Examiners' Report
Principal Examiner Feedback

January 2017

Pearson Edexcel International
Advanced Level
In Physics (WPH04) Paper 01
Physics on the Move

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The assessment structure of Unit 4, Physics on the Move is the same as that of Units 1, 2 and 5, consisting of Section A with ten multiple choice questions, and Section B with a number of short answer questions followed by some longer, structured questions based on contexts of varying familiarity.

This was a relatively straightforward paper that allowed candidates of all abilities to demonstrate their knowledge and understanding of Physics by applying them to a range of contexts with differing levels of familiarity.

Candidates at the lower end of the range could complete calculations involving simple substitution and limited rearrangement, including structured series of calculations, but could not always tackle calculations involving several steps or other complications, such as a choice of angles. They also knew some significant points in explanations linked to standard situations, such as electromagnetic induction, but missed important details and did not always set out their ideas in a logical sequence, sometimes just quoting as many key points as they could remember without particular reference to the context.

Steady improvement was demonstrated in all of these areas through the range of increasing ability and at the higher end all calculations were completed faultlessly, most definitions were given with all the required details and most points were included in ordered explanations of the situations in the questions.

Section A

The multiple choice questions discriminated well, with performance improving across the ability range for all items. Candidates around the E grade boundary typically scored about 6 and A grade candidates usually got 9 or more correct.

The percentages of correct responses for the whole cohort are shown in the table.

Question	Percentage of correct responses
1	60
2	87
3	70
4	95
5	84
6	46
7	96
8	87
9	35
10	61

Q11 The majority of candidates approached this question by calculating the gravitational and electrostatic forces, usually successfully. Some did not make an appropriate conclusion and were limited to three marks. A small minority of candidates used the charge on an electron instead of 1 coulomb and occasionally an incorrect power of ten was used for kilometre. Some answers were so high or so low that candidates should have seen that they were unrealistic and tried again. As with several later questions, units were not always included – even though a comparison was required.

Q12(a) Several different methods were used for this question, nearly always successfully with the great majority being awarded both marks. Occasionally students did not make clear enough connections between steps to gain the second mark.

Q12(b) A majority of candidates completed the calculation successfully for 4 marks. Some omitted the conversion from keV to J or applied the wrong power of ten. A minority attempted to use $E = hc/\lambda$ even though they had just shown that $E_k = p^2/m$.

Q13(a) The majority of candidates scored at least 2 marks, with about 40% getting at least 3. Most of them gained credit for describing flux linkage and for stating that an e.m.f. is induced. The next most common mark was for linking the current to a complete circuit, although many missed this mark because they just stated that a current is produced. The varying magnetic field due to the alternating current was less frequently mentioned and many candidates appeared to describe a situation when there was a change in flux only at the point the watch was placed on the charger. A minority described a direct connection of some form of electrostatic induction.

Q13(b) A majority were awarded the mark, but many lacked clarity, some just rewording the question, saying that a diode is needed so the battery can charge.

Q14(a) A majority were awarded at least one mark, but only a quarter got all three. Nearly half failed to gain a mark, usually by applying $F = BIl$ without an angle, even if they wrote $F = BIl \sin\theta$. Some of them even said $\theta = 90°$. Many who used $\sin\theta$ used the smallest angle in the triangle, so they were using the component of the field parallel to the wire instead of perpendicular to the wire.

Q14(b) The great majority gained at least one mark, with about 40% scoring both. Of the two marks, the reference to Fleming's Left Hand rule was most common as quite a few students said the force acted downwards rather than into the page, down being ambiguous as it would more normally mean along a line from the top of the page to the bottom.

Q15(a) Three quarters of candidates scored all three marks, with a minority losing the third mark by using quarks other than those shown in the single model. An even smaller minority mixed up the meson and the baryon.

Q15(b) Candidates are familiar with this conversion and well prepared for it, most getting the correct answer without difficulty. The most common error was applying the wrong power of ten for Giga, although some failed to convert from eV to J along the way.

Q15(c)(i) Candidates rarely failed to apply the speed equation, although some went wrong with cm. While most recognised that the calculated sped was greater than the speed of light, about half did not make an additional appropriate comment on this. A scattering of candidates did not include the unit.

