Examiners' Report

Summer 2014

Pearson Edexcel GCE Physics (6PH04)
Paper 01R

Physics on the Move

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Summer 2014
Publications Code UA039721

General Comments:

This is the second year that a regional paper has been set for candidates based overseas. Since last summer, the International Advanced Level (IAL) has been introduced and there has been an excellent take-up of that qualification. As a result, only a very small number of candidates sat this paper. It was planned that this paper and the IAL paper were of the same standard and style as the home paper and special care has been taken to ensure that the marking and grading are been done to the same level.

Candidates were able to attempt nearly of the questions, (the exceptions being question 12 and 18d) 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 they score better on the calculations and not so well on the more wordy descriptive questions. Candidates also have a tendency to memorise mark schemes from previous examination papers and then quote them without thinking about the context of the specific question. They need to always read the question carefully and make sure that their answer is appropriate.

Section A

Questions 1 – 10

These were generally well answered with a number of candidates scoring full marks.

Question	Topic	Correct Answer	% Correct	Common wrong answer
1	Angular velocity	B	94	-
2	Units of electric field strength	D	93	-
3	Alpha particle scattering experiment	B	53	C/D
4	Force on ball when rebounding off a wall	D	65	A
5	Inelastic collisions	C	89	-
6	Length of tubes in Linac	C	77	A
7	Energy stored on capacitor	B	78	A
8	Kinetic energy to electron volt conversion	A	75	C
9	Kg to MeV/c^2 conversion	B	73	C
10	Thermionic emission	D	93	-

Question 3:

A common misconception is that Rutherford's alpha scattering experiment provided evidence for a positively charged nucleus. In fact it only established that there was a central nucleus that contained most of the mass of the atom and had a concentration of charge. Rutherford's paper says that the results he obtained could be produced by a positive or a negative nucleus. It was other work going on at the same time that established that the nucleus was in fact positive. This is a point that we have tested before and I regularly comment on in my report but still candidates get it wrong.

Question 4:

The common error was to not notice that the unit on the time axis was milliseconds and not seconds as quite a few candidates assumed.

Question 6:

A is a correct statement but is not the answer to the question.

Question 7:

Because the capacitance was halved and the potential difference doubled some candidates thought that the two effects cancelled each other out but they forgot the effect of squaring the potential difference.

Question 8:

All candidates had to do was the equate eV to ½ mv^2 to arrive at answer A. Some candidates may not have written it down and recognised the expression for velocity, and so chose C.

Question 9:

C is the answer you get if you forget to square c when converting mass to energy.

Section B

Question 11: (mean mark 3.0 max mark 5)

Nearly all candidates were able to effectively find the weight of the car in (a)(i) but the error occurred in (a)(ii) when some candidates chose to ignore the weight and just equate the upward force *R* to the centripetal value or they add the weight rather than subtracted the weight. Not many candidates were able to state in (b) that the required value of the centripetal force was greater than the weight of the car.

Question 12: (mean mark 1.1 max mark 6)

This particular context has not been assessed before and candidates really struggled to express themselves.

They were directed to consider conservation of momentum and energy but could not follow an argument through. Some candidates could state that in the fixed target that there was a net momentum before the collision but they did not carry this on to say that there had to be a momentum after the collision which mean that the particle(s) had to have kinetic energy. Some candidates could state that for the colliding beams that there could be a net momentum of zero before the collision but again they did not go on to explain that this meant that in order to have a net momentum after, a single stationary particle could be produced, i.e. no kinetic energy so all of the initial kinetic energy had been converted to mass. Candidates were unable to apply a conservation law to both before and after a collision. A very small number of candidates (5%) scored six marks but 58% scored zero.

Question 13: (mean mark 4.7 max mark 7)

This was generally well answered with marks usually lost for the definition. The definition of the de Broglie wavelength has been asked before and we always use the same mark scheme for definitions so we expected them to say that it is the wavelength associated with a particle with a given momentum. This is because a stationary particle does not have an associated de Broglie wavelength. In the calculation some candidates rather than use $E_k = p^2 / 2m$ decided to use the mass of the electron in $E_k = ½\, mv^2$ to find v and then use $p=mv$ to calculate momentum. The danger of doing extra steps is the increased risk of making an arithmetic error. Also some candidates set their calculation up correctly but did not do the calculation to show the answer to one more decimal place as is required in a 'show that' calculation.

