OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL A-LEVEL PHYSICS

(PH04) Energy and Energy Resources
Report on the examination

June 2019

REPORT ON EXAMINATION: INTERNATIONAL A-LEVEL PHYSICS (PH04) ENERGY AND ENERGY RESOURCES – JUNE 2019

The paper seemed to be accessible to students; there were no indications that they faced significant time constraints. The average performance of students was similar in section A (extended questions) to that in section B (multiple-choice questions). Among the extended questions, students were, on average, most successful with question 3 (rotational dynamics). The other questions in the section had broadly similar success rates.

Students were happier with straightforward familiar calculations than with calculations in unfamiliar contexts. When students could see their way through a calculation from the start, they set their answers out well. Such calculations tended to be successful and, even when not completely successful, it was easy to award partial credit because correct work was easy to identify. When answers were poorly organised, correct ideas were less identifiable and so, less likely to be credited. Students should pay due attention to significant figures.

Written responses tended to be better when questions were direct and less context dependent. In general, students' abilities to produce clear and unambiguous answers seems to be improving. Every attempt is made to credit correct ideas in written answers. It is easier to do so when students use subject-specific technical vocabulary correctly.

QUESTION 01.1

Many students had the right idea, that internal energy is the sum of the individual potential and kinetic energies of the particles but that, for an ideal gas, the particles had no potential energy. There was some evidence of difficulty in expressing this idea and some students thought that there was zero potential energy in the particles of solids. Most students talked loosely of gases having no potential energy rather than the particles of gases having no potential energy. This was condoned on this occasion but students should be reminded of the need for accurate expression of ideas.

QUESTION 01.2

This part was well done by nearly all of the students. Very few students forgot to convert the temperature into kelvin.

QUESTION 01.3

Many students gained full marks for this part. However, a significant number thought that they could use the change in pV rather than the area under the curve. Some of those who attempted to find the area used techniques that were insufficiently accurate, for example, by considering the area under the graph to be a trapezium,. Others who seemed to be working along the correct lines did not make it clear what they were doing and lost marks. For example, when finding the area using square counting, students are advised to state the number of squares clearly and to give the 'value' of one square.

QUESTION 01.4

A few students tried to answer this question without reference to the first law of thermodynamics. Many gave good answers, appreciating that work was done on the gas and that the internal energy and therefore the temperature would rise. Complete explanations were rare as most students did not realise that, because the change was rapid, there would be negligible heat transfer to or from the gas.

QUESTION 02.1 & 02.2

This was very well done with most students completing all three calculations and finding the mean correctly. There were very few power-of-ten errors. 2.2 was less well done. It is expected that students use half the range as the value of the absolute uncertainty as outlined in the *Practical Handbook for A-level Physics*. Many use the full range or the difference between the mean and the maximum (or minimum); others use 0.01 as the absolute uncertainty, confusing uncertainty with precision.

QUESTION 02.3

Many students did this well, either by calculating all three densities or by showing that the density is constant by an algebraic method. Students are advised to state a conclusion in questions of this type. For example, when using the first method, they should make a statement that all three values are similar. Alternatively, having derived an expression for density they should state that density is a constant since all of the terms in the equation that they have derived are constant.

QUESTION 02.4

This was generally well done but some students lost marks through poor drawing. There were some very sloppy freehand sketches that spoiled the detail that the students probably intended. Other students drew everything with a ruler, even the curved turning points of the paths.

QUESTION 02.5

Many students knew this. A few drew a reasonable sketch graph but failed to notice that they were asked to label the diffraction angle.

QUESTION 03.1

Most of the students used the correct equation relating torque to angular acceleration. Some were not able to find the resultant torque but many got to the correct answer.

QUESTION 03.2

This part was well done by almost all of the students; even those who had the wrong answer to 03.1 benefited from an error carried forward here.

QUESTION 03.3

The great majority of students did this correctly. Students should be reminded of the need to quote their answer to '*show that*' questions to more significant figures than the value stated in the question. In this case, for example, students were asked to show that the angular speed was approximately 120 rad s^{-1}. An answer of 117 rad s^{-1} was expected; most students provided this. A few students rounded their calculated value incorrectly and quoted 116 rad s^{-1}; this was penalised.

QUESTION 03.4

There were a great many almost correct solutions to this calculation. Only a few students recognised that the total kinetic energy of the motorcycle included the rotational kinetic energy of the wheels as well as the translational kinetic energy of the motorcycle. Some students did not recognise that there were two wheels and a few more tried to work out their own value of the moment of inertia of a wheel.

QUESTION 03.5

This was generally well answered. The most common mistake was to omit reference to the appropriate equation when explaining that higher accelerations could happen with a lower mass ($F = ma$) or lower moment of inertia ($\Gamma = I\alpha$).

QUESTION 04.1

There were few complete and correct responses to this part. Few students chose to mention that the plasma consists of atoms stripped of their electrons. Clarity of expression was often lacking, even to the extent that students were unsure of the distinction between nuclei, nucleons and neutrons. It is important to be clear about subject-specific vocabulary.

QUESTION 04.2

The great majority of students did this calculation correctly. A few miscalculated the change in mass during the reaction.

QUESTION 04.3

The solar (fusion) hydrogen cycle was not well known. A significant number of students did not attempt this part.

QUESTION 05.1

Most of the students did this correctly. A few students rounded their answer incorrectly and lost a mark.

QUESTION 05.2

Most of the students calculated the number of panels required correctly. In this case, answers to one significant figure were tolerated but this is rarely allowed. Students are advised to choose their number of significant figures on the basis of the significant figures in the data provided.

QUESTION 05.3

Answers to this question were quite limited. Most students confined their responses to comments about radioactive waste. Few thought that solar panels had any environmental impact. Answers tended to be poorly expressed. However, most students gained some credit for their answers.

QUESTIONS 06 – 35

Students tended to be relatively successful in the multiple-choice questions although some of them were found to be difficult. Questions 8, 14, 15, 18, 25, 27, 29, 32 and 35 had very high success rates whereas questions 7, 10, 11, 13, 16, 19 23, 26 28, 30 31 and 34 were answered correctly by fewer students.

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