		3	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
01.3	$\varepsilon = Blv$ or 75 ($\times 10^{-3}$) × 8.75 ($\times 10^{-2}$) × 2.3 seen ✓ 0.015 (V) ✓		2	1 × AO1 1 × AO2

Total			**6**

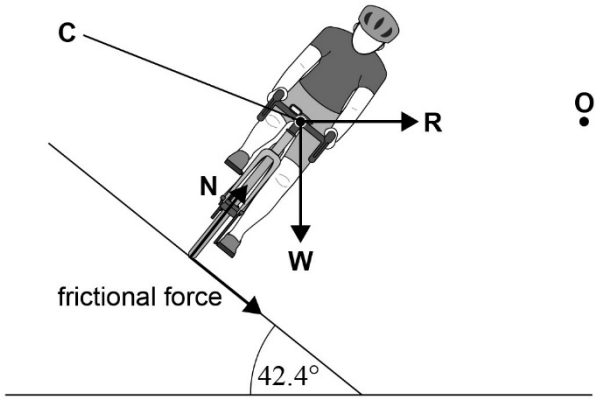
Question	Answers	Additional comments/Guidelines	Mark	AO
02.1	Substitution into $A = A_0 e^{-\lambda t}$ or valid rearrangement ✓ $t \left(= \frac{\ln\left(\frac{51}{121}\right)}{-3.08 \times 10^{-3}} \right) = 281$ (s) ✓		2	1 × AO1 1 × AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
02.2	Any **two** from: ✓✓ • use of $N = \frac{A}{\lambda}$ • use of $n = \frac{N}{N_A}$ • mass = n × molar mass mass = 1.4×10^{-12} (kg) ✓		3	2 × AO1 1 × AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
02.3	The uncertainty in the activity is very much less than the activity (for the sample) ✓ Cannot predict when a nucleus will decay / whether the nucleus will decay in 1 ms ✓	Condone for mp1 the activity / number of decays in one second for the large sample can be predicted	2	AO2

Total			7

Question	Answers	Additional comments/Guidelines	Mark	AO
03.1	Maximum frictional force $= \frac{mv^2}{r} = \frac{79.5 \times 14.2^2}{22.5} = 712$ N ✓	At least 3 sf required	1	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
03.2	Any **two** from: ✓ • normal acting at right angles to the surface where the tyre meets the road • weight acting downwards from centre of mass • resultant (centripetal) force acting horizontally to the right, touching rider or bike All **three** ✓		2	AO1

Question	Answers	Additional comments/Guidelines	Mark	AO
03.3	Finds horizontal component of N ✓ Resolves towards **O** and attempts to set up equation $N \sin 42.4° + F_2 = \frac{mv^2}{r}$ ✓ Shows that $F_2 = 11.2$ (N) **and** $11.2 < 710$ ✓	Allow ecf for wrong trig function in mp2 Allow use of $F_2 \cos 42.4°$	3	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
03.4	Component of normal contact force contributes to the centripetal force ✓ As the speed increases the required centripetal force increases ✓ The maximum speed on the flat is when max friction = centripetal force ✓ The maximum speed on the bank is when (horizontal component) max friction + (horizontal) component of reaction force = centripetal force which can be greater than maximum frictional force ✓	Condone 'provides' for 'contributes to'	4	AO2

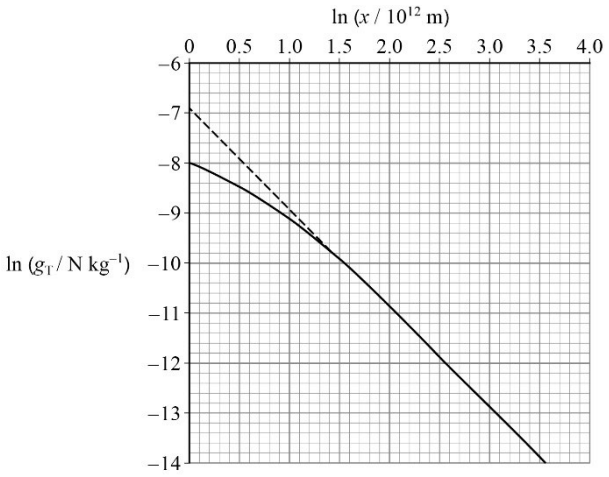
Total			**10**

Question	Answers	Additional comments/Guidelines	Mark	AO
04.1	The work done per unit mass ✓ in moving a (small test) mass from infinity to the point ✓		2	AO1

