OXFORD
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INTERNATIONAL AS LEVEL PHYSICS

(9630) PH01

Report on the examination

January 2020

REPORT ON EXAMINATION: INTERNATIONAL AS LEVEL PHYSICS 9630 PH01 JANUARY 2020

General comments

The paper contained a wide range of question styles on a variety of topics giving students many opportunities to demonstrate their knowledge and understanding. The performance on mathematical questions was particularly strong, with questions requiring extended arguments and precise scientific language causing more of a challenge for students. Answers to these questions were often incomplete or ambiguous. There was no suggestion that students ran out of time.

Section A

Question 1

Few students were able to give clear and correct examples of both types of error. There was, for example, some confusion over whether parallax errors are random or systematic. Answers were seen that had little relationship to the practical situation being tested. In questions like this, students should be encouraged to give clear examples that relate directly to the context.

Question 2

It was rare to see answers that scored all three marks on this question. Answers confusing pair-production with other processes such as annihilation or beta emission were common. Another popular misconception was that two gamma photons interact to produce the particle–antiparticle pair. Students were expected to refer to the production of a positron given the mention of an electron in the question. Too many students who understood the situation missed a mark by referring only to the production of a particle–antiparticle pair.

Question 3

3.1

Most students were aware that the majority of the alpha particles are not deviated. Many students then went on to say only that “some bounce back” with no mention of those that are deviated through small angles. Many students who referred to the different amounts of scattering failed to mention the relative numbers involved; this was required for all three marks.

3.2

Most students were able to give confident answers describing the nuclear model, although a significant number showed some confusion by including a description of the electron shells in their answer. There was further evidence of confusion associated with Thomson’s plum-pudding model, with many students suggesting that protons and neutrons were mixed with the electrons. Many students made no reference to the Thomson model and could therefore only access one mark.

Question 4

4.1

Almost half of the students obtained all three marks for this question. A common error was omitting the proton number and nucleon number of the antineutrino. Answers that did not make it clear that an antineutrino was produced, by writing ν underneath the answer line for example, did not gain the third marking point. Other problems were associated with the proton number of the molybdenum nucleus by, for example, writing 44 rather than 42. Students should be encouraged to balance the proton numbers on each side of the equation.

4.2

Many incomplete answers were seen to this question. For example, some students correctly stated that there were no changes to the constituents of the nucleus without going on to describe the change in energy state that does occur.

4.3

Although correctly answered by many students, answers were often poorly set out with omitted steps such as a clear reference to the graph. Whilst this did not prevent a correct answer getting full marks, students should be aware that incorrect answers are less likely to be awarded partial credit when they are set out negligently. A surprisingly common error was to subtract the two extremes of the graph and divide by 2. Many of those that showed a better understanding of half-life failed to achieve all three marks through omitting the effect of the background count in one or more of their steps.

Question 5

5.1

Most students were aware of the power equation and were able to get at least one mark. Those who received both marks understood the significance of the 20° angle and accounted for it correctly.

5.2

This was correctly answered by most; the most common mistakes were simple algebraic errors.

5.3

In contrast to the calculations in the first two parts of this question, this part was poorly answered by many. Answers were seen that referred to the increase in tension, or to the change in gravitational potential energy, without going on to explain why these result in an increase in power output. Students should be encouraged to look back to check that their answers are complete.

5.4

A surprisingly large number of answers suggested that the speed of the car increases as it moves along the lorry bed; such answers received no credit. There was further evidence of confusion in answers that suggested the lorry itself was moving. Other difficulties were seen with students being unable to express themselves sufficiently clearly to obtain the marks. It was quite common to see answers that suggested the car was being lifted upwards.

Question 6

6.1

Most students obtained both marks for this question. Again, incomplete answers were relatively common. Students should be encouraged to look at the marks available for an answer, as this is often an indication of the level of detail expected. Two marks were available here, so examiners were looking for two clear statements.

6.2

This straightforward calculation was produced correctly by most. Students should be reminded that, in a “show that” calculation, answers should be set out clearly and answers should be given to at least one more significant figure than the “show that” value.

6.3

This question was slightly more demanding and there were several routes to the correct answer. The most straightforward answer was to double the time to reach the highest point, which is found using the answer to 6.2 divided by *g*. Students were given the “show that” value in order to facilitate this. It is very important that students use the printed “show that” value from an earlier question whenever their own answer is very different.

6.4

Although most students correctly identified the highest point as the position, a clear explanation proved to be more difficult for them. Far too many simply stated that the speed would be zero at this point thus failing to take into the account the constant horizontal motion.

6.5

This straightforward calculation was done correctly by the majority.

