OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL AS PHYSICS

(9630) PH01

Report on the examination

January 2024

REPORT ON EXAMINATION: INTERNATIONAL AS PHYSICS (9630) PH01 JANUARY 2024

This examination paper was similar to those of previous years in terms of demand and specification coverage. There were many opportunities for students to demonstrate their skills, knowledge, and understanding across a wide range of topics. The usual question styles were used. These included long and short answers, single and multi-step calculations and multiple-choice questions set in both familiar and novel contexts.

SECTION A

QUESTION 01

This single-mark question was answered correctly by the majority of students. The unit includes two negative indices, and therefore answers that used the solidus (/) were sometimes unclear. Students should be encouraged to use a negative index rather than the solidus to avoid confusion. Note also that the use of the upper case K (kelvin) for lower case k (kilo) was not accepted.

QUESTION 02

About 85% of students obtained full marks for this question. A small number of students had difficulty including efficiency in their answers to this question. The mark scheme was designed to reward partial answers with one mark. The best answers were set out clearly with the answer written without a rounding error. The calculator value is included in the mark scheme to help examiners spot answers that suffer from rounding carried out during an intermediate step. Students are advised not to round values until the end of a calculation is reached.

QUESTION 03

Most students drew a line that ended at the same maximum stress, which gave them the second marking point. Far fewer obtained both marks. The point about a brittle material is that there is very little, or no, extension beyond the limit of proportionality. Only about 25% of students showed an understanding of this.

QUESTION 04

The calculation in 04.1 was completed correctly by most students. A common error was a failure to take into account the two strings, thus omitting a factor of 2 in their working. In addition, many answers were seen that used the incorrect angle. This question discriminated quite well.

In 04.2, the first mark was given for the use of the equation for stress or for the Young modulus. Several students who obtained this mark failed to get the second mark due to errors in algebra or powers of ten (POT). Note that any error from 04.1 was carried forward so that students were not penalised twice. This question also discriminated well.

QUESTION 05

Students should have an awareness of typical values for common physical quantities. This was tested in this question, although a wide range of mass was accepted for the apple. Most students were able to calculate the speed from the vertical height. The most common error was to quote the final answer to more than two significant figures. The question produced a good spread of marks and discriminated quite well.

QUESTION 06

This question was one of the best discriminators on the paper. Most of the students who began by considering work done and kinetic energy went on to get full marks. Although the calculations were reasonably straightforward, some of the best answers made use of a diagram to help make clear what was happening to **P** and **Q**.

QUESTION 07

This question produced a good spread of marks and discriminated well.

Students had to make it clear in 07.1 that they knew what they were doing and were not just working from the equation they were given. This was largely shown by how they obtained the factor of '2'. The best answers used subheadings for the time and speed before explicitly combining them to obtain the correct answer.

Examination questions on projectiles often include the idea that air resistance is negligible. Despite this, fewer than half of the students obtained the mark in 07.2. Statements such as '*energy is conserved*' were fairly common and were not rewarded.

Most students were able to make progress with 07.3, with over half of the cohort getting full marks. The evaluation of the gradient was rarely carried out but the mark was rewarded for evidence of values that would have given the correct answer.

QUESTION 08

There was evidence in 08.1 of students failing to read the question carefully. Students were required to describe the model of the atom of aluminium. Most merely stated the number of protons and neutrons in the nucleus. The mark scheme expected two of the points to be made for the first mark. Students who made no reference to the model were usually awarded zero marks.

08.2 proved to be even more difficult. In the past most students have been able to state that most alpha particles '*pass straight through*'. Transferring this knowledge to a graphical answer was too demanding for many students. Only about 1% obtained both marks.

QUESTION 09

The mark scheme to 09.1 was constructed so as to reward the cognitive steps required to reach the answer. This meant that errors were only counted once. Consequently, this was the best discriminator on the paper. Common mistakes included failing to take into account the background radiation or miscalculating the inverse-square relationship.

09.2 discriminated poorly and was not answered well. Many students' answers were vague or irrelevant.

09.3 used a level-of-response mark scheme and also discriminated well. Generally, students were able to suggest relevant improvements but explanations were rare. It was clear that most students used the bullet points in the question sensibly when formulating their answers. The question gave a good spread of marks but about 33% did not get any marks and about 15% did not even attempt it. This suggests that there is a large number of students who are not confident when describing experimental procedures, particularly those related to radioactivity.

QUESTION 10

This six-part question was one of the least accessible on the paper, with few students obtaining full marks on any of the question parts except 10.3.

