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# International AS and A-level

## Physics (9630)

## PH01 Mechanics, materials and atoms

## Report on the examination

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

This paper was accessible to students and discriminated well. The mean mark was slightly up on the previous series. There were no indications of time constraints, with very few students unable to complete the paper. The cohort answered calculation questions better than those requiring written explanations. Students performed particularly well on question 08.

## SECTION A

## QUESTION 01

01.1 Just under half of students were able to show a correct value for the minimum energy the photon must have. Some students failed to show their working properly.

01.2 Only approximately 20 % of students recognised that the excess energy is the kinetic energy of the electron–positron pair. The most common error was to simply divide the energy by two and to state that this was the energy of each particle.

## QUESTION 02

02.1 Students generally answered this question well, with over 80% of students answering correctly. Most answered in terms of momentum being the product of mass and velocity and then went on to explain why velocity is a vector.

02.2 This question discriminated quite well; most students were able to calculate the momentum before the collision. Approximately 30% of students went on to either state or show that momentum was conserved in the collision. Only around 10% of students clearly showed that truck X must change direction for momentum to be conserved. Many students incorrectly assumed that the trucks moved together after the collision and attempted to calculate the velocity of truck X after the collision.

## QUESTION 03

03.1 Most students described a procedure that would introduce a random error, the most common of which was a simple description of not using a ruler correctly. Only approximately 10% of students recognised that the distance would be shorter than the true distance.

03.2 The majority of students understood the need to measure the background count, but some did not go on to explain that the background count must be subtracted from the count with the source present. Only approximately 15% of students described taking measurements of a long period of time or repeating and then taking a mean.

## QUESTION 04

This question required students to use a velocity-time graph to calculate the average velocity and the resultant force acting during the period that the object was decelerating. The time was given in milliseconds and many students did not read the time from the graph in milliseconds. The two parts


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of the question were marked together so that a failure to read in milliseconds only prevented the award of one mark.

04.1 85% of students attempted to calculate the area under the graph to determine the distance. The vast majority of the students who correctly determined the area were able to read the total time correctly, but only 30% of students were awarded full marks due to power of ten errors.

04.2 The first mark was quite accessible with credit being given for either the determination of the acceleration or the use of $F = ma$. It was surprising that some students who gave the time in milliseconds correctly in question 04.1 did not do so in this question.

Question 4 discriminated really well.

## QUESTION 05

Most students correctly identified the anti-neutrino and were awarded one mark. Only 40% of students got all the numbers correct and a large number of students wrote 99m for molybdenum which was incorrect. 05.2 was not well answered; the majority of students were unable to explain what is meant by metastable. Some students incorrectly wrote that an atom was in an excited state and not that it is the nucleus that is in an excited state.

Most students were able to calculate the time taken in question 05.3. The question discriminated quite well, but nearly all students either got full marks or zero marks.

Students found question 05.4 quite challenging. There were lots of answers that implied that the technetium-99m was detectable outside the body and not the emitted gamma. Students who answered in terms of the half-life struggled to indicate that the half-life was long enough for the patient to be examined or did not link the fact that the half-life is short enough to limit damage to the body.

## QUESTION 06

Students should be able to recall the conditions needed for an object to be in equilibrium. Less than half the students could recall both conditions. For those who only correctly gave one condition the choice of condition was evenly distributed.

06.2 was very well answered, but 06.3 gave a really good spread of marks and discriminated well. Many students were able to correctly equate the clockwise moments to the anticlockwise moments but were unable to determine $F_{\mathrm{A}}$ and/or $F_{\mathrm{B}}$.

## QUESTION 07

Approximately 50% of students correctly gave one reason why the two forces are not an action-reaction pair. The vast majority who answered correctly stated that both forces act on the same object, not that they are different types of force.

07.2 and 07.3 were quite challenging questions. There were many vague answers with poor use of scientific terminology. Many students have misconceptions about acceleration, and very few were able to link this to resultant force in a coherent way. There were, however, some excellent answers that gained full marks from students who clearly understood why the car reaches a constant speed.



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## QUESTION 08

Question 08 was the most accessible question on the paper. The vast majority of students were able to answer at least a few parts of the question. The question was very structured for the students and it was obvious that most were very well prepared to answer projectiles questions. The last three parts of the question discriminated particularly well and the last part proved to be a bit more challenging.

## SECTION B

## QUESTION 09

This question required students to apply their understanding of the Young modulus to a novel context. Some of the question parts were very challenging and most parts discriminated well.

Three-quarters of students were able to use the graph to determine the Young modulus. For '*show that*' questions students must clearly show how they arrive at their answer including any manipulation of powers of ten. Many students did not read the $10^6$ factor from the graph, then just wrote the answer in GPa.

Students found question 09.2 demanding. Some students correctly identified that the central body should be rotated, but the question asked students to state and explain and many did not go on to explain that, when the screws move closer together, the cable extends.

In 09.3, approximately a quarter of students correctly calculated the ratio, but most students did not divide by two to determine the pitch.

The next three calculations gave a good spread of marks and discriminated well.

## QUESTION 10

Students should be able to determine the percentage uncertainty based on a range of measurement. Nearly 90% of students were able to determine the mean, but only about 30% of students were then able to use the mean and range to determine the percentage uncertainty.

The line of best fit was relatively straightforward for an AS paper. Students should take their time and draw the line as accurately as they can. They should ensure it is one continuous thin line drawn with a ruler. Only just over 50% of students gained the mark for 10.2.

50% of students did not clearly show how the relationship is derived. Students must show each step in a question like this.

10.4 discriminated well and gave a good range of marks. Some students were not awarded marks as they did not use a large triangle for the gradient calculation and there were also power of ten errors.

## SECTION C

Many of the multiple-choice questions were answered very well. C12, C15, C20 and C22 were each answered correctly by more than 75% of the students.

The questions that proved to be most demanding (answered correctly by fewer than 50% of students) were C13, C14, and C23.



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In C13 there was an almost even distribution of incorrect answers, so over half the students could not write the correct expression using $F = ma$ with only two forces acting.

In C14 the most popular incorrect answer was A, indicating that the majority of students ignored the weight of the ball.



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