Question	Answers	Additional comments/Guidelines	Mark	AO
04.2	Any **one** from: ✓ • halve the potential or mass • use of $M = -\frac{Vr}{G}$ Mass of star **A** $= 8.0 \times 10^{30}$ (kg) ✓		2	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
04.3	Change in potential / change in distance ✓$_1$ Tangent drawn at their distance (range tbc) AND used for gradient with at least 4 squares on shortest side ✓$_2$ $g_T = 1.8 \times 10^{-4}$ (N kg^{-1}) AND $x = 1.1 \times 10^{-12}$ (m) ✓$_3$ (tolerance tbc)	[Show answer of 4.2] Condone misreads and data taken from curve for ✓$_1$ Condone misreads and missing or incorrect minus signs for gradient value in ✓$_2$ **Alternative** Read off max value from graph ✓$_1$ Use of trig to get component ✓$_2$ $g_T = 1.8 \times 10^{-4}$ (N kg^{-1}) AND $x = 1.1 \times 10^{-12}$ (m) ✓$_3$ (tolerance tbc)	3	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
04.4	Gravitational field strength is 0 at **O** ✓ Increases in magnitude (to a maximum) as x increases, then decreases in magnitude as x increases further ✓		2	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
04.5	Any **two** from: ✓✓ • straight line drawn as tangent to line at $\ln x = 4.0$ or statement that line has to be straight or use of logged equation aligned with $y = mx + c$ or idea that gradient = –2 • read-off where their straight line and curve diverge or attempt at read-off where line stops being straight • use of e^x with their read-off $x_{min} = 4.5–5.5 \times 10^{12}$ (m) ✓		3	AO3

Total			12

Question	Answers	Additional comments/Guidelines	Mark	AO
05.1	Use of $\Delta V = Ed$ ✓ 2.7×10^5 (V) ✓ 2 significant figures ✓	2.66×10^7	3	AO1

Question	Answers	Additional comments/Guidelines	Mark	AO
05.2	Use of $F = QE$ ✓ Use of $F = ma$ ✓ 1.27×10^{15} (m s^{-2}) ✓		3	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
05.3	The electric field is 0 / $\Delta V = 0$ inside the cylinder ✓ So no work is done / there is no force ✓ Vacuum so no collisions with gas particles to slow electrons down / change their direction ✓		3	1 × AO1 2 × AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
05.4	Protons travel faster in subsequent tubes ✓ Reference to $s = vt$ to give longer distance for same time ✓		2	AO2

Total			**11**

Question	Answers	Additional comments/Guidelines	Mark	AO
06.1	$(1 - e^{-1} =) 0.63$ ✓	Allow 63%	1	AO1

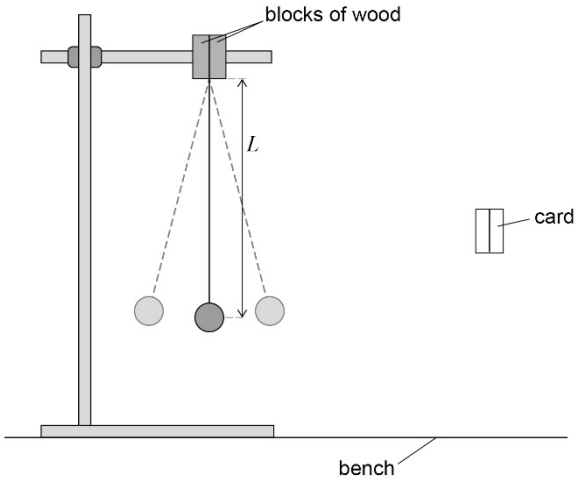
Question	Answers	Additional comments/Guidelines	Mark	AO
06.2	Reading of 5.5 (mA) for y-intercept and use of $I = \frac{V}{R}$ ✓ 1100 (Ω) to at least 2 sf ✓		2	1 × AO2 1 × AO3

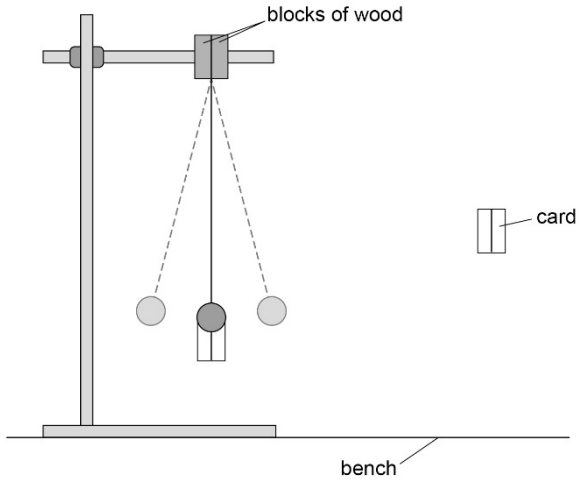
Question	Answers	Additional comments/Guidelines	Mark	AO
06.3	Use of $I = I_0 e^{-\frac{t}{RC}}$ with data from graph ✓ Time constant = 8.0–8.4 (s) ✓ Capacitance = $\left(\frac{\text{their time constant}}{\text{their answer to } \mathbf{06.2}}\right)$ ✓		3	AO3