There were several ways to approach 10.1, all of which gained credit. The most common one was to consider the forces acting and to apply Newton's third law. This law is not well understood, however. Many students could not work out which pair of forces they were dealing with, so that many considered the force of the water on the launch tube. Some students attempted to answer the question without any reference to the direction in which the forces act. The best answers made it clear that the force on the water downwards from the compressed air and bottle meant that there was an upwards force of equal magnitude acting on the bottle that accelerated it upwards.

10.2 required the students to refer to the graph. Most students picked up one mark for identifying the maximum velocity at $1.3\ \mathrm{s}$, but few could go on to explain why that meant that there was no water left. Some failed to gain the first mark as they only stated that the acceleration was zero, without explaining how the graph shows that.

10.3 gave a good spread of marks and discriminated quite well. Most students successfully worked out the area. Those who made a crude attempt, by assuming it was a triangle, could get no more than the first marking point. Students who attempted to use the constant-acceleration equations failed to grasp that the curved line on the graph indicates that this is not a valid approach.

Identifying the steepest part of the graph in 10.4 proved to be trickier for many students than was expected. In the best answers a clear tangent to the top of the negative curve was seen, with readings leading to an answer in range.

The importance of the direction of forces was the key to 10.5. Again, few students were able to make much progress. A simple sketch with a force diagram would have probably helped some students. A clear understanding that the downwards drag force is added to the downwards weight when the rocket is moving upwards was rarely seen.

Several answers that showed some idea of what was expected for 10.6 were seen but were either expressed poorly or were too vague to gain credit. Those few students who managed to obtain both marks gave answers that referred to the need to find the time at which the areas above and below the axis are equal, and then they set out clearly how that was obtained by extending the line horizontally.

SECTION B

QUESTION 11

This question required students to apply the principle of moments in a novel context. Few students managed to pick up more than the most straightforward marks on the different question parts.

The statement in the mark scheme for 11.1 is clear and concise and students should be encouraged to learn it or something similar. There were some who failed to reference the need for equilibrium, and some students also confused moment with momentum.

11.2 was the most accessible part in this question. Although it is disappointing to see moment equations expressed in terms of mass rather than weight, this was tolerated in this case. There was some confusion about one of the perpendicular distances; students could have dealt with this had they added the distance between the handle and hook themselves.

Question 11.3 was fairly open-ended and there are many points in the mark scheme that would have rewarded students. There was very little seen of any credit, however. Answers were often vague or incomplete and it was not always clear which balance was being referred to. Students should be encouraged to structure comparisons of this kind and to set out their discussions logically.

QUESTION 12

This question required students to demonstrate their ability to analyse data. The questions were marked together so that an error was only penalised once. Despite this, many students found this question very challenging.

In 12.1 the students are told that there is one reading and should therefore simply use half of a scale division divided by the reading value. Many students doubled this answer to get 0.6%.

In 12.2 there is a clear anomalous reading which should have been discounted so that the required percentage uncertainty was calculated. Having incorrectly included the anomalous reading, many students tried to obtain the ‘show that’ value incorrectly, thereby compounding their error. If students had checked to see what had caused their value to be incorrect, they could have corrected the error and gained full marks. The error in the mean value and range was only penalised once and was accepted in the rest of the question.

12.3 was the most accessible of the parts to this question. The most common error was the use of an incorrect equation for the volume of a sphere. There was also evidence of simple algebraic mistakes and some difficulties with powers of ten. This meant that, although more than 70% of students obtained the first mark point, only about half of them went on to get both marks.

12.4 proved to be more challenging than expected. 25% of students did not attempt an answer, despite all of the information needed being in earlier question parts. The rules for combining percentage uncertainties are fairly straightforward. Students should practise calculations of this kind to prepare themselves for an examination question that is often asked, in one form or another.

Answers to 12.5 were often unclear, ambiguous, and incomplete. The most common answer suggested that the water would affect the steel in some way, or that water would cling to the steel, causing an error in the mass. Few students demonstrated a familiarity with use of a measuring cylinder to determine volume by displacement.

SECTION C

Many of the multiple-choice questions were answered very well. C24, C18 and C17 were each answered correctly by more than 75% of the students.

The questions that proved to be most demanding were C14, C13, C23 and C15.

In C14 the most popular distractor was B, but this was only slightly more popular than C or D. This suggests that some students have a difficulty with the vector nature of velocity, perhaps.

In C13 the most popular distractor was C. This suggests that students assumed the weight acted at the end of the beam, or that the students equated the upwards and downwards forces, ignoring the force at the hinge.

In C23 the most popular distractor was C, suggesting a major misconception about beta decay.

In C15 the most popular distractor was D. This supports the evidence of poor performance in questions set in a practical context, as seen in Section B.

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