OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL AS LEVEL PHYSICS

(9630) PH01 – Mechanics, materials & atoms
Report on the examination

June 2022

REPORT ON EXAMINATION: INTERNATIONAL AS LEVEL 9630 PH01 – MECHANICS, MATERIALS & ATOMS – JUNE 2022

In terms of demand and coverage this examination was very similar to those set in previous years. Students were given the opportunity to demonstrate their knowledge and understanding in many different areas of the specification.

As in previous years, mathematical questions were generally answered better than those requiring extended writing. In particular, questions that required students to ‘explain’ were answered without essential detail.

The combination of questions allowed the assessment of students across the full ability range.

QUESTION 01

A common error in 01.1 was the idea that background radiation came from only natural sources, or from beyond the atmosphere. Answers that qualified the sources in this way were not credited. Similarly, students who suggested it was the radiation that did not come from ‘*the source*’ were not credited unless it was clear that they were referring to the source under investigation.

Question 01.2 proved to be one of the most demanding questions on the paper. Examiners were looking for an example of the origin of the radiation, rather than a simple reference to nuclear power stations or space, for example. Students who suggested a named isotope obtained this mark.

QUESTION 02

Most students were able to obtain both marks for this question. Those who missed marks either gave the wrong proton number for boron or suggested that the additional particle was an antineutrino.

QUESTION 03

This question on pair-production produced a range of marks. Most students correctly identified the positron as the antiparticle of the electron. Far fewer were able to gain marks for the explanation in part 03.2. The best answers referred to the rest mass or rest energy of the particles involved and went on to give some idea of why there is a minimum photon energy.

QUESTION 04

This was answered well by most students. Some students struggled with the term ‘*quantity*’, replacing it with words such as ‘*value*’ or ‘*magnitude*’ that did not gain credit.

Question 04.2 produced a greater range of responses. Referring to changing velocity without mentioning direction, for example, meant that some students did not gain full marks. Other answers illustrated some basic misconceptions about speed, velocity and acceleration.

QUESTION 05

Only about half of the students were able to give a satisfactory answer to 05.1. Although definitions of centre of gravity were condoned, the best answers referred to the lack of turning effect of a force that acts through the centre of mass.

The relatively straightforward calculation in 05.2 was answered successfully by very many students. The most common errors were associated with the conversion of the weight to a mass. Some students made no attempt. Others multiplied the weight by g rather than dividing it. It should be noted that students are expected to use the value of g provided in the Formulae and Data booklet. Although the value of 9.8 was condoned (students should normally quote and use 9.81), students using 10 could not access the second mark.

Most students who could make a start with 05.3 went on to complete it successfully. Students who did not realise that the answer involved moments, and attempted a resolving approach, were not given credit. Many students who obtained full marks made annotations to the diagram to help with their answer. This question discriminated well.

QUESTION 06

06.1 was a ‘show that’ question, with students being given an approximate answer to aim at. In questions of this kind students *must* set out their approach clearly. Full credit is rarely given unless each step in the student’s work can be seen. This question was answered correctly by most students, however, and generally those that could make a start completed it correctly. Students should be reminded to give their answer to at least one more significant figure (sf) than the value provided in the question.

Another issue that was seen with this question was the use of the constant acceleration (*suva*t) equations. Although this can give the same answer, the physics is incorrect: the situation was not one where the acceleration was constant and therefore an energy approach was required.

The reason for the ‘show that’ in part 06.1 was to provide a value for the kinetic energy for later parts. Despite this some students still attempted to use a clearly incorrect value from 06.1. It may be that students who do not make use of a ‘show that’ value will not gain full credit in the future.

06.2 proved to be difficult. The most common error was to give a one sf final answer (8). Students also caused themselves problems when they attempted to go back to first principles, or somehow involved weight in their calculations. A simple ‘work done’ approach was used by most students who got this right.

The answer to 06.3 required several steps, although partial credit was awarded where answers were clearly set out. Many students struggled when given a final value (the speed hitting the barrier) and they then had to work out an initial value (the speed at the start of the flat section). These students were unsure about what to do with the ‘90%’ quoted in the question. Students who could gain no other credit were sometimes given a compensatory mark for calculating the kinetic energy at the barrier. This could only be done when this step could be identified in the student’s working.

