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Examiners' Report/ Principal Examiner Feedback

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Pearson Edexcel International Advanced Level in Physics (WPH04) Paper 01

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Candidates were able to attempt all of the questions and could demonstrate a good understanding of the physics that was being assessed. All of the marks were scored by some of the candidates, with some excellent responses from the most able of the candidates. As often happens with overseas candidates the majority score better on the calculations and not so well on the more wordy descriptive questions. There was evidence that candidates are still memorising markschemes from previous examination papers and then quoting them without thinking about the context of the specific question. This occurred in question14 with an aeroplane flying in a circular path. Some candidates wrote about electromagnetic induction which was from a question from 2014. Question 16 asked about the magnetic fields in the Large Hadron Collider and many candidates wrote about the electric field as well because again, last year there was a general question about the role of magnetic and electric fields in accelerators. Candidates need to always read the question carefully and make sure that their answer is appropriate.

Questions 1 – 10

There was a range of responses to these questions with less able candidates struggling to get any marks but a number of candidates did score full marks.

Question	Topic	Correct Answer	% Correct	Common wrong answer
1	Angular velocity	B	88	-
2	Particle tracks	B	58	C
3	Conservation laws in elastic collisions	A	83	-
4	Fleming's left hand rule	C	70	D
5	Use of energy on a capacitor formula	B	41	A/D
6	Alpha particle path near nucleus	B	47	A
7	Units of electric field	A	67	B
8	Charge stored on capacitor calculation	C	76	D
9	Rutherford's' alpha scattering conclusions	B	68	-
10	Energy and momentum relationship	C	49	A/D

Question 5 required candidates to think of the most appropriate equation to use. Since the question asked for the $(V_1/V_2)^2$ the most suitable equation to use was $W = ½ CV^2$ giving the answer as the inverse ratio of the capacitances. The common answers of A and D imply that most candidates were squaring their ratio of capacitance.
Question 6 was about the parabolic path of an alpha particle as it approached a nucleus. At its point of closest approach, the force acting on it is the largest so it will have the largest acceleration. However, it is a repulsive force and so the force has been reducing the speed of the alpha particle so that it has its lowest speed at this point.
Question 10 is best solved by using the equation $E = p^2/2m$ so that halving the momentum twice and doubling the mass leads to a factor of 8. Many candidates will have tried to use $p=mv$ and $E_k=mv^2/2$ which would have been much more difficult to sort out.

Question 11

(a) This was generally well answered with most candidates able to show, by means of charge conservation, that the quark combination was correct. The main error being the omission of the "=0" part at the end. Quite a few candidates did "2/3 – 2/3 = 0", which was not deemed to be sufficient to answer the question.

(b) The majority of candidates were able to state that a baryon is composed of three quarks and a meson of a quark and an antiquark. A common answer was 'a meson is composed of two quarks, a quark and an antiquark.' Candidates were given the mark, but this is not a good answer because an antiquark is not a quark and so the opening part of that answer is wrong. All candidates need to say is that a meson consists of a quark and an antiquark.

(c)Candidates found this more difficult possibly because they needed to first of all work out the quark composition of a proton. Also some of them did not read the question properly since different information was required for two particles. Some candidates gave the quark combination of the pion instead of the charge. It was surprising how many candidates were not able to work out the charge on the pion. 30% of candidates scored zero for this part.

Question 12

Candidates are familiar with this type of question and a significant number scored full marks. This question did not provide much discrimination since nearly all candidates scored either full marks or zero. Those who scored zero either used the potential difference of 3000 V as a velocity or when trying to use $\lambda = h/mv$, used the speed of light as the velocity.

Question 13

Most candidates knew what to do in part (a) but many made power of 10 errors. There were many perfect answers for part (b) but several candidates were confused over the use of N and made errors. Part(c) was very poorly answered with very few candidates scoring any marks. They did not realise that the gradient to the graph gave the e.m.f.; and so the maximum e.m.f. was where the gradient was a maximum. Quite a few candidates attempted to substitute into the formula which would give an average value for their time interval, however the common answer was to use a value of $\Delta N\Phi$ of 2 or 4 with a time interval of 15ms. This showed that they did not realise that the change in flux and the time interval had to be related.

Question14

(a) was generally well answered but some candidates gave so much detail about the centripetal force that they forgot to mention that the velocity of the object was changing or that the object had an acceleration, which is the basic point that candidates need to state.

(b)The most common mark for this section was zero, scored by 39% of the candidates. This was a straightforward resolving the lift into a vertical and horizontal component and appreciating that the horizontal component was the centripetal force. A small number of candidates resolved the weight and had a component of weight along the wing as the centripetal force. For candidates who did realise that they needed to resolve the lift force, some made errors in their resolving and stated incorrectly that the horizontal force was $L \sin \theta$. The more able candidates were able to successfully complete the calculation.

Question 15

(a) This was generally answered very well, with the majority of incorrect answers being due to power of 10 errors and unit errors (either missing or ΩF).

(b) This was very poorly answered, with many candidates failing to realise that cells later in the spreadsheet should not be used in order to calculate the value of the cell in question i.e. you cannot use charge to determine current because the spreadsheet uses current to determine charge. Candidates did not realise that the modelling spreadsheet is based on the quantities given in the table and so it is not appropriate the use the exponential equation with the values of C and R in order to find a cell value. Having said that, the number of candidates who were able to answer this question part was so small as to be negligible that it was decided to allow 1 mark for the attempt at the exponential equation or 1 mark for a fully explained current = charge /time method. This will not necessarily happen in future examinations.

