OXFORD AQA

INTERNATIONAL QUALIFICATIONS

INTERNATIONAL A-LEVEL

PHYSICS

PH05

Unit 5 Physics in practice

Mark scheme

January 2026

Version: 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 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	Take the voltmeter reading with the switch open – this is the emf (ε) ✓1 Determination of the lost volts = emf – voltmeter reading with switch closed ✓2 Valid method to find r eg use of potential divider formula **OR** $r = 210 \times \frac{\varepsilon - V}{V}$ **OR** $I = \frac{\text{lost volts}}{210}$ and use of $V = IR$ ✓3	If ✓1 and ✓2 are not awarded then allow ✓12 for recording the voltmeter reading with the switch open and closed. To award the mark, method must show how to determine r Do not credit methods using an ammeter for ✓3	3	1 × AO1 2 × AO4

Question	Answers	Additional comments/Guidelines	Mark	AO
01.2	Any **two** from: ✓✓ • when capacitor is fully charged, current is zero • no lost volts, (since no current through internal resistor) • voltage across capacitor = emf – 0 **OR** voltage across capacitor = emf – lost volts – voltage across resistor	Condone missing voltage across resistor	2	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
01.3	Determination of gradient using triangle with $\Delta t > 30$ s ✓ 2 sf or 3 sf answer that rounds to -0.043 ✓	Answer must be negative	2	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
01.4	Use of $C = \dfrac{1}{210 \times \text{gradient}}$ to produce answer that rounds to 0.1 to at least 2 sf ✓	Allow ecf from **01.3** Answer must be positive	1	AO3

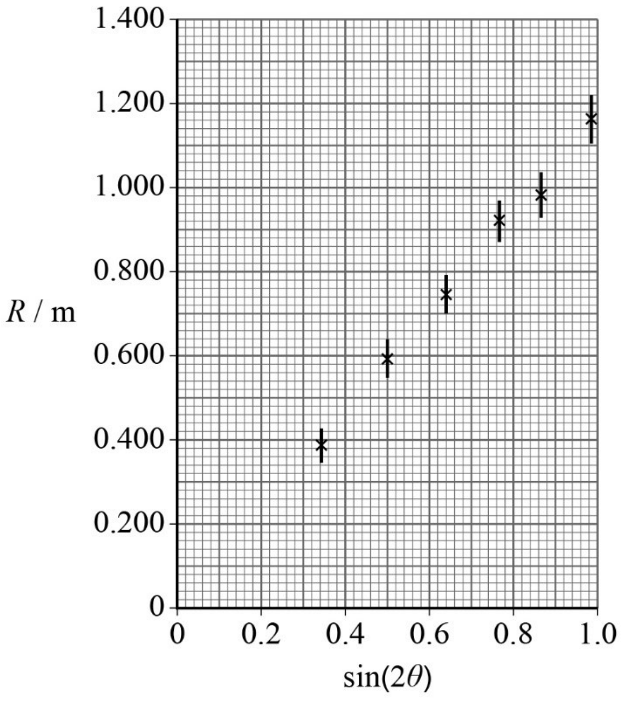
Question	Answers	Additional comments/Guidelines	Mark	AO
01.5	Correct method to determine time constant in range 24 s to 25 s ✓ Use of $T = RC$ with their T and C ✓ Use of r = their $R - 210$ ✓	Allow determination of the half life in range 16 s to 17 s for mp1 Allow use of $RC = \dfrac{T_{\frac{1}{2}}}{\ln 2}$ for mp2 Allow ecf from **01.4** for their C Do not award a negative value for r or 210--R Alternative method for mp1 and mp2: Use of $V_0 = 1.5$ V and correct t and V reading ✓ Use of $V = V_0\left(1 - e^{-\frac{t}{RC}}\right)$ ✓	3	AO3