The idea of ‘crumple zones’ is often used to assess students’ understanding of momentum, force or work. There were several approaches to 06.4 that could have gained credit. The most common mark given was for the idea that the time of impact was increased. Many students struggled after that to put together a coherent argument using correct physics. Often vague answers involving how ‘*soft*’ materials ‘*don’t hurt*’ were seen. This is an example of a question where students need to use accurate technical language.

QUESTION 07

07.1 caused few problems for most students. Most commonly, students who did not get the mark failed to spot that it was the horizontal angle that was given, but the vertical component that was required.

07.2 was also answered correctly by most students. Those who had difficulties often failed to spot that they needed to work out first the vertical displacement from the machine to the top of the motion.

More difficulties were encountered in 07.3. The best answers calculated the two separate times and added them to calculate the time of flight. A common error was to assume that the time taken to rise and fall were the same. Some students used a quadratic approach that also gained credit. This question discriminated well.

07.4 was a multi-step calculation that provided a range of marks. Answers that set out clearly the energy stored in the spring, and then related it to the gain in gravitational potential energy, tended to gain most credit. This question was one of the most discriminating.

Many vague and incomplete answers meant that the award of full marks for question 07.5 was rare. It is important with explanations of this kind for students to be clear about what they are discussing, and to use the correct physics terminology to do it.

QUESTION 08

In 08.1 many students did not understand the relevance of the values of A and Z in front of the Au symbol. Seeing the mass divided by the charge was also fairly common. The majority of students were able to answer this correctly, however, and it was one of the most discriminating questions on the paper.

The rest of question 8 contained some of the most demanding parts on the paper.

Perhaps some unfamiliarity with the process, or misunderstanding about Figure 7, caused many students to believe that detector 2 would detect the most alpha particles, despite it being very clear that detector 1 was straight ahead.

In 08.3, vague or inaccurate answers were again common. Many students made comments about '*electron shells*' and made no reference to the nucleus in their answers. Students who suggested that there was a '*lot of space inside an atom*', or that the nucleus had a '*lot of mass*', also gained little credit.

Some good answers to 08.4 and 08.5 were seen, but they were rare. These answers generally made clear points about what caused the path to be different. In other answers it was sometimes unclear whether it was the gold or the alpha particle that was replaced by the copper.

QUESTION 09

Most students knew the answer to 09.1.

They also knew that the important aspect of 09.2 was the lead shielding. Many students were unable to get further credit because they suggested the shielding stopped all the radiation.

The unusual scale in 09.3 may have caused some students problems, but the majority were still able to get the mark.

In 09.4, most students were also able to spot that the activity of the technetium dropped to zero after 24 hours, as it was removed. Most of these students, however, simply copied the original shape and made no allowance for the reduction in amount of technetium as the amount of molybdenum decreased.

It was rare to see a fully correct answer to 09.5. It was clear that very few students had much idea about what was happening, or what the graph they had just drawn told them about the amount of technetium in the generator.

QUESTION 10

A familiarity with a stretching-wire experiment probably benefitted some students, but the majority found question 10 very demanding.

In 10.1 few students drew the initial part of the graph as a straight line. Lines were also often too thick, or did not follow the trend sufficiently well for the mark.

Those who understood that the graph was initially linear had an advantage in part 10.2. Several students drew tangents or simply joined the origin with the last point. In the better answers, students also made it clear that the determination was not just based on a single point.

In 10.3, the scatter of points gave some students the correct idea that the uncertainty could be determined from best- and worst-fit lines. Students who attempted to answer in terms of the values of the points did not get credit.

10.4 was also very demanding. There was some confusion about which area was being referenced in the answers. Many students simply tried to use the energy stored in a stretched spring.

SECTION C

The easiest multiple-choice questions were C12, C13, C15, C19 and C20.

The hardest were C16, the force-extension curve, and C24, the application of momentum conservation to beta decay.

In C16 the most popular answer was A. Students did not appreciate that the unloading curve was the same as the loading curve.

In C24 both B and C proved to be very popular.

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