General Certificate of Secondary Education

Additional Science 4463 / Physics 4451

PHY2H Unit Physics 2

Report on the Examination

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ADDITIONAL SCIENCE / PHYSICS

HIGHER TIER PHY2H January 2012

General

Questions 1-3 were standard demand, targeting grades C and D. Questions 4 – 6 were high demand, targeting grades A* - B.

The majority of students attempted all parts of all questions.

The questions involving calculations were generally well answered.

Question 1 (Standard Demand)

(a)(i) Just over 40% of the students were awarded full marks – some for excellent, succinct answers. About 24% scored 2 marks as they omitted to write about friction or failed to gain the mark because it was not clear that the friction was between the beads and the pipes. Other students scored the friction mark alone but did not mention electron transfer at all, so missing the last two marks, and other students spoilt a correct response by also writing about positive charges transferring. A small number of otherwise good answers were spoilt by stating that the electrons went *from* the beads *to* the pipe

(a)(ii) Approximately 60% of the students wrote an acceptable answer although significantly more probably knew it, but used vague language, for example 'amount'. This mark was often scored by answers such as 'the same amount, 75 cm^{3}'. A small number correctly identified the pipe length as a control variable. Common suggestions that did not score were the 'same size/mass/weight' of beads.

(b)(i) The great majority of students (95%) wrote succinct answers making a clear comparison between bead size and total charge. A few students attempted to explain what caused the pattern in the data. Most of these also described a correct relationship, but occasionally missed the mark by failing to describe the relationship.

(b)(ii) Almost 40% of the students reasoned that the total charge would be smaller and gave a reason why, gaining both marks. Most of the other students only scored the first mark because they could not give a clear enough reason for the reduction in charge on the beads. Some offered no reason at all, others gave vague ideas such as 'less friction'. A smaller group gained the second mark point only, missing the first mark because they stated only that the charge changed, without saying it reduced. A small but significant number of students scored zero, either through poorly worded answers or because they misunderstood the physical situation. eg 'they wouldn't have space to lose charge so it will be higher'.

(c)(i) Just over 40% of students gave a correct answer in terms of the greater charge on the smaller particles. Some students correctly selected 'finer powders' but did not give a sufficient reason to explain the answer. They often mentioned greater surface area but made no reference to the charge. A number of students related surface area to ideas about the rate of chemical reaction, which was not the focus of this question. A few students misunderstood the question and answered ‘yes’ or ‘no’, presumably misreading the question and thinking that it asked whether an explosion is more likely with fine powders *than* with larger particles.

(c)(ii) Almost 40% of students answered correctly by mentioning earthing, and a smaller number suggested metal pipes. Many non-scoring answers suggested changing the industrial process itself, e.g. ‘use larger powder’, ‘pump the powder in smaller amounts’ or ‘use shorter pipes’. Other vague ideas that did not score included using anti-static material, using frictionless pipes and neutralising the particles. A small number of students gave answers that would produce the wrong outcome, for example insulating the pipe or using finer powders.

(d) This was not well answered. A third of students gained the mark, usually by explaining that changing temperature and pressure would alter the results. A smaller number of students scored the mark for stating that controlling the other variables allows a comparison between powders. Too frequently answers implied that temperature and pressure had no effect on MIE values eg ‘so that only one factor affects the result’.

Question 2 (Standard Demand)

(a)(i) Schools must emphasise the need for the clear writing of fission and fusion , if they cannot be distinguished marks will not be given. The majority of students gained some credit, but a significant number of students failed to refer to the nucleus or nuclei, settling for vaguer words such as atom or particle. Some students wrote in terms of neutrons splitting or fusing. A significant number of students lost the fission mark by talking about a nucleus breaking down or by dwelling on the cause of the fission or talking solely about chain reactions so, consequently they tended to gain the fusion mark for the more straight forward idea of combining, where they were often more likely to use the word nuclei. Nearly 50% of students scored zero.

(a)(ii) Just over 73% of students scored this mark.

(b)(i) The vast majority of students scored this mark, although spelling and handwriting were often poor. Most students scored the mark by giving uranium rather than another of the ‘acceptable’ answers.

(b)(ii) On the whole this was well answered with reference to number of protons being the most common answer although ‘same atomic numbers’ was also given. Some answers referred to the isotopes having the same properties, but the more common mistakes involved numbers of neutrons, or electrons (without the mentions of protons as well). There is still confusion between the terms atomic mass and atomic number.

Question 3 (Standard Demand)

(a) Nearly 60% of students scored all three marks. However, “standing still” or “stationary” was a common wrong answer to A, even though the students were told the car was moving. Often, in B and C, students calculated the resultant force and did not describe the motion, just the direction; forwards for B or backwards for C.

(b)(i) Most students correctly gave the distance travelled while braking. Some students correctly wrote about the distance travelled after braking, or distance travelled in the braking time. A common wrong answer was to involve total distance travelled before the car stops, since this would include the reaction time. Many students lost the mark by putting a list of “braking and stopping distance”.

(b)(ii) Only 25% of students scored this mark. Students often wrote about factors affecting stopping and braking distance; ‘bad weather conditions’ was a very common wrong answer. Also tiredness, being drunk, condition of road and state of vehicle were often given.

