OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL A-LEVEL

PHYSICS

PH05

Unit 5 Physics in practice

Mark scheme

January 2020

Version: V1 Final Mark Scheme

201XPH05/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	$t = 41.9(2)$ ✓	Accept 3 or 4 sf only	1
01.2	1.4 ✓	no sf penalty	1
01.3	• Reaction time error when starting and stopping the stopwatch • Not all water samples exactly the same volume • Not all water samples at the same temperature • Movement of the flexible tubing ✓✓	Any two from four Accept other reasonable answer – eg no clear end to flow (drips)	2
01.4	2.86×10^{-6} ($m^3\,s^{-1}$) ✓	Exact answer only	1
01.5	Finds the percentage uncertainty in V ✓ Candidate's % uncertainty in V plus candidate's 01.2 ✓	Expect 1.7% but accept 0.8% if the candidate assumes that measuring cylinder reading can be interpolated. Expect 5% No sf penalty	2
01.6	It is precise if there is only a small (random) variation in (repeated) measurements wtte ✓		1
Total			**8**

Question	Marking guidance	Additional comments/guidelines	Mark
02.1	Well drawn smooth curve passing through or near to all the plotted points with an even scatter of the points about the line ✓		1
02.2	Subtracts: $\ln R_1 - \ln R_2 = B/2kT_1 - B/2kT_2$ so that $\ln A$ disappears ✓ Manipulation of logs seen $\ln R_1 - \ln R_2 = \ln\left(\frac{R_1}{R_2}\right)$ ✓		2
02.3	$T_1 = (200 \pm 2) + 273 = 473 \pm 2$ $T_2 = (242 \pm 2) + 273 = 515 \pm 2$ ✓✓	First mark for two correct read-offs Second mark for correct conversion of read-offs to kelvin	2
02.4	Correct substitution into formula ✓ $B \approx 2.5 \times 10^{-19}$ J or 2.6×10^{-19} J ✓ J ✓ expressed to 2 sf✓	condone 3 sf	4
Total			**9**

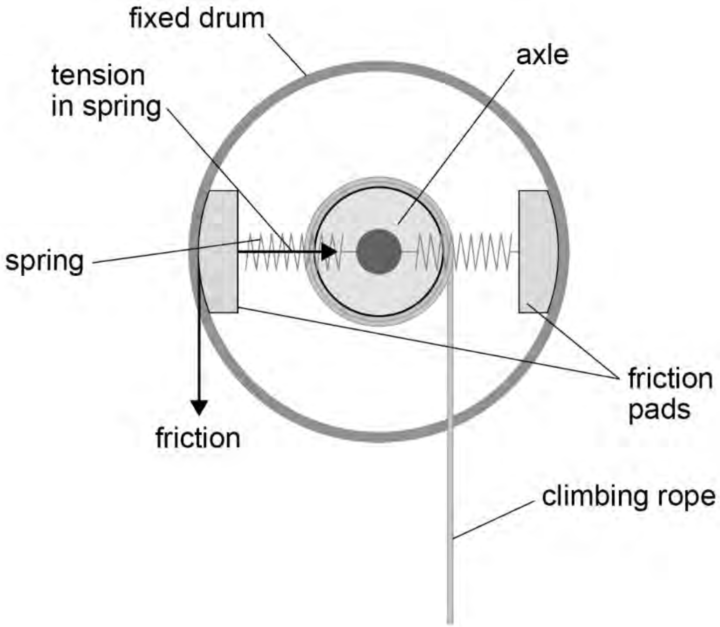
Question	Marking guidance	Additional comments/guidelines	Mark
03.1	$Mgd = TD$ OR $T = k\,\Delta L$ or $T = 25\ \Delta L$ ✓ Both equations seen with convincing manipulation to give $M = \dfrac{25D\Delta L}{dg}$ ✓		2
03.2	Any five from: • use a metre ruler to measure D • then for 6 (or more) values of d, measure d and ΔL • adjusting the support so that the bar is horizontal each time OR means of checking that bar is horizontal or spring is vertical • plot a graph of ΔL against d and draw a best-fit straight line • measure the gradient of the line equate this value to $(Mg\,/\,Dk)$ to find M ✓✓✓✓✓		5
Total			**7**

Question	Marking guidance	Additional comments/guidelines	Mark
04.1	Sensible scale marked on the ordinate ✓ At least three points accurately plotted ✓ All six points accurately plotted ✓ All error bars correctly marked ✓ Well drawn straight line of best fit ✓	The scale should allow points to plotted on half the graph area or more Accurately means within half a grid square. The line of best fit should pass through all error bars and follow the trend of the points with an even scatter of points on either side of the line.	5
04.2	Large triangle used to find the gradient of the line of best fit ✓ Value of gradient in the range 2.8 to 3.0 ✓	2 or 3 sf only	2
04.3	ε calculated correctly from $4.80 / \text{gradient}$ ✓ Attempt to find r from a point on the line of best fit ✓ r in the range 0.3 to $0.5\ \Omega$ ✓	The expected value for ε is about $1.6\ \text{V}$ No unit penalties	3
04.4	Minimise heating effect changing the resistance of the wire ✓ The percentage uncertainty in L is smaller for longer lengths (leading to more accurate value for the gradient) ✓		2
Total			**12**

