Qualification Accredited

Oxford Cambridge and RSA

AS LEVEL

Examiners' report

PHYSICS A

H156

For first teach in 2015

H156/02 Autumn 2020 series

Version 1

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates.

i	Reports for the Autumn 2020 series will provide a broad commentary about candidate performance, with the aim for them to be useful future teaching tools. As an exception for this series they will not contain any questions from the exam paper nor examples of candidate responses.

The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

A full copy of the exam paper and the mark scheme can be downloaded from OCR.

Paper 2 series overview

A good range of marks were achieved by candidates and it did not appear that candidates were short of time. There are several questions on the paper which test the practical skills that candidates should have experienced in their AS course.

Candidates should be encouraged to show their working in numerical questions. It is important for all candidates to understand key command terms such as state, describe, define, etc.

There were two Levels of Response (LoR) questions which gave candidates the opportunity of demonstrating their knowledge and understanding of physics. It is important that candidates answer the question set in a logical way with clear explanations. Candidates should also make sure that they answer the question set.

There were also several 'show' questions on the paper. These types of questions prevent candidates who struggle with one part of a question being penalised on the next part. These 'show' questions do require candidates to clearly indicate their method. The unknown should be the subject of any equation – credit is not given for using the 'show' value. It is expected that equations will be rearranged.

Candidates who did well on this paper generally did the following:	*Candidates who did less well on this paper generally did the following:*
• demonstrated clear, detailed reasoning in explanation type questions • showed clear logical working in calculation type questions • used technical terms correctly • demonstrated an understanding of a practical physics course, particularly about the use of graphs and the treatment of uncertainties • used clear and sensible sketches • where possible explained their responses quantitatively.	• omitted the detail needed in explaining concepts and understanding • did not use appropriate units in their quantities and were unsure of conversions • omitted steps in their calculations • were unsure of some technical terms and did not know definitions in detail • were unsure in the interpretation of graphs and the treatment of uncertainties • did not take care when adding to the diagrams.

Comments on responses by question type

Level of response questions

The two LoR questions were Question 4 and Question 8.

In Question 4, candidates were required to plan an experiment. A diagram should have been drawn which should indicate a workable experimental set-up. In this particular case, it was expected that candidates would include a method of support for the horizontal surface, a method to release the ball (e.g. a curved slope or a horizontal spring) and a method to determine the velocity as the ball left the horizontal surface. Most candidates indicated a rule to measure distance *R.* Candidates should also describe the method – perhaps indicating that *R* would be measured several times for same *v* and an average calculated. Safety precautions should also be included.

Some candidates suggested good methods of identifying where the ball would land, e.g. use sand or add paint to the ball. High achieving candidates clearly described how the velocity of the ball as it left the horizontal surface could be determined. Some used an energy conversion either of gravitational potential energy to kinetic energy or elastic strain energy to kinetic energy. Others suggested the use of either one or two light gates connected to a data-logger. In the case of using one light, the diameter of the ball would need to be determined while for two light gates, the gates should be positioned close to each other and the distance between the two light gates would need to be measured.

Most candidates suggested an appropriate graph to plot and then described how *Q* could be calculated using the gradient.

Question 8 tested an understanding of electron diffraction. Many candidates gave a good qualitative explanation of how the pattern would change. High achieving candidates clearly demonstrated how the de Broglie wavelength λ was related to the potential difference *V* by equating the energy *eV* to kinetic energy, then using the definition of momentum and the de Broglie wavelength. Some candidates confused speed *v* with potential difference *V.* Many candidates gave a good qualitative explanation. Many candidates did not state that the rings would become brighter.

	AfL	Candidates should be able to describe how to use light gates. In particular, candidates should be able to indicate the measurements that are needed to determine speed and acceleration. Candidates should state that the light gates should be connected to a timer or data-logger.
	AfL	When analysing experimental data, candidates should be able to determine appropriate graphs to plot which will give a straight line (if the given relationship is true). Candidates should also be able to describe how unknown quantities may be determined using the gradient and/or *y*-intercept.

?	**Misconception**	There is some confusion between the equations to use for photoelectric effect and the equations to use when considering the de Broglie wavelength. For the de Broglie wavelength, a common misconception is to relate the energy to wavelength by the equation for the energy of a photon, $E = \frac{hc}{\lambda}$.

Other

In Question 1 (a)(ii), candidates were required to sketch the trace. While perfect drawings are not expected, since the grid is given, candidates should try to use it effectively. The amplitude should be two squares above and two squares below for the peaks and troughs respectively. Similarly, for the period (4cm) using the grid, candidates should be able to make sure that the drawing is consistent at the peak, trough and zero lines.

In Question 3, most candidates clearly identified the points on the line that were to be used for the gradient calculation. High achieving candidates clearly showed their working when determining the percentage uncertainty.

In Question 5 (b) some candidates were vague in their responses, for example, stating that the gradient changes rather than stating that the gradient decreases. In part (c) most candidates were able to draw a reasonable tangent. Parts (d) and (e) were harder to answer. Part (d) required the correct time interval to be applied by interpreting the braking time and not including the thinking time. In part (e), high achieving candidates applied the halving of the initial speed to the effect this had on the thinking distance, the thinking time, the braking distance and the braking time.

In Question 6 (a), most candidates answered this well although a significant minority confused the calculation of the volume. Answers such as $2\sqrt{5}$ did not score in (b)(i); it is expected that decimal fractions should be used. In 6 (b)(ii) high achieving candidates labelled the forces and correctly indicated the direction of the forces. Some candidates omitted to use the scale for their final response. In part (c), many candidates were confused in determining which forces and distances should be used.

High achieving candidates found Question 7 straightforward. Some candidates on (a)(iii) used *N* instead of *n.* Part (b) caused the most difficulty with candidates either using 150 W rather than 0.150 kW or changing the time to seconds.

?	**Misconception**	The worst acceptable line is either the steepest line that passes within all the error bars or the shallowest error line that passes within all the error bars.

Common misconceptions

Electromagnetic waves travel in a vacuum at a constant speed of 3.0×10^8 m s^{-1}.

The drawing of worst acceptable lines – see above.

Confusion about the determining the area *A* of a circle from the radius *r* or the diameter *d*:

$$A = \pi r^2 = \frac{\pi d^2}{4}$$

Moment of force = force × perpendicular distance

Key teaching and learning points – comments on improving performance

Candidates should learn the prefixes for units. For example, in Question 1 (b)(i) many candidates seemed unsure of the difference between 200 nm and 200 pm.

Candidates should consider whether the values calculated are reasonable. For example, in Question 2(a)(ii) answers of $4.59 \times 10^8\ \mathrm{m\,s^{-1}}$ (larger than the speed of light).

Candidates should be confident in find the gradient (and *y*-intercept) from a line on a graph. To determine the gradient:

1. Choose two points on the line which are easy to read-off. The points should be at least half the length of the line apart. Data points from the table should not be used unless the points are on the line.
2. Substitute the data points into

$$\text{gradient} = \frac{y_2 - y_1}{x_2 - x_1}$$

Answers should always be given as decimal fractions and to at least two significant figures.

Where quantitative data is given, then responses should wherever possible be answered quantitatively. For example, 2 (b)(ii), candidates should have calculated the critical angle. In Question 5 (e) the distances and times should have been calculated or compared in terms of halving/quartering.

Guidance on using this paper as a mock

The paper is a standard AS H156/02 paper.

Candidates will have plenty of opportunity to demonstrate their knowledge and understanding. There are several practical skills which are also tested.

When reviewing the mock paper, candidates will have the opportunity of learning from the key points indicated above.

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