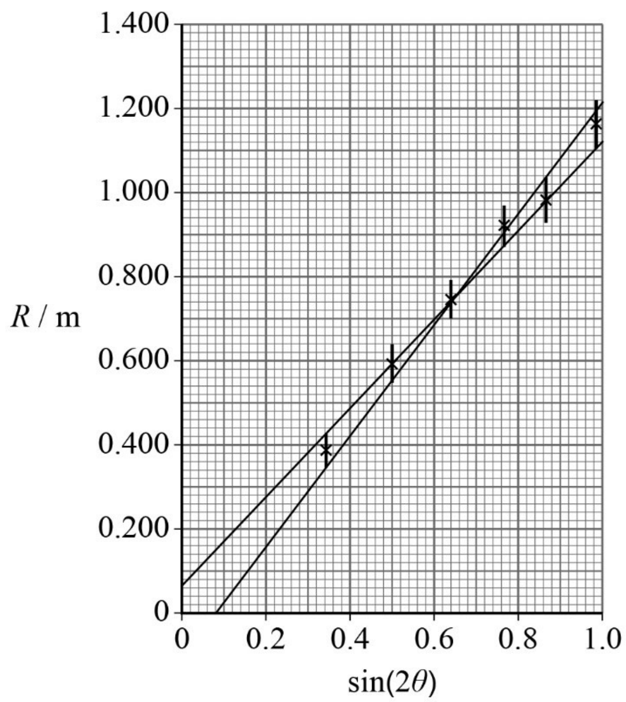
Question	Answers	Additional comments/Guidelines	Mark	AO
01.6	Any **two** from: ✓✓ • no (variation in) reaction time for datalogger • datalogger allows simultaneous reading of time and voltage • datalogger reduce uncertainty in time readings • change in resistance due to use of datalogger / max charging voltage leads to an incorrect value for r • voltmeter measuring r closer to accepted value • smaller **total** resistance of datalogger is likely to lead to an incorrect value for r or incorrect time constant. • extra resistance in charging circuit leads to lower value of max voltage Idea that voltmeter and stopwatch are better with at least one advantage for voltmeter AND the datalogger ✓	Allow measures in smaller time intervals Do not accept records time more accurately Alternative for mp3: idea that datalogger is better if resistance of voltage sensor is measured and included in value for R In MP3 a disadvantage for the datalogger is equivalent to an advantage for the voltmeter.	3	AO2

Total			**14**

<table>
<tr><th>Question</th><th>Answers</th><th>Additional comments/Guidelines</th><th>Mark</th><th>AO</th></tr>
<tr><td>02.1</td><td><table><tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th></tr><tr><td>0.708</td><td>0.733</td><td></td><td></td><td>0.793</td></tr></table>
All three correct and 3 sf ✓</td><td></td><td>1</td><td>AO1</td></tr>
</table>

Question	Answers	Additional comments/Guidelines	Mark	AO
02.2	mean = 0.745 (m) ✓ uncertainty = 0.043 (m) ✓	Condone 0.75 if uncertainty quoted to 1 sf Condone 0.04 Do **not** allow more sf	2	AO1

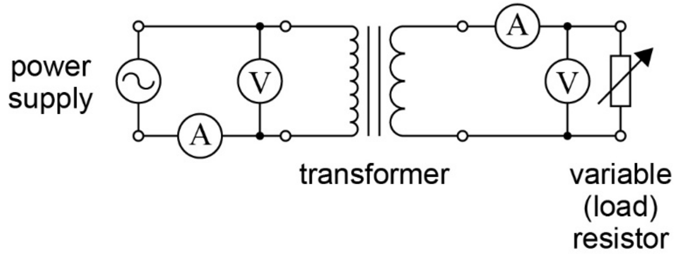
Question	Answers	Additional comments/Guidelines	Mark	AO
02.3	Mean marked by cross at $(0.643,\ 0.745)$ ✓ Error bar consistent with their plotted point and their uncertainty. Expect top of bar $= 0.788$ (m) and bottom of bar $= 0.702$ (m) Expect error bar to around 4.3 boxes ✓	 Do **not** allow: min $= 0.708$ m and max $= 0.793$ m Allow ecf for their values in **02.2**	2	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
02.4	Correct max line (bottom of first to top of fifth) ✓ Correct min line (top of first to bottom of last) ✓ Correct method and data from triangle of minimum side length $0.6\ \mathrm{m}$ ✓	 Allow ecf for their error bars Each line should go through all the error bars. For mp1 and mp2 lines must extend to cover the range of all the points.	3	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
02.5	Mean gradient found ✓ Use of square root of (mean gradient $\times$ 9.81) ✓ Answer that rounds to 3.3 to 3.5 ($m\ s^{-1}$) ✓	Do not accept a third best fit line for mp1 cao	3	2 × AO3 1 × AO4

Question	Answers	Additional comments/Guidelines	Mark	AO
02.6	Uncertainty $= \dfrac{\text{max gradient} - \text{min gradient}}{2}$ ✓ Percentage uncertainty of gradient calculated ✓ Add 0.4 to the percentage uncertainty in gradient and multiply by 0.5 ✓	$\dfrac{\text{max gradient} - \text{min gradient}}{\text{max gradient} + \text{min gradient}} \times 100$ scores mp1 and mp2. Allow ecf Allow 1 sf Expect 5.5%	3	1 × AO2 2 × AO4

