General Certificate of Secondary Education

Additional Science 4463 / Physics 4451

PHY2H Unit Physics 2

Report on the Examination

2012 Examination – June series

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Additional Science / Physics
Higher Tier PHY2H

General

It seems that the standard of handwriting is getting more and more difficult to read with some students still using blue pens or pencil. For some students the writing is so small that even when magnified it is still indistinct.

Students should be advised not to use symbols where the interpretation may not be clear e.g. # instead of 'number of' in question 7(a)(i)

Question 1 *(Standard Demand)*

(a) This part of the question was well done with the majority of students scoring both marks. Some students failed to score the second mark as the reason given was muddled with statements involving acceleration, or an observation that wasn't comparative e.g. the line is steep, rather than steepest.

(b) The distinction between speed and velocity was known by most students. The most common errors seen were 'velocity is change of direction and speed', or 'velocity is acceleration in a particular direction'.

Question 2 *(Standard Demand)*

(a) Over half of students obtained 2.75 and gave the correct units. Common incorrect answers were 5.75 and 3.75. A significant number of students either missed out the units for the final answer, or wrongly quoted m/s. There are still a number of students writing mph or mps.

(b) Most students correctly stated that during the first two seconds of acceleration, the driving force increased, and many students obtained the final marking point, correctly stating that driving force was greater than frictional force. Unfortunately, many students either failed to comment on the frictional force increasing, or simply stated, wrongly, that frictional force decreased.

Question 3 *(Standard Demand)*

(a) Over half of students scored both marks, but there are still a significant number of students who think that positive electrons exist and that protons move. A certain number of students started with an already charged cloth and/or rod but this tended to occur more in the weaker answers.

(b) In both parts of 3(b) it was not unusual to see reference to magnetism.

(b) (i) Although a large number of students mentioned that repulsion caused some downward force, an alarming number then lost credit by taking this to mean increased mass or weight. Even more disappointing was the frequency of answers that talked of weight / mass gain because electrons were added to the lower rod. On occasion the insulating material or the balance pan was brought into the argument. About half of students failed to gain any marks on this question.

(b) (ii) A few students scored both marks with a third of students giving an answer scoring a single mark. Again there was much reference to particles transferring more easily to affect the mass, weight or charge on a rod, or the insulating material or the balance. Very few students referred to the distance between *charges* but made a more general reference to the rods and many students referred to 'greater repulsion' or 'repels more' rather than writing about force.

Question 4 *(High Demand)*

(a) (i) Excellent responses in most cases, with three quarters of students scoring this mark. The most common error was: 'current will halve'; the other common error was to simply restate proportionality.

(a) (ii) This was not well answered with only approximately two fifths of students giving the correct answer. The most common incorrect answer was battery. Other incorrect answers included 'voltmeter', 'resistor' and 'diode'.

(b) (i) Nearly three quarters of students gave a good answer; most students wrote 'data / results', rather than 'variables' being continuous.

(b) (ii) This was poorly answered, with only one tenth of students giving a correct response. Far too many answers were vague, e.g 'human error' or 'random error'. Similarly 'misreading meter / voltmeter' was another frequently incorrect response.

(b) (iii) There were many excellent straight lines drawn, often with absolute clarity and passing through the origin. There were very few 'curvy' lines trying to hit all points. The students who just failed to score the mark often did so by not starting at the origin but at 1V and 0.2 A.

(b) (iv) Just over a tenth of students scored this mark; many 'Yes' answers failed to score the mark because it was simply stated that 'as voltage increased so did current' or 'current proportional to voltage" etc. Quite a few correct answers used a mathematical argument well.

Question 5 *(High Demand)*

(a) (i) Only a few students scored both marks. The first mark for calculating 30 cells was most frequently scored however the mark for series circuit was rarely given. Appearances of 'parallel circuit' were fortunately rare. Those students who did attempt to describe the connection needed for the cells to make a battery said 'positive to negative' without realising that this could be achieved both in series and parallel.