<table>
<tr><th>Question</th><th>Answers</th><th>Additional comments/Guidelines</th><th>Mark</th><th>AO</th></tr>
<tr><td>06.4</td><td>
<table>
<tr><th>Mark</th><th>Criteria</th></tr>
<tr><td>6</td><td>All three areas covered in some detail.
6 marks can be awarded even if there is an error and/or parts of one aspect missing.
However, for 6 marks an explanation for the negative current after 7 s must be present.</td></tr>
<tr><td>5</td><td>All three areas covered, at least two in detail.
Whilst there will be gaps, there should only be an occasional error.</td></tr>
<tr><td>4</td><td>Two areas successfully discussed, or one discussed and two others covered partially. Whilst there will be gaps, there should only be an occasional error.</td></tr>
<tr><td>3</td><td>One area discussed and one discussed partially, or all three covered partially. There are likely to be several errors and omissions in the discussion.</td></tr>
<tr><td>2</td><td>Only one area discussed or makes a partial attempt at two areas.</td></tr>
<tr><td>1</td><td>None of the three areas covered without significant error.</td></tr>
<tr><td>0</td><td>No relevant analysis.</td></tr>
</table>
</td><td>Changes from $t = 0$ to $t = 7$ s
• capacitor charges
• voltage increases
• larger charge on capacitor

Relationship between meter readings
• voltage across capacitor increases so voltage across resistor decreases, so current falls
• making it more difficult for charge to be added to capacitor, so current falls
• current = voltage across resistor/ resistance of resistor
• emf = voltage across capacitor (voltmeter reading) + voltage across resistor

Changes after $t = 7$ s
• current flows in opposite direction when discharging hence negative
• capacitor discharges
• voltage across capacitor falls so voltage across resistor falls, so current falls
• charge falls on capacitor
• so less force on pushing charges round circuit so current falls</td><td>6</td><td>2 × AO2
4 × AO3</td></tr>
<tr><td>Total</td><td></td><td></td><td>12</td><td></td></tr>
</table>

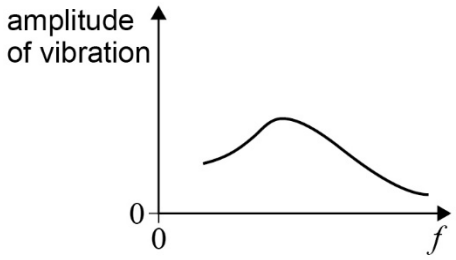
Question	Answers	Additional comments/Guidelines	Mark	AO
07.1	Arrow drawn from bottom of blocks of wood to level with the centre of the pendulum bob ✓		1	AO4

Question	Answers	Additional comments/Guidelines	Mark	AO
07.2	Vertical line aligned with string in vertical position. Part of card should be behind and below the bob ✓ The bob is moving fastest here (so the uncertainty in judging the time when it passes the mark is smallest) ✓		2	1 × AO3 1 × AO4

Question	Answers	Additional comments/Guidelines	Mark	AO
07.3	Any **two** from: ✓✓ • measure $10T$ and divide by 10 • repeat and average • ensure pendulum is viewed perpendicular to oscillations	Condone: • ensure that the pendulum is only allowed to swing through a small angle ($<15°$) / pendulum is only displaced a small amount / small-amplitude oscillations • countdown method for timing	2	AO4

Question	Answers	Additional comments/Guidelines	Mark	AO
07.4	Recorded half oscillations instead of full oscillations ✓ $g\left(=\frac{39.1}{4}\right)=9.78\ (\text{m s}^{-2})$ ✓		2	AO3

Total			**7**

Question	Key	Answer	AO
08	**C**	$0.37\ \text{m s}^{-1}$	AO1
09	**D**		AO1
10	**A**	$\frac{R}{4}$	AO1
11	**D**	$9.0\ \text{nC}$	AO2
12	**A**	A s V^{-1}	AO1
13	**C**	$0.08 \quad 3.6$	AO2
14	**D**	8.37×10^{19}	AO2
15	**B**	ln(number of decayed nuclei) against ln(time)	AO1
16	**B**	The kinetic energy of the particle is constant.	AO1

17	**C**	69°	AO2
18	**C**	2A 0.5f	AO2
19	**A**	**P** and **R** arrive together, followed by **Q**.	AO1
20	**D**	8 A	AO2
21	**C**	95%	AO2
22	**C**	2.8 cm	AO2

Total marks = 15