Q15(c)(ii) While about half of candidates scored for at least one of the points, only a quarter achieved two and only few more than this. The most common references were to the repulsive force between the protons and the need to overcome this, although they did not always really address the high energy part. Some mentioned that new particles were created, but didn't refer to their mass or mass-energy conservation or $E = mc^2$. Quite a few candidates appeared to be giving a prepared answer to a different question about the advantage of colliding two beams rather than using a stationary target in terms of momentum and energy.

Q16(a) About a third worked this sequence of calculations through successfully, gaining 8 marks and the majority scored at least 5, often getting them all for parts (ii) and (iii) after difficulties with part (i). Successful approaches to part (i) were divided between using the time constant determined from the graph and using the exponential equation for a pair of readings. Some candidates applied a half-life approach. Some candidates attempted part (ii) using the area under the graph, but this was not credited fully because the graph did not show full discharge.

Q16(b) Just under half completed this fully for 3 marks. While a majority of candidates attempted to use the exponential decay equation, a significant proportion had difficulty applying 15%, despite this being easier than if they had been by how much the potential difference had fallen. Having applied 15% to the equation, some had problems with logarithms and there were a few unit errors with μF.

Q17(a) The great majority were awarded the first mark for stating thermionic emission or for describing it, although many who stated it also gave unconvincing explanations. Fewer candidates described the acceleration of the electrons, even in the minimal detail required by the mark scheme. Overall, more than a third got both marks.

Q17(b) This was well answered with a good majority completing it successfully. Some students had problems applying the square root in their rearrangement.

Q17(c) Only a small minority failed to gain both marks, sometimes for drawing arrows pointing up the page but more usually for unequal line spacing or too many gaps between the lines and the plates.

Q17(d) About a third got right to the end of this sequence of calculations correctly. A majority were able to calculate the force, the acceleration of the electron and the time taken to travel 10 cm but then didn't know what to do next. Some used $v = u + at$ and some applied equations for circular motion. Some did not know what to do for part (ii) at all and tried a variety of calculations to see what came up.

Q18(a) A good majority of candidates scored 6 out of 7 marks for this sequence, the missing mark most often being one of the conclusions relating to conservation of momentum or elastic collisions. Almost all candidates could apply the equations for momentum and kinetic energy and understood the conservation principles they were investigating. Some candidates did not use the angles provided to find components for momentum in the required direction and some used the angles the wrong way round. Some candidates carried the angles through to part (ii), using components of velocity for the kinetic energy calculations. A few candidates also confirmed conservation of momentum in the vertical direction, which was not required.

Q18(b)(i) Only about a quarter of candidates gained a mark here, most commonly for suggesting the time interval or frame rate. A lot mentioned the angles and the distance between the balls, not appreciating that these would be obtained by taking measurements from the photograph.

Q18(b)(ii) About one in eight candidates got full credit for this answer and nearly half managed to get the required angle from the photograph, the determination of energy then being relatively straightforward. Many others did not understand what they were being asked to do and tried to explain in general terms unsuccessfully.

Summary

Based on their performance on this paper, candidates are offered the following advice:

- Check that quantitative answers represent sensible values and to go back over calculations when they do not.
- Learn standard descriptions of physical processes, such as electromagnetic induction, and be able apply them with sufficient detail to specific situations, identifying the parts of the general explanation required to answer the particular question.
- Be sure to know the standard SI prefixes and be able to apply the correct power of ten – this is frequently required with eV.
- Be sure you know the command words and understand the level of required response for each of them, e.g. explain would mean a candidate must say why something happens and not just describe what happens.
- Explanations can often be supported by reference to formulae on the data, formulae and relationships sheet.
- While past paper mark schemes can be useful revision aids, questions will not be identical so quoting them directly is unlikely to answer the particular question. Be sure to answer the question on the paper and not the question from a previous paper.
- Physical quantities have a magnitude and a unit and both must be given in answers to numerical questions.
- When working with components it can help to sketch the relevant triangles rather than trying to apply them from memory.

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