Question	Marking guidance	Additional comments/guidelines	Mark
05.1	Reactant nuclei need to get within ~ fm✓ Large electrostatic repulsion between nuclei ✓ Initial E_k of nuclei equivalent to E_p when in close proximity ✓ Nuclei have sufficient E_k only at very high temperature ✓ MAX 3		3
05.2	Ionised so there are significant forces between particles (even when particles are between collisions) ✓ May be high pressure so volume occupied by particles not negligible compared with volume of plasma ✓ Short time/distances between collisions so duration of collisions not negligible ✓ ANY 2	Allow Effect of magnetic field means motion not random.	2
05.3	Attempts to calculate change in binding energy including multiplying BE/nucleon by numbers of nucleons. ✓ 17.6 (MeV) seen OR multiplies by 1.6×10^{-13} ✓ $2.8(2) \times 10^{-12}$ (J) ✓	Expect to see $(4 \times 7.07) - \{(2 \times 1.11) + (3 \times 2.83)\}$	3
05.4	$\frac{5 \times 10^{8}}{2.82 \times 10^{-12}}$ seen ✓ Divides by Avogadro and multiplies by 5 (total molar mass of reactants) OR multiplies by $5 \times 1.661 \times 10^{-27}$✓ 1.47×10^{-6} (kg s^{-1}) ✓	If using N_A, condone 10^{-3} error for 2nd MP Accept use of 1.67×10^{-27}	3

Question	Marking guidance	Additional comments/guidelines	Mark
05.5	Charged particles so trapped within containing magnetic fields wtte ✓	Accept comments relating to the penetrating power of neutrons and alpha particles	1
Total			**12**

Question	Marking guidance	Additional comments/guidelines	Mark
06.1	Correct substitution in $f = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$ leading to 73.6 (m) ✓	To at least 3 sf	1
06.2	Use of Pythagoras ✓ 9.65×10^{-5} (m) ✓	To at least 2 sf	2
06.3	Attempt to use $E = \frac{Fl}{\Delta l A}$ ✓ Correct substitution including use of ΔF as 1.4 ✓ 1.9×10^{11} (Pa) ✓		3
06.4	Use of any $E = F\Delta l$ ✓ $7.1(4) \times 10^{-3}$ (J) ✓	Accept use of $E = \frac{1}{2}F\Delta l$ for MP1 Look for average F = 74.3 or 74.7 multiplied by their 06.2 To at least 2 sf	2
06.5	Use of $I = \frac{P}{4\pi r^2}$ ✓ 8.0×10^{-6} (W m^{-2}) ✓	Condone omission of 8 seconds, ie accept P = 7 × 10^{-3} for 1st MP ecf from 06.4 – look for candidate's 06.4 divided by 900	2
06.6	Frequency of string not similar to <u>natural</u> frequency of nut✓ Heavy damping (prevents large amplitude oscillations) ✓		2
Total			**12**

Question	Marking guidance	Additional comments/guidelines	Mark
07.1	Use of $v = r\omega$ ✓ leading to 65.2 (rad s^{-1}) ✓	Substitution or rearrangement To at least 3 sf	2
07.2		Forces must be positioned and labelled correctly Friction should be at any point between pad and drum	2

Question	Marking guidance	Additional comments/guidelines	Mark
07.3	Uses $mr\omega^2$ ✓ $mr\omega^2$ = normal reaction + spring tension ✓ 380 N or $20(.25)$ N seen ✓ 2530 (N m^{-1}) ✓	Allow variation of answer for use of 65 instead of 65.2 for angular speed: force = 22.2 N and spring constant = 2780 N m^{-1}	4
07.4	Attempts to use principle of moments ✓ 818 or 820 (N) cao ✓	Candidates who forget that there are 2 friction pads can still get this mark	2
07.5	Candidate's answer to 07.4 ✓ Travelling at uniform speed so in equilibrium wtte ✓		2
07.6	Emf induced in plate as it is a conductor moving through a magnetic field or wtte ✓ Either: disc experiences a force due to current in mag field with possible reference to BIl ✓ force opposes motion of disc with reference to Lenz's Law ✓ OR Current in disc heats disc with possible reference to I^2r ✓ Energy comes from work done by climber descending on rope with reference to conservation of energy ✓		3

Question	Marking guidance	Additional comments/guidelines	Mark
07.7	Use of $Q = mc\Delta\theta$ ✓ Use of $E_k = \frac{1}{2}mv^2$ ✓ Use of $E_p = mg\Delta h$ ✓ Any of the following energies seen $E_p = 5100$ $E_k = 203$ J ; $Q = 4898$ J ✓ 20(.5) K ✓	Correct answer gets 5 marks	5
Total			**20**