Question 14: (mean mark 3.5 max mark 6)

In (a) less than half of the candidates were able to identify that only changed particles can be deflected by a magnetic field. In fact it is only moving charged particles that can be deflected but since the question told then that the beam was moving we did not insist of the candidates referring to the movement. Just over half of the candidates could identify the direction of the field which since it is a straight forward application of Fleming's left hand rule, was a surprisingly low number. The calculation was well done with the majority of candidates scoring two or three marks. The most common error was either forgetting to convert cm to m or forgetting to half the diameter. Again, less than half of the candidates were able to draw a semicircle with a smaller radius and starting from the same initial point.

Question 15: (mean mark 6.2 max mark 10)

40% of candidates were able to score either nine or ten of the marks which was very pleasing to see. Most candidates scored the marks for (a) but if a mistake was made it was to say that flux was flux density over area which means that candidates weren't sure which symbol was which in the equation $\Phi = BA$. Section (b) was the most challenging part of the question. Most candidates realised that the needed to use $\varepsilon = \Delta\varphi/\Delta t$ but the weaker candidates struggled with finding a time and failed to use time is distance divided by speed with the distance being the dimension 2.4 cm. However there was an error carried forward and quite a few candidates who went wrong in (b) but did end up with a value for e.m.f. were able to work through section (c) and score more marks.

Question 16: (mean mark 6.6 max marks 11)

The free body force diagram was generally well drawn but candidates then struggled to demonstrate the relationship $F = W \tan \theta$. Some did not realise that they had to resolve the tension into vertical and horizontal components. For both parts of (b) 24% of candidates scored the full 7 marks but another 20% scored zero. For the demonstration of the inverse square law most candidates realised that they needed to take two pairs of reading from the graph and demonstrate that Fr^2 had the same value for both pairs. For this part the marks could be scored even if the powers of ten were not taken into account. For the charge calculation, if the powers of ten were correct the easiest way to do the calculation was to use the constant found in (i). However many candidates chose to do it by taking a pair of values from the graph.

Question 17: (mean mark 5.1 max marks 12)

Most candidates were able to identify that the capacitor would charge up or store charge but very few were able to say that the capacitor would not fully discharge before the cycle repeats itself and it is recharged. Candidates were not very good at reading the graph. The potential difference varies between 6.4V and 4.4V giving an average of 5.4 V but not many candidates gave that value as their answer. Nearly all were successful in finding an average current using whatever value they had for potential difference. The poor answers to (a) and (b)(iii) are explained by the fact that the candidates did not realise that the capacitor was discharging on the straight part of the graph and charging during the curved part of the graph. Therefor the time that the capacitor was discharging for was 17.5 ms not the 20 ms that most candidates said. In (iv) candidates knew that they had to use $Q=It$ and $C = Q/V$ but did not appreciate that the change on voltage during discharge was only 2.0 V and not 6.6 V. This meant that the most common mark for this calculation was 2. Although the calculations indicated that the candidates had not really understood what was happening in this question, they were often able to score the marks for the last part of the question about how to reduce the magnitude of the variation in potential difference.

Question 18: (mean mark 5.9 max mark 13)

The majority of candidates were able to score the marks for identifying the quark combination of the negative pion and the type of pion produced in the interaction. Also the calculation of the lifetime of the meson was usually correct. It was (d) that was very badly answered with 46% of the candidates scoring no marks. There were actually nine marking points with six marks available so just by saying things such as ‘the particle entering at X must be charged since it leaves a trail’ would score a mark. Or ‘the particle decays into two neutral particles because there are gaps in the trail’ would score two marks. This type if question has appeared in past papers so it is difficult to understand why candidates did so badly on it. After zero the most commonly awarded mark was three and only just under 20% scored four or more marks.

The last part was slightly better answered with more or less the same number of candidates scoring each of the possible marks of 0, 1, 2 or 3. For the last part candidates often wrote the word annihilate for their answer but they needed to show that annihilation only occurs between a particle and its antiparticle and so they needed to say that the antiproton would annihilate with a proton.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

Pearson Education Limited. Registered company number 872828
with its registered office at Edinburgh Gate, Harlow, Essex CM20 2JE