6.6

Many good answers to this question were seen. Some students lost a mark by failing to be clear which angle they had calculated. Others failed to calculate an angle at all, simply making a vague reference to "upwards to the right". Students who took no account of their previous answers and tried to calculate the velocity from first principles often failed to receive any credit.

Question 7

7.1

This was answered correctly by many students. Some students failed to work out the weight correctly or demonstrated some confusion about work done.

7.2

This was also correctly answered by most students. A common mistake was to confuse *F* and *k* in the equation for the energy stored. There were also some power of ten errors, with students failing to deal with the "k" in kN correctly. This may have been due to confusion with the stiffness *k*.

7.3

Some students had already answered this question on their way to answering question 7.2 and, if unsure of what they were doing, then attempted to answer a different question here. Consequently, this was not answered very successfully.

7.4

Although many students had little difficulty with this question, there were several careless errors that prevented full marks being awarded. Answers commonly failed to include weight in the equation of motion. It was also common to see answers that only included the weight and obtained an answer of *g* for the acceleration. This should have suggested to students that they had made an error. Students are encouraged to check their answers to see if they are reasonable and make sense.

7.5

This is another example of students giving incomplete or vague answers that prevent marks being awarded. There was a sense in some answers that the friction would "obviously" reduce the acceleration without any supporting argument. Answers referring to the resultant force tended to be the most successful. Alternative answers discussing the energy transforms involved tended to be less well expressed and therefore gain fewer marks.

Section B

Question 8

8.1

Most students were able to carry out this straightforward analysis. Those who failed to gain the mark had often misunderstood what they were being asked to do rather than making mathematical errors.

8.2

This was also well answered by most. Any difficulties may have been because the data required were in different parts of the question. Students should be encouraged to read the whole question carefully so that they are aware of where the required data are located.

8.3

This question proved to be more difficult. There was some evidence that students were confused about the difference between absolute uncertainty and percentage uncertainty. Students should carry out this type of analysis in a wider range of practical contexts.

8.4

Most students failed to identify this line as a curve, ignoring the point at (0.012, 1.5) even though error bars were included on the graph. It was also common to see answers that made no attempt to plot the extra data point. Even when the point was given, it was common to see incorrect or missing error bars.

8.5

Most answers demonstrated that students knew that the relationship was “directly proportional”. Very few correctly related it to the results from the experiment, i.e. F being equivalent to the weight and u being equivalent to v, so answers simply suggested a plot of F against u^2. Other answers lacked detail by failing to mention the straight line passing through the origin as a part of the test.

Question 9

9.1

The majority answered this correctly. Some students did not get the mark because, although they knew that impulse is Ft, they did not explain what they meant by F and/or t.

9.2

Having been given the answer, many students were able to combine the numbers correctly to obtain the correct value. In common with other “show that” questions, full marks could only be given if the principles behind the answer were clear. In this case examiners were looking for the idea of rate of change of momentum, rather than just $F = ma$, to award the final mark. Some students were able to arrive at a value similar to the “show that” value without their answer having any basis in physics; these answers received no credit. Students should be told that random combinations of data to obtain a “show that” value are unlikely to get any credit.

9.3

Many good answers were seen to this question. It was common to see answers that omitted the force from the belt or the friction force. Partial credit was awarded to these answers provided there was clarity in the solution. Other common errors included failures to convert 24 hours to seconds.

9.4

Answers to this question suggested that many students do not understand the law of conservation of momentum. They failed to realise that change of momentum when an external force acts is a consequence of the law. Many answers tried to argue that the vertical momentum of the falling sand became the horizontal momentum of the sand on the belt. This is points to major misunderstandings of the physics of momentum conservation.

Section C

Most of these questions were answered correctly with only a few exceptions.

The most challenging questions in this section were 12, 15, 20 and 22.

Question 12

The correct answer is A; the most popular answer was C.

This suggests that students taking moments about the hinge did not realise that the weight acts through the centre of the bar rather than through the end, where the tension acts.

Question 15

The correct answer is B; the most popular answer was D.

The word “always” is in bold in the question. Students who gave the answer D perhaps failed to realise this. When it is elastic a material returns to its original shape when stress is removed. Many elastic materials do not have a stress–strain graph that is a straight line.

Question 20

The correct answer is D; the most popular answer is B.

Again, there is the emboldened word “total” in the question. Students who gave the answer B may have failed to include the extension of P in their answer. Rather than answer the question, they provided the missing value from the table (the extension of Q).

Question 22

The most popular answer was the correct answer A. The other options were also reasonably popular, however. In particular, the most popular distractor was B. This may suggest that students did not recognise that the background radiation had been accounted for, and that the values were for the corrected count rate.

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