Total			**14**	

Question	Answers	Additional comments/Guidelines	Mark	AO
03.1	Ammeters and voltmeters placed to allow primary and secondary currents and voltage to be measured, with connections connected correctly into a working circuit ✓	 Allow oscilloscope instead of voltmeter	1	AO4

Question	Answers	Additional comments/Guidelines	Mark	AO
03.2	Vary the resistance of the variable resistor ✓ Determine $R = \frac{V_S}{I_S}$ ✓ Calculate the efficiency $= \frac{I_S V_S}{I_P V_p}$ ✓		3	AO4

Question	Answers	Additional comments/Guidelines	Mark	AO
03.3	Draw line of best fit ✓		1	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
03.4	70 to 90 (Ω) ✓		1	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
03.5	Take more readings around the peak ✓ Idea that there are smaller intervals between readings ✓		2	AO4

Total			**8**

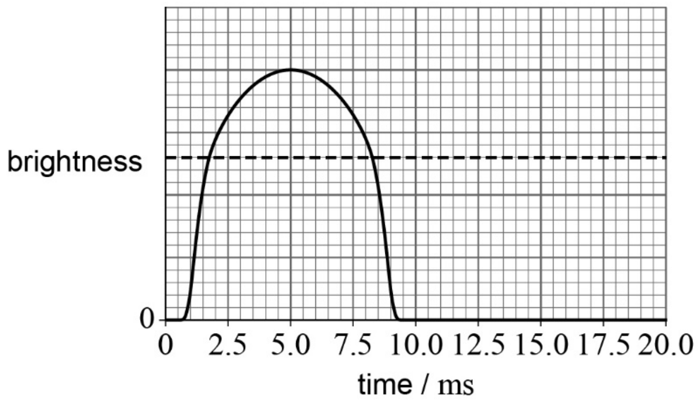
Question	Answers	Additional comments/Guidelines	Mark	AO
04.1	Use of $R = \frac{V^2}{P}\left(= \frac{12^2}{19} = 7.6\ \Omega\right)$ **OR** $\rho = \frac{RA}{l}$ for their resistance ✓ 7.9×10^{-7} (Ω m) ✓	Allow PoT in mp1	2	AO1

Question	Answers	Additional comments/Guidelines	Mark	AO
04.2	Any **three** from: ✓✓✓ • use of $V = Al$ • use of $\rho = \frac{m}{V}$ with their volume • use of $Q = mc\Delta\theta$ with their mass • use of $t = \frac{Q}{P}$ with their heat 8.4×10^{-3} to 8.5×10^{-3} (s) ✓	Allow PoT in mp1 and mp2 Expect $V = 2.66 \times 10^{-11}\ \mathrm{m^3}$ Expect $m = 5.05 \times 10^{-7}$ kg Expect $Q \approx 0.2$ J (allow use of 2700 for $\Delta\theta$ but expect subtraction of 300 K)	4	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
04.3	Resistance increases with temperature **OR** resistance is lower while temperature is lower ✓ $P = \frac{V^2}{R}$ OR P=IxV with a correct reference to I **AND** power is higher at a lower temperature / lower resistance so t will be less / faster heating ✓	If no other mark, award max 1 for resistance increases without reference to temperature Do not allow $P=I^2R$ For mp2 the time taken for the real value of t must be less than the calculated t.	2	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
04.4	$V_0 \left(= 12\sqrt{2}\right) = 17 \text{ (V)}$ ✓		1	AO1

Question	Answers	Additional comments/Guidelines	Mark	AO
04.5	Use of $R = \frac{V}{I}$ for their V and I **OR** $V = 5 - 2.8$ **OR** $V = 2.2$ (V) seen ✓ $R = \left(\frac{V}{I} = \frac{5 - 2.8}{44 \times 10^{-3}}\right) = 49$ to 55 (Ω) ✓		2	1 × AO2 1 × AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
04.6	0 brightness for $t > 10$ ms ✓ Brightness 0 for $t < 0.8$ ms (1-2 boxes) and $t > 9.2$ ms (1-2 boxes before 10) **AND** brightness > 0 for 0.8 ms $< t < 9.2$ ms ✓ Brightness is at dashed line when $t = 1.7$ s (3-4 boxes) **AND** $t = 8.3$ ms (3-4 boxes before 10ms) ✓ Rises to a peak at 5 ms ✓	 Do **not** allow mp4 for a sine wave. Check the points only; do not insist on a particular shape of graph Allow tolerance of ± half a grid square Allow the non-zero part of the graph anywhere as long as it lasts for 8.4 ms	4	AO3