(c)(i) This mark was for giving both 5000N and a clear direction. A lack of a simple arrow drawn in the correct direction kept many students from gaining this mark. Some students simply wrote ‘a very large force’ rather than quantifying it. A common incorrect answer was “5000N on the car”. One of the most common responses was “5000N towards the car”, which gained credit. Some students failed to include 5000N in their answer, just stating that the resultant force was equal and opposite.

(c)(ii) This question is about a dummy being used to measure/record the effects of impact/force. Many students wrote around this answer. “To see the force” was a common incorrect answer. Many students answered in terms of how much damage the dummy received, not mentioning measurement of the forces causing the damage and many students wrote about “impact”, instead of “force”, and did not gain credit for their answer.

(c)(iii) A great number of students knew how to find the gradient of a velocity-time graph in order to calculate the acceleration, However, they failed to use only the straight line part of the graph - between 2 and 4 seconds. As a result, 10/4 was a common answer, giving 2.5 instead of 4. Often, the unit was the only credit-worthy part of an answer, although there were a number of mps, mph, km/s, etc. An answer of 40 was also quite common, multiplying 10 by 4. About half the students gave the correct unit; although m/s was a common incorrect answer. Some students drew a triangle correctly, but failed to use it, gaining one mark only. Some students correctly found 2 and 8, or 1 and 4, but then didn’t know how to calculate the acceleration; obtaining 16 or 0.25.

Question 4 (High Demand)

(a)(i) The majority of students, over 90%, scored 2 marks. Very few gained 1 mark.

(a)(ii) Very few students produced a correct graph to gain 2 marks. A large percentage of students did not appreciate the importance of using the answer to part (a)(i). Common “wrong” answers included a straight line from the origin to (12,2), a straight line from (12,2) through (2,0.8) and continued back to the y axis, and two straight lines, one from origin to (2,0.8) and then from that point to (12,2). Otherwise, all sorts of curves, including s-shaped and convex all the way from the origin.

(a)(iii) There were only a minority of correct answers, less that 25%. Many answers referred to how the resistance changed as the current increased but not why. There were also lots of answers given in terms of the resistance changing to allow or stop the current flowing and for safety to keep the “fuse” from blowing.

(b) The majority of students gave correct answers. The most common incorrect response was “144”, by multiplying the charge by the time in minutes. An answer scoring one mark was rare – and seemingly from students who did not possess a calculator.

Question 5 (High Demand)

(a) Nearly 60% of students scored this mark, usually for the accepted answer ‘it is positive’. Failure to earn the mark was usually due to the mention of a nucleus or protons.

(b) This was very poorly answered and correct answers were often poorly worded. Too many students simply wrote how the “new model” was different from the “plum pudding” model, not why the evidence failed to support the old model.

(c)(i) The majority of answers referred to the observations and made no attempt to explain the paths in terms of the nuclear model. Quite a number of students tried to explain the paths as those of alpha, beta and gamma. Just over 76% of students scored zero. Only approximately 6% of students scored 2 or 3 marks.

Path A: Many answers referred to “passing straight through the empty space”, suggesting students had the idea of what was shown by the results but were unable to be precise enough.

Path B: Some students gained the mark for the nucleus being positive. However some answers talked loosely about repulsion but failed to explain why this should happen. Some students referred to interaction with electrons.

C: Those students scoring a mark here generally did so for the nucleus being positive; if not scored in B. A very few students scored the mark for “nucleus very small”, or for “very concentrated charge”

(c)(ii) Many students scored this mark for simply stating that Rutherford was correct or had been proved to be correct. Those students that failed to score this mark usually wrote in general terms and often about reliability, accuracy and validity.

Question 6 (High Demand)

(a) A large majority of students (85%) scored full marks demonstrating an ability to use the given equation correctly. About 3% of students were able to substitute the values correctly into the equation but then made mistakes with the arithmetic. Approximately 12% of students were unable to correctly substitute values; often using v instead of v^2

(b)(i) While most students were able to calculate a momentum using the given equation only about 23% of students recognised that they needed to find the difference between the initial and final momenta. Very few correctly calculated the change in velocity to be 60m/s to gain the compensation mark. Most of the 75% of students who scored zero on this part question only calculated the final momentum, albeit correctly, but unfortunately this was not creditworthy in the context of this question. Some students who did recognise that a change in momentum needed to be calculated confused signs and ended up with a change in momentum of zero thus demonstrating a lack of understanding of the concept.

(b)(ii) Of the 23% of students that answered part (b)(i) correctly only a small number then made errors in this question. The vast majority of students managed to substitute their answer to (b)(i) into the equation for force and calculate the answer correctly, gaining an 'error carried forward' mark. Approximately half of the students who failed to score here did so because their answers to part (b)(i) were zero, making it impossible to gain this mark. There were a few students who at this stage realised that their answer of zero earlier must be incorrect so they deleted the calculation that resulted in a force of zero and came up with the correct figures, but failed to amend (b)(i) to match. Just over 83% of students scored this mark.

(c) Just over half of the students gained some credit on this question but only 28% scored both marks. Of these about half gained the marks by correctly stating that 'the rate of change of momentum had decreased'. Other students were less concise but did tie-up increased time to the change in momentum. Of the students who did not score fully on this part question many offered confused statements, that the change in momentum was smaller, not realising that it is the same change in momentum to bring the ball to a stop or offered vague statements about the time taken slowing down.

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