(c)(i) This was generally well answered although a small number of candidates did not plot the missing points and so were unable to score the mark for line of best fit.

(c)(ii) This was also generally well scored with methods 2 & 3 on the mark scheme being the most commonly used ones. Again some misread the question and instead of finding a second value for the time constant, they doubled their answer to give twice the time constant.

(c)(iii) Candidates needed to appreciate that it was the time interval on the spreadsheet that needed to be reduced. Answers such as have more readings or use a wider time range were common but did not convey the idea of a smaller time interval.

(d) 60% of the candidates scored zero because they failed to realise that the question was referring to the exponential equation. Of the candidates who did talk about the exponential equation many would have scored more marks if they had acknowledged that this was a question where the quality of written communication was being assessed. This means that just drawing a set of labelled axes is not sufficient. Other candidates wrote the log expression correctly but did not actually say what variables they would plot on each axis.

Question 16

(a) This part was generally not very well answered, MP1,2 and 3 were commonly seen (particularly MP2). An alarming number of candidates clearly talked about linear accelerators in spite of the extensive information to the contrary given in the question. Perhaps the candidates just looked at the photograph rather than reading the question as the large radius of the LHC means that a photograph of any particular section does look fairly linear. Even those who were clearly talking about circular motion decided to discuss cyclotrons, with frequent mention of "dees" being made. In spite of the question clearly stating a fixed speed and radius for this motion, many tried to answer MP4 in terms of "increasing radius" or "increasing speed" – perhaps still convinced that this was a cyclotron. It was also of concern how many candidates included a lot of detail about electric fields where the question only asked about the magnetic field.

(b) A decision as to whether the magnetic field increases, decreases or stays the same had to be based on an equation and not a guess. This meant that the 2nd mark was dependent on the inclusion of an equation which most candidates failed to do.

(c) This was generally well answered with the majority of candidates scoring 2, 3 or 4 of the possible marks. The common error in (i) was the omission of the factor of 2. Part (ii) proved more challenging with candidates just not realising the equivalence of the units. They do no appreciate that an energy of 0.51 MeV is a rest mass of 0.51 MeV/c^2. Most candidates want to use c^2 as well as converting from joules to eV. Candidates who omitted the factor of 2 in both cases appeared to get the correct answer. When this happened, they scored 1 mark in (i) and were limited to 2 marks in (ii).

Question 17

(a) It is disappointing that a standard definition scores so badly from so many candidates with only 29% scoring both marks and 41% scoring one mark. That leaves 30% scoring zero. A number of candidates were missing any reference to "sum" or "total" from their answer, and many did not include any extra detail about external forces or closed systems. Another common mistake was to say 'provided no external force acts, momentum is conserved.' This did get 1 mark for no external force but the whole point of the question is for candidates to say what is meant by conservation.

(b) This was poorly answered by most candidates. Too many just saying "they are proportional" or "as one goes up, so does the other". It was a 1 mark question and the answer needed to specifically relate force to rate of change of momentum.

(c)(i) Most of the diagrams scored only 1 mark, as nearly all candidates were attempting to draw the resultant of the two vectors rather than the change.

(c) (ii) Having drawn the wrong vector diagram candidates were given a full ecf for their direction provided they specified either the direction or labelled the angle on their diagram. Some candidates wrote down the value of 51° but did not add to their diagram or explain that this was the angle above the horizontal. Most candidates started the magnitude calculation correctly, using Pythagoras and arriving at 19 m s^{-1} but failed to realise that this was the change in velocity and so proceeded to subtract 12 m s^{-1} from their value.

(c) (iii) This calculation required again using the change in velocity. Some candidates who had correctly left their answers as 19 m s^{-1} in (ii) proceeded to subtract 12 m s^{-1} in this section, thus losing a mark. Having said all of this, the most common mark scored for this section (total of 7 marks) was 6 (19%) and 5 (31%) was this was a generally well answered question.

Question 18

(a) 69% of candidates scored this mark, whereas there was an expectation that more would have known the answer.

(b)(c) The most commonly scored mark was the full 10 marks scored by 31% of the candidates which is extremely pleasing. In the main (b) was answered well but errors began to appear in (c)(i) usually in the use of $E = V/d$. Candidates forgot that there is a uniform field between the plates, determined by the values of 800 V and 0.05 m. 400 V and/or 2.5 cm were used because the particle was half way between the plates. Also the 4800 V which was the accelerating potential difference were also used. Whatever value candidates reached for their force was given a full ecf in their calculation in (ii). For this final calculation candidates needed to use their force with the mas of the electron to find an acceleration in the vertical direction. Some candidates did not realise that this was a projectile question and that they just had to use time = distance /speed (from (b)). Only candidates who had the correct method for these two marking points could proceed to the other two marks. Another error often seem was that having correctly found an acceleration and a time, when these values were substituted into the given equation candidates forgot to square the time.
(d) Rather disappointingly these paths were generally very badly drawn with 44% scoring zero, usually because the lines drawn were very uneven with inconsistent amounts of curvature.

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