Total			**15**

Question	Answers	Additional comments/Guidelines	Mark	AO
05.1	vernier or digital callipers ✓		1	AO4

Question	Answers	Additional comments/Guidelines	Mark	AO
05.2	Any **two** from: ✓✓ • use of $p_1V_1 = p_2V_2$ or use of $pV=nRT$ or use of $pV=NkT$ • calculation of length using correct area and either $V_2 - V_1$ **OR** V_2, V_1 • use of $mg = k\Delta L$ **OR** use of $F = pA$ 2.2×10^3 (N m^{-1}) ✓ Temperature remains constant / allowed to come to thermal equilibrium with room OR There is no friction between plunger and barrel ✓	Expect $V_2 = 8.88 \times 10^{-5}$ m^{-3} Expect $\Delta L = 4.5 \times 10^{-4}$ Allow $p_1L_1 = p_2L_2$ Allow 2.3×10^3 Allow isothermal change Ignore references to no air leaks, references to ideal gas and plunger mass.	4	3 × AO2 1 × AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
05.3	Decreases the (initial and final) volume(s) (leading to a smaller change in volume) ✓ Decreases the extension (for the same mass) and hence increases the spring constant ✓	Allow for the same extension a greater mass/force is required and hence increases the spring constant.	2	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
05.4	Any **two** from: ✓✓ • damping force • due to friction (in syringe) • force is in the opposite direction to motion	Allow correct answers beyond the specification e.g. reference to critical damping	2	AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
05.5	Use of $pV = nRT$ ✓ 0.021 (mol) ✓	Condone use of $21\ °\mathrm{C}$ for T	2	1 × AO1 1 × AO3

Question	Answers	Additional comments/Guidelines	Mark	AO
05.6	Read volume from at least 2 peaks or troughs ✓ Use of ratio of $\frac{\Delta V_1}{\Delta V_2}$ for at least 2 sets of data ✓ Use at least 3 sets of data and conclusion that it is exponential ✓	Peaks: V (ΔV) 5.058 (0.058), 5.041 (0.041), 5.029 (0.029) Troughs: V (ΔV) 4.930 (0.070), 4.951 (0.049), 4.966 (0.034) Allow ecf for incorrect mean volume but not for using V rather than ΔV Allow any valid method	3	AO3

Total			**14**	

Question	Answers	Additional comments/Guidelines	Mark	AO
06.1	Any **three** from: ✓✓✓ • the spring provides a centripetal force (that pulls friction blocks inward) • centripetal force increases with (angular) speed • idea that if the centripetal force required is greater than the spring provides, the friction block moves outward • idea that greater (spring) force requires greater extension / increases in length.		3	2 × AO1 1 × AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
06.2	Any **three** from: ✓✓✓ • use of $F = k\Delta L$ • use of their $F = \dfrac{mv^2}{r}$ **OR** $F = mr\omega^2$ for either r • use of $v = r\omega$ for either r • use of $r = 2.1$ in $v = r\omega$ **AND** $r = 10.3$ with centripetal force 0.63 (m s^{-1}) ✓	Ignore PoT for first **3 marks** Expect $F = 12$ N Expect $\omega = 30$ rad s^{-1}	4	1 × AO1 3 × AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
06.3	Any **three** from: ✓✓✓ • idea that some of the gravitational potential energy is turned into rotational energy in the friction brake • idea that some of the gravitational potential energy is turned into elastic potential energy in the friction brake • resultant force on boat = weight – tension OR weight – friction • idea that there is tension in the rope (due to centripetal force acting on the drum) • idea that there is friction at the axle or at the pulley or between the rope and a named surface • smaller **resultant** force means a is decreased OR use of F=ma with the resultant force to show a reduced a	A valid location for the friction must be named, do not allow just friction of the rope	3	AO2

Question	Answers	Additional comments/Guidelines	Mark	AO
06.4	Any **five** from: ✓✓✓✓✓ • moving magnets creates a changing magnetic <u>flux</u> (or flux linkage) in the copper strip • according to Faraday's law this induces an emf in the copper strip • copper is a conductor so there is a current • this current produces a magnetic field • which according to Lenz's law opposes the change that created it • the magnetic field created exerts a force to slow down the moving magnet (which is connected to the shaft)	Allow statement of Faraday's law in words or equations which is applied for bp2. A reference to magnetic field is not required for bp5	5	2 × AO1 2 × AO2 1 × AO3
Total			**15**	