(a) (ii) About three fifths of students could describe a direct current however there were a lot of common misconceptions: a current which goes straight to where it is needed, it flows through all of the circuit, a current which travels in a straight line. A few students tried to describe d.c. only in terms of a CRO display which was insufficient for this question.

(a) (iii) About a quarter of students scored all three marks. The most common mistake was the failure to convert the time of two hours to seconds. Of the third of students who gained two marks, the majority gave the 'fall back answer' of 10 or 600 with the correct unit, those who gained one mark achieved this mostly with answers of 10 or 600 with very few gaining 1 mark from a correct unit without a correct calculation. A number of students had been well trained to put a really large C but unfortunately a number of small c's and q's were also in evidence. A few students scored no mark.

(b) (i) This question was well done compared to recent years, with nearly three quarters of students scoring both marks. Common mistakes were the failure to square '6', and erroneously changing 120kg to 120 000g.

(b) (ii) Most students correctly stated that the distance was reduced (in their own words) but some mistakenly gave an answer of 'time being less between recharge' thus not answering the question. A common misconception is that more KE is needed to move the bicycle with a greater load rather than more energy from the battery being transferred as more KE for a bicycle of greater mass moving at the same speed. Very few students who mentioned KE in their answer managed to do so in an appropriate way to score the mark. The two fifths of students who scored the reason mark generally did so by simply stating that 'more energy is needed'.

Question 6 *(High Demand)*

(a) About two thirds of students scored this mark, showing that they had learnt that momentum has direction. A significant number of students ignored the information given in the question and stated that the two teenagers had different speeds or different mass.

(b) (i) Over two fifths of students scored this mark, giving a clear statement explaining momentum conservation, e.g. 'momentum before = momentum after' with many giving a textbook answer including the proviso that no external forces act. Some students suggested that the momentum was used up or ran out, or gave poor answers about forces and energy. Some students attempted to apply the rule to the particular case of the skateboard, explaining about the teenager and the boy having equal and/or opposite momenta. Unfortunately they generally did not go on to say that the (total) momentum had not changed.

(b) (ii) Over two fifths of the students showed an excellent understanding of momentum conservation and presented clear working leading to a correct three mark answer. Another two fifths of students gained no marks at all. Their working showed little grasp of the mathematical aspects of momentum. There were many different wrong answers, the most common being 10/0.4 = 25, with no mass values involved at all. Of the remaining students, most gained a single mark for calculating the teenager's momentum. Very few students obtained the second compensation mark by either stating the conservation of momentum or giving a numerical expression of this.

(c) Many students showed misconceptions about 'force' and 'energy', e.g. stating that without a force pushing it the board no longer has any energy, that it needs a force to keep it moving, or that friction is stronger than the kinetic energy. Very few connected friction with the work done against it. Too many wrong answers were comparing this question with question 2(b) and mentioning an increasing frictional force. As a result about two thirds of students did not score on this question. On the other hand, a few students showed clear understanding of the key terms and gained both marks for saying that kinetic energy is transferred as heat because of the friction force. About a third of students gained a single mark, usually for correctly referring to a friction force or, less often, for stating that kinetic energy is transferred by heating.

Question 7 *(High Demand)*

(a) (i) Most students knew the answer but some failed to score the mark as they just wrote 'protons and neutrons'. Other incorrect answers concerned the 'weight of an atom' or an answer of '212', the mass number given in the question.

(a) (ii) About one fifth of the students scored both marks and a few more scored 1 mark. Many students explained that as an electron was emitted and as it had negligible mass the overall mass would not be affected. However this did not answer the set question. Worryingly, far too many of those students thought that the emitted electron had come from the shells rather than from the nucleus.

(b) (i) Over three quarters of students scored both marks. However a number of students wrote a correct answer only to change to a wrong one. A large proportion of those students who got it wrong insisted on adding 4 and 2 to get 216 and 85, others divided by 4 and 2.

(b) (ii) The final item on the paper might be expected to help to identify the A* students, and this succeeded; only a few students scored both marks but most of those answers were beautifully written. Many students didn't make it clear that it is the proton number that defines the element and many students hedged their bets by stating that it couldn't be the same element as both the atomic number and the mass number had changed in alpha emission.

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