Pearson Edexcel

Examiners' Report

Principal Examiner Feedback

October 2019

Pearson Edexcel International Advanced Subsidiary Level

In Physics (WPH04)

Paper 01Physics on the Move

Grade Boundaries

Grade boundaries for all papers can be found on the website at:
https://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html

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Introduction

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 taking into account the angle of the support for a rotating body. They also knew some significant points in descriptions and explanations linked to standard situations, such as the standard model, the operation of a cyclotron and 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, 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 or 7 and A grade candidates usually got 8 or 9 correct.

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

Question	Percentage of correct responses
1	66
2	65
3	39
4	94
5	61
6	63
7	77
8	77
9	93
10	94

Question 11

(a) The majority of candidates were able to use the graph to calculate the change in momentum, although they did not always identify it as such. Some students divide this quantity by mass, giving this change in velocity as their final answer. Most went on to apply the concept of conservation of momentum, but a substantial number applied the directions incorrectly

(b) A typical score for this question was 1 mark because of lack of detail in the answer. Students knew that values of distance and time needed to be determined but did not always explain how this could be done from the video recording, for example by including an object of known size in the background for scale and using the time track or frame rate of the recording.

Question12

(a) Candidates typically scored 2 marks for the electric field diagram. While the arrows were rarely incorrect, failure to use a ruler meant that many of the lines were not straight and were not parallel to the plates. Similarly, the spacing of the lines was often irregular. Drawing too many lines gave more opportunities to make errors, students drawing five having fewer opportunities to make a slip.

(b) The majority of candidates across the range completed this straightforwardly, the most common difficulty being with the power of ten for picofarad.

(c) About half of the entry scored 1 or more for this question, most with 1 mark for use of $Q = CV$ and the rest scoring 3 for a correct final answer. Although the question stated that the p.d. was the same for both capacitors, a very common approach was to apply the p.d. rather than charge in the ratio of the capacitances.
Some candidates attempted to use the energy from part (b).

Question 13

(a) Most candidates drew the expected two forces but did not always gain both marks because they either drew extra forces, often one labelled ‘centripetal force’ or the two components of tension as forces in their own right, or did not label the forces.

(b) The majority of candidates were awarded 2 or more marks for this question, most commonly 2, by calculating the angular velocity, 4 or 6 because many of them applied circular motion using the length of the lever as the radius and ignored the angle θ entirely, effectively taking it to be 90°.

Question 14

(a) Candidates’ responses showed a good level of familiarity with the operation of the cyclotron, the majority scoring 2 or more marks, but not always with the details. Imprecise language meant that candidates did not always gain credit for what they may have known. For example, it was not uncommon to see a reference to protons being accelerated by the electric field ‘between the gaps’ rather than ‘in the gaps’ or ‘between the dees’. The description of the timing of the alternation of the applied p.d. was also frequently similarly ambiguous. There was often reference to the polarity switching, but, as the cyclotron uses both magnetic and electric fields, if this was not related specifically to the p.d. across the gap, credit could not be given. Candidates who simply referred to an a.c. supply and did not refer to p.d. or the electric field could not gain credit for these marks either.

(b)(i) The majority did not score on this question, often because they did not include the proton on the left of the equation, so they effectively wrote an equation for beta decay, with or without an antineutrino. Most who wrote the correct equation scored all 3 marks, although some did not make the required statement that a neutron was produced.

(b)(ii) Most students were able to use the Coulomb equation, but about a quarter of those who did so failed to use the correct charge for the oxygen nucleus. Candidates sometimes wrote out the full Coulomb formula but omitted the square for separation when the substituted the values, in which case they gained no credit. Occasionally a student would use the Boltzmann constant for k.

Question 15

(a) Only about a quarter of candidates gained credit for this question. The majority wrote simply about moving in opposite directions, despite the particles having a very small angle between their paths initially, and without any suggestion of curvature. Quite a few wrote about unlike charges repelling to explain the different paths. MP2 was seldom awarded and then only for FLHR. Often, students assumed that the magnetic field was into paper, and so justified the pion as negative because it was 'going the wrong way', without any reference to the proton.

(b) The great majority stated this correctly.

(c) **(i)** A majority correctly stated the field direction.

(ii) Over half of the entry gained credit for this question, with a good proportion scoring 2 or more marks for applying $p = Bqr$ to a radius obtained from the diagram. Few students, however, measured from the diagram with sufficient accuracy to arrive at a value within the required range for full marks.

(iii) Few students gained significant credit for answers to this question. Many did not draw a triangle or parallelogram and the vector diagrams drawn infrequently represented the relationship of the particle momenta correctly, that is, with the momentum of the lambda particle as the resultant of the momenta of the other particles. Students sometimes gained credit for showing the proton momentum vector as greater than that of the pion.

Question 16

(a) Although candidates generally demonstrated knowledge of the process of electromagnetic induction, describing it in terms of change of flux linkage or magnetic field lines being cut, but only about a quarter of candidates gained credit for their responses. Some stated that induced e.m.f. 'depends on' rate of change of flux linkage rather than 'is proportional to'. Students were rarely able to state the correct coil position for maximum and zero e.m.f. In some cases, this may have been because they confused maximum flux with maximum rate of change of flux linkage. Others seemed to confuse a vertical coil with vertical movement of the wires.

(b) **(i)** Few candidates gained credit for this question. Of those who wrote Faraday's law, few rearranged it. Others missed Δ or d and wrote $Et = \varphi$, usually omitting N also. Those who made a correct rearrangement to gain the first mark did not often equate their terms to area and change in flux linkage.

(ii) About half of the entry scored 2 or more by using the area under the graph, but the final answers were not often accurate enough for full credit.

(c) A majority correctly drew either halved amplitude or doubled period, but only a minority correctly drew both. Some had the right idea but did not draw accurately enough.

(d) This was answered successfully by a relatively small minority of candidates. Students often thought it was something to do with Lenz's law or mentioned a back e.m.f. but did not link this to force. Students often thought that there was a current n the coil before it was connected into a circuit, referring to induced current in their answers, and therefore did not appreciate the change in conditions. Some suggested that the resistance would increase with the bulb so that the e.m.f. must increase.

Question 17

(a) A majority of candidates gained full marks for this question. Some calculated the mass correctly but did not make the required comparison and so were awarded 3 marks. Some candidates appeared unfamiliar with Giga and used incorrect powers of ten.

(b) The majority of candidates scored 1 or more for this question, but relatively few made all three points. Students did not often refer to the conservation of mass-energy and a lot failed to achieve a mark by referring only to the energy of the photons rather than the kinetic energy.

(c) A good majority achieved 2 or more marks, the calculation of speed being straightforward. While most stated that the calculated speed was greater than the speed of light, a number failed to make an additional statement, such as that this is not possible.

(d) and **(e)** The great majority of students made sensible suggestions for these questions and scored both marks.

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
- Physical quantities have a magnitude and a unit, and both must be given in answers to numerical questions.
- When substituting in an equation with a power term, e.g. r^2, don't suddenly miss off the index when substituting or forget it in the calculation.
- When drawing electric fields, use a ruler and ensure that field lines are parallel and equally spaced for a uniform field.
- Be sure to learn the correct meaning of the symbols in a given formula, not confusing similar symbols such as *k* for the Boltzmann constant with *k* for the Coulomb law constant

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