OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL A-LEVEL
Physics

PH05-Unit 5 Physics in practice
Mark scheme

June 2018

Version/Stage: 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 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 aqa.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	Answer in the range 0.185 to 0.200 ✓ Large triangle plus some evidence of correct data extraction ✓	2	
01.2	$g = \frac{2}{\text{gradient}}$ ✓ Answer in range 10.0 to 10.8 ✓	2	Ecf from 01.1 Max 1 dp
01.3	Draws another line that has max possible or min possible gradient and finds a new value for g ✓ Draws 2 lines: max gradient and min gradient ✓ Uncertainty is half of the range of values of g given by their 2 extreme gradients expect to see approx $\pm$ 1.6 **or** uncertainty is the difference between their new g and their value for 01.2 ✓	3	Condone max or min gradient through the origin Not through the origin for this mark
Total		**7**	

Question	Marking guidance	Mark	Comments
02.1	0.4 ✓	1	Accept 0.38
02.2	Reduce the effect of random errors **or** identify anomalous results to reject these **or** confirm the uniformity of the wire ✓	1	Not just to ensure accuracy or to get a mean
02.3	0.20 cao ✓ (±) 0.01 ✓	2	
02.4	$A = 3.1 \times 10^{-8}$ ✓ ecf from 02.3 % uncertainty in d is 5% **or** doubles candidate's % uncertainty in d to find % uncertainty in A ✓ 10% cao ✓	3	2 or 3 sf only
02.5	1.1×10^{-6} ✓ adds the percentage uncertainty in L, A and R ✓ ecf uncertainty in $\rho = 0.1 \times 10^{-6}$ **to** 0.15×10^{-6} **ecf** ✓	3	1 or 2 sf

02.6	(If the wire were to be twice as thick then) The percentage uncertainty in area would reduce **or** the percentage uncertainty in resistance would increase ✓ correct numerical comment about the change in percentage uncertainty eg: percentage uncertainty in area becomes ¼ of previous value **or** the percentage uncertainty in R would increase by a factor of 4 ✓ Correct comment about the combined effect of the changes in uncertainties eg this would have a smaller effect on uncertainty in ρ since (%) uncertainty in R < (%) uncertainty in A ✓	3	Can get this mark for calculating a new uncertainty (look for 8.9%)

Total		**13**	

Question	Marking guidance	Mark	Comments
03.1	665 6.500 572 6.349 513 6.240 428 6.059 381 5.943 336 5.817	1	All 6 correct to either 3 or 4 sf in the ln column.
03.2	Sensible scale (with appropriate label/unit) marked on the y-axis ✓ five points accurately plotted ✓ Six points accurately plotted ✓ Well drawn straight line of best fit ✓	4	The line of best fit should follow the trend of the points with an even scatter of points on either side of the line. Must have acceptable scales to get the plotting marks Can get the final mark even with a poor scale
03.3	Gradient value quoted with a minus sign ✓ Value in the range 0.0136 to 0.0140 (with or without minus sign) ✓	2	2 or 3 sf only Ignore any unit given
03.4	Candidate's answer to 03.3 **without a minus sign** ✓ Unit = s^{-1} ✓	2	
03.5	There could be a systematic error in the measurement of h ✓	1	Accept other plausible answers
03.6	Since h is numerically large this would be unlikely to affect the gradient and hence λ ✓	1	Sensible comment about significance of the error
Total		**11**	

Question	Marking guidance	Mark	Comments
04	• Take measurements of T for six (or more) different values of l ✓ • Use the metre ruler to measure l ✓ • Time ten (or more) oscillations and repeat and average this measurement ✓ • Calculate the mean value of T ✓ • Plot a graph of T^2 against l^3 ✓ The formula would be verified if • The best-fit line is straight through the origin ✓	5	Award any four of the first four marking points plus last marking point
Total		**5**	

Question	Marking guidance	Mark	Comments
05.1	The dust particle loses electron(s) leaving them with surplus positive charge wtte ✓	1	
05.2	Use of $E = \frac{V}{d}$ ✓ **or** use of $F = Eq$ ✓ Both seen and leading to 2.14×10^{-13} (N) ✓	2	To at least 2 sf
05.3	$s = vt$ in some form as a symbol equation leading to 0.047 (s) ✓	1	
05.4	Use of $a = \frac{F}{m}$ ✓ Use of $s = \frac{1}{2}gt^2$ ✓ Leading to 48 mm ✓ Conclusion that particles (between 48 mm and 56 mm from the negative plate) will fail to reach the plate wtte ✓	4	39 mm, 42 mm, 45 mm or 48 mm according to which data is used from 05.2 and 05.3.
05.5	Any plausible conclusion with reasoning eg Gap narrower so field strength or force greater so more particles reach the plate ✓ **or** gap narrower so air flow obstructed so more time in which to reach the plate ✓ **or** gap narrower so less vertical distance to travel so more particles reach the plate ✓ Charged particles will be pushed closer together and be affected by stronger electrostatic forces ✓ ANY 3	3	
Total		**11**	

Question	Marking guidance	Mark	Comments
06.1	Use of $E_k = \frac{3}{2}kT$ ✓ Conversion to absolute temperature – look for 773 ✓ 1.60×10^{-20} (J) ✓	3	
06.2	(number of molecules) $\frac{16000}{18} \times N_A$ **or** multiplies candidate's number of mol by candidate's 06.1 ✓ 8.6×10^{6} (J) ✓ **ecf from 06.1**	2	
06.3	Argues that the pressure is too high to be an ideal gas and there will be intermolecular forces so it is not the same ✓	1	
06.4	Some steam condenses in the turbine… ✓ releasing latent heat ✓	2	Allow 1 for candidate who argues that energy stored in gas at high pressure / reference to p×V
06.5	Uses $P = T\omega$ ✓ Uses $\omega = 2\pi f$ ✓ 5.09×10^{4} Nm ✓	3	
06.6	14.4 MW seen ✓ Uses power = V × I ✓ 565 A ✓	3	

06.7	Emf induced in coil ✓ Causes current in coil ✓ Current carrying conductor in magnetic field experiences a force ✓ Torque = force distance or mention of Lenz’s law ✓	4	

Total		**18**	

Question	Marking guidance	Mark	Comments
07.1	Large amplitude oscillations …✓ Driving frequency matches natural frequency (of oscillating system) ✓	2	
07.2	Correct general shape with peak marked at 2 MHz ✓ No intercept with either axis, point of inflexion to right of peak and apparently asymptotic to f axis ✓	2	
07.3	Removal of energy from an oscillating system ✓	1	Allow reduction in amplitude of an oscillating system
07.4	Substitution into equation seen **or** c = 1160 (m/s) ✓ Uses $s = vt$ ✓ 6.0×10^{-5} (s) ✓	3	Allow 2nd mark for use of 3.5 cm instead of 7 cm
07.5	Substitution into equation $I_x = I_0 e^{-1.2 x 7}$ ✓ 2.24×10^{-4} ✓ Uses 66% or 34% ✓ 7.6×10^{-5} ✓	4	Accept 1.2×3.5 **or** 1.2×0.035 **or** 1.2×0.070 as the exponent for the 1st mark
07.6	Smaller distances involved for babies **or** larger distances for adults ✓ Too much attenuation at higher frequencies for large distances / adults ✓ Larger frequency used for babies since resolution or detail is better with high frequency ✓	3	Accept adults having thicker skin, hence need to use lower frequency to limit attenuation in skin
Total		**15**	