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# Examiners' Report/
# Principal Examiner Feedback

Summer 2013

GCE Physics (6PH04)
Paper 01R: Physics on the Move.

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**Examiner's Report Summer 2013**
**GCE Physics 6PH04/01R**

## General

Although it is pleasing to see that so many students are making use of available mark schemes from previous examination sessions, it is important that students read questions carefully to ensure that similar concepts are being questioned. On a number of questions for this paper, many of the answers were almost identical to the answers from a previous mark scheme for a past paper question, even when the topic of the question on this paper was not quite the same, or in some cases not at all the same. In particular, questions 11, 12 and 14b were similar, but not identical, to past paper questions, and the answers from candidates often seemed more appropriate for another question.

## Multiple Choice Questions

The majority of the questions were answered well. However, the worst answered questions were questions 5, 8 and 10. Just 19% of the cohort correctly answered Question 5, and "A" grade students were equally as likely to get this question wrong as "E" grade students. Questions 8 (average 40% correct) and 10 (average 55% correct), tended to be better-answered by stronger candidates. Questions 5 and 10 perhaps scored poorly due to the level of application of knowledge required. However, question 8 seemed to catch students out, as the "correct" answer (i.e. the answer which was NOT a valid conclusion of the alpha particle scattering experiment), was a statement that the candidates would have known to be true (that the nucleus is positively charged), but obviously in this case many did not realise that it was not conclusively proved by this experiment.

## Question 11

The role of electric and magnetic fields in a cyclotron is a standard question which generally scores well. The majority of the students achieved the basic statements about the "electric field causing particles to accelerate" and the "magnetic field causing particles to move in a circle whilst in the dees". The other marking points were less commonly awarded, although it was quite common for candidates to achieve all 3 marking points for the magnetic fields, which could only score a maximum of 2 marks. The idea of frequency/period being constant was rarely discussed, and those who had the concept of the p.d. changing every half cycle rarely put it into the correct words.
A small number of candidates did not clearly distinguish between the role of the electric field and the magnetic field, leading to very few (if any) marks being awarded here.

## Question12

Overall, this question was not answered well; not a single student scored all 5 marks. A surprisingly high number of candidates assumed that prior to their separation; the rocket and module were stationary. This is despite the suggestion from the question that the speed of the module increased after separation (implying that is was already moving). Many candidates were obviously confused about whether total energy or total kinetic energy should be conserved in such an event. Some who had the right idea in terms of energy only mentioned the increase in kinetic energy of the module, not for the whole system. They often seemed to feel that the collision was elastic, so the gain in kinetic energy of the module was counteracted by the loss in kinetic energy of the rocket.

## Question 13a

The ideal answer for this question was not always given, as many candidates were led by the wording of the question into writing about the current-carrying conductor, rather than simply "the current".

**Question 13b**
It was disappointing to see the significant number of candidates who considered either Coulombs or Newtons to be base units. Many answers included one or the other of these, even when they had shown the correct base units in their earlier working. In spite of this, there were many correct answers given.

**Question 13c**
This question certainly represented a challenge in terms of the fact that the term for length had to be kept in algebraic form as the value was not known. However, a large majority of the students managed to rise to this challenge, with a disappointing number forgetting some more obvious details such as the insertion of "g" into the formula. The other main area of downfall was a failure to correctly convert the dimensions given into metres.

**Question 13d**
Generally well-answered, although a fair number of candidates managed to find interesting alternatives such as "clockwise". Although it is perfectly acceptable to refer to the diagram in the answer, this needs to be clearly stated, as the diagram was not visible to the examiners marking this question. If candidates just draw their answer on the diagram and did not ask the examiner to refer to the diagram in their answer line to 13d, the examiner would not know that the answer was on the diagram.

**Question 14a**
Very well answered on the whole. Many of the incorrect answers were due to candidates giving the quark constituents of a single particle e.g. Proton (uud). This does not prove that the candidate knows that ALL baryons contain 3 quarks (or antiquarks).  For baryons, the term "quark triplet" is not acceptable.

**Question 14b**
Most candidates managed to correctly establish a similarity. However, terms such as "different charges" is not good enough for a difference, as this could be +2 instead of +1. On a past paper, candidates were asked to highlight the difference between hydrogen and antihydrogen – both have the same (neutral) charge overall, so in that examination the candidates had to say "opposite charges on the nucleus" to get the mark. Many candidates in this examination lost the difference mark as they used this phrase, which is not applicable in the majority of particle/antiparticle pairs, as they often do not have a nucleus.

**Question 14c**
Generally well understood on parts (i) and (ii). However, on part (iii) there were a large number of candidates who decided to add in an additional step in the calculation by dividing by the speed of light squared. This was rectified by some who subsequently multiplied by the speed of light squared to get the correct answer. Generally, candidates were able to identify the need to multiply by e, but a number missed the fact that because there were two particles involved (with the same mass) that the mass given needed to be doubled.

**Question 15a**
Part (i) was almost always answered entirely correctly. Part (ii) was more mixed, although many candidates scored 2 marks for realising that they should calculate the time constant. In spite of this, the subsequent discussion (if any) demonstrated that a number of candidates were not aware of the significance of their answer in relation to the given time.

