Pearson Edexcel

Examiners' Report
Principal Examiner Feedback

January 2025

Pearson Edexcel International Advanced Level in Physics (WPH14)
Paper 01 Further Mechanics, Fields and Particles

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Introduction

The assessment structure of Unit 4: Further Mechanics, Fields and Particles 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 paper provided candidates of all abilities the opportunity to demonstrate their knowledge and understanding of Physics by applying it to a variety of contexts with differing levels of familiarity.

Candidates at the lower end of the ability spectrum were able to perform simple calculations involving substitution and basic rearrangement. However, they often struggled with multi-step calculations or those involving more complex concepts like trigonometry. Common mistakes included using the diameter instead of the radius. Candidates should be encouraged to pause and review their work for such simple errors.

Candidates at the lower end also had difficulty recalling specific terms, such as "thermionic emission." They should be encouraged to ensure they can explain common concepts, such as cyclotrons and linear accelerators, in a clear, step-by-step manner.

More able candidates generally excelled in mathematical problems but had difficulty explaining more complex concepts, such as how forces combine to produce circular motion or how force and changes in momentum are related. It may be beneficial for candidates to incorporate the relevant equations into their explanations and consider what each symbol represents.

Most candidates communicated their knowledge of Physics clearly, even if their written English was not always perfect. Apart from * questions that assessed the structure of responses alongside the physics content, a lack of written English proficiency was not penalised as long as the answers were clear and unambiguous.

Comments on Individual Items

Section A: Multiple Choice

	Subject	Correct response	Comment
1	Conversion between degrees and radians	**A**	$40° \text{ in radians } = \frac{40 \times 2\pi}{360°}$
2	Standard model	**B**	A pion is the only meson
3	Coulombs law	**B**	$F = \frac{Q_1 Q_2}{4\pi\varepsilon_0 r^2}$
4	Particles and antiparticles	**D**	An electron and a positron have the same mass but different lepton numbers
5	Alpha particle scattering experiments	**A**	The reason that some alpha particles were deflected by angles of up to 180° was that they were affected by electrostatic forces. There are other reasons but there was no other option in this question.
6	Factors influencing the e.m.f. when there is a change of current in another coil linked with this coil	**C**	More turns in coil Q will increase the emf due to the transformer effect and the coils being closer will increase the flux linkage in coil Q.
7	Using equation $\Delta E=\Delta mc^2$ in examples of creation of matter	**D**	One photon produces a position **and** an electron $\Delta E = 2\times 9.11 \times 10^{-31} \times (3 \times 10^8)^2$
8	Interpreting particle tracks	**D**	The diagram shows a constant radius so there is no way of knowing which direction the particle is travelling. So, the only answer can be that the particle experiences a centripetal force.
9	Relationship between electric field strength and electric potential	**B**	The potential at 0.5 m is equal to the area under the E-r graph from r to infinity.
10	Energy stored in a capacitor	**A**	$2C_1=C_2$ $2V_1=V_2$ So $\frac{C_1V_1^2}{C_2V_2^2} = \frac{C_1V_1^2}{2C_2 4V_2^2} = \frac{1}{8}$

Question 11

About half of the candidates scored full marks on this question.

The best approach was to identify each particle (including the zeros) as shown in the mark scheme, and then to be specific about what is being conserved. Approximately 25% of candidates failed to specify what each particle was. For example, some wrote "$e^+ + \nu_e = 0$," which was unclear. The most common error was not knowing the correct lepton number for the positron and neutrino.

Some candidates made simple statements, such as "baryon number is conserved because the total number before is two and the total number after is two," without providing any further explanation, which resulted in a score of zero.

Question 12

12 (a) Most candidates answered this correctly. However, some failed to give one more significant figure than was provided in the question, resulting in the loss of one mark.

12 (b) About half of the candidates scored full marks. Common errors included using **V/d** or incorrectly applying the electron charge in the formula. Some candidates lost a mark for forgetting to include units.

Question 13

Most candidates scored full marks, but some struggled to correctly apply trigonometry and thus scored 1 mark.

Question 14

14 (a) Only about a third of candidates scored full marks. This is a specific specification point, yet many failed to mention "thermionic emission" or referred to it incorrectly, such as calling it the "thermal effect." The first mark, related to the filament getting heated, was more commonly achieved; however, some candidates did not specify what was being heated.

14 (b) Just over half of the candidates achieved full marks. Many could use De Broglie's formula but struggled to progress further. It is important to clearly show each step of the solution and specify which equation is being used at every stage.

Question 15

15 (a)(i) Most achieved full marks

15 (a)(ii) Just over half of the candidates achieved full marks. The most common error was using the diameter instead of the radius, and many also missed units, resulting in the loss of a mark.

15 (b)(i) Just under half of the candidates scored full marks. This question asked for labelled arrows. When a question requests labelled arrows to show forces, candidates should remember to label the forces specifically, rather than using the generic "F". Candidates should also include only the actual forces, not the resultant forces. The reaction force was the most difficult for candidates to identify correctly.

15 (b)(ii) Only one in ten candidates scored full marks. Scoring two marks was common for the equations at the top and bottom. However, many did not explain how the reaction force differed between the top and bottom. Instead, they often discussed the resultant centripetal force rather than the actual forces. Additionally, many candidates failed to mention that weight is constant.

15 (b)(iii) Only about one in 5 candidates scored a mark. There were many vague responses, such as "it shoots away from the drum" or "it moves to the side." Some candidates described the subsequent motion of the water, such as parabolic motion or downward motion due to the force of gravity.

Question 16

16 (a) About three quarters of candidates scored full marks. Arrows going in the wrong direction often resulted in the loss of one mark. The exam paper specifically asked for a ruler, and this was the question where using one was most beneficial.

16 (b) About half of candidates scored full marks. Some lost a mark because they did not recognize that 4.97 is approximately equal to 5. Additionally, some candidates failed to specify that it was a multiple of the electronic charge.