**Question 15b**
On part (i), the majority of the candidates scored 0 or 2. Many chose the wrong method, using V=IR, and did not pick up any marks here. On part (ii), many continued with the same incorrect method by applying P=VI. Quite a few who did manage to start on the correct path with equations such as W = ½ QV, made the mistake of thinking that W was Power in Watts, so only did the energy calculation and leaving it as their answer.

**Question 16a**
Generally well-answered. Most candidates were scoring both marks, as the first mark could be awarded in a number of ways. The second mark was occasionally lost by candidates who suggested that the direction of the force was perpendicular to the direction of motion. Although this is correct, this could also be outwards from the centre of the circle, so was not precise enough to gain the second marking point.

**Question 16b**
A large number of vague answers were given for this question, many of which did not address the information given in the question about maximum frictional force. Although many candidates might take it for granted, the mention of "sharp bends" in the question has to be related to "smaller radius" if a candidate is to get the first marking point by using this line of argument.
A significant number of candidates felt it only necessary to quote an equation with a statement such as "as r goes down, F goes up". If an equation is to be used in a question starting with the word "explain", all terms in a given equation need to be defined in words.

**Question 16c**
(i) As with many "show that" questions, candidates can get some idea of how the equation is derived by looking at the answer they are working towards. In this case, following on from parts (a) and (b), a number of candidates realised that the answer would be generated with some reference to $F = mv^2/r$. This led to a number of failed attempts to combine equations, and unfortunately this question ended up tending to score 0 or 3. Some candidates were obviously familiar with other forms of this equation, as they did all the correct working, but mistakenly used letters such as "T" rather than "N" in their method. Part (ii) was answered very well on the whole, with the only mistakes being generally down to a failure to square v, or to have their calculator in radian mode.

**Question 17a**
A large majority of candidates answered this question correctly. Almost all of the rest had upward arrows drawn.

**Question 17b**
Another generally well-answered question. One of the main causes for students not scoring all 3 marks was a failure to convert 5cm into metres. Another cause for mistakes was from a number of students who felt that Electric Field Strength IS Force (Giving their answer as 3,200N). It is worth noting that the example of calculation on the mark scheme uses the method employed by a significant number of candidates, where they have combined the two equations quoted for marking points 1 and 2.

**Question 17c**
The vast majority of candidates on this question scored 1 mark. Many failed to recognise that the force between the plates was acting vertically, with many stating that it was centripetal. Rather more worryingly, a significant number described the force between the plates as being magnetic in origin. However, the least commonly awarded mark was the second marking point. It was rare for students to recognise that this was equivalent to projectile motion at AS, where gravitational force provides the vertical force, and horizontal velocity remains constant. It would be interesting to know how many more candidates would have picked up the second marking point if the path shown curved downwards.

**Question 17d**
Part (i) was done well on the whole, with the majority of those candidates who failed to gain the mark being some way off the required answer. The majority of incorrect answers were clearly referring to the photoelectric effect. The process of heating the metal was required, rather than just stating that the metal was hot.
Part (ii) was done well by most, although it was clear that the candidates who did not get the correct answer were often completely incorrect in their method. A significant number tried to use incorrect methods involving equations of motion. A more worrying number tried to equate equations for kinetic energy (E) with those for electric field strength (E). As has happened on many occasions, a large number of people failed to square the v in the kinetic energy equation, even when they had written the term squared in the original equation.

**Question 18a**
Most candidates were able to successfully complete the calculation. However, there were a number of unit errors, and a number of candidates who decided to multiply a correct answer by Sin (0) to get an answer of 0.

**Question 18b**
On part (i), the main loss of marks was generally due to a failure to correctly calculate the time taken for one quarter of a revolution. Students who had obviously attempted to calculate a time for use in the equation were often scoring marking point 2. However, a number of candidates decided to multiply the whole equation by 200 turns once again, which led to marking point 2 not being awarded. There were very few unit errors on this part.
On part (ii), there was clear evidence that candidates had not taken time to look closely at the diagram given at the start of the question. The angle given was between the magnetic field lines and a line perpendicular to the coil. Most candidates seemed to think that the angle was between the magnetic field lines and the coil itself, as the majority of answers discussed "maximum values when coil is perpendicular to the field". A considerable percentage of the cohort were confusing rate of change of flux with change of flux, thereby failing to recognise the point of the question. In spite of this, many of these candidates picked up 1 or 2 marks on part (iii). Candidates familiar with the mark scheme to the January 2013 paper perhaps felt that this question was similar to the e.m.f. graph for a magnet dropped through a coil. Many said that the area under the graph would be the same, when it clearly would not be in this scenario. This resulted in not awarding the first marking point.

**Question 18c**

Many candidates are aware from past papers, that questions can follow each other in a linked fashion. As a result, a number of candidates in this exam seemed to assume that the answer must lie within the discussion of rate of change of magnetic flux, leading to lots of answers based upon magnetic fields. However, the expectation was that students should consider the energy for the generator having to come from somewhere, and the fact that the kinetic energy of the vehicle turning the generator would reduce the kinetic energy. Even those candidates, who realised that this was perhaps the answer, did not often put it into the right sort of wording. As a result, the average score for the two parts of this question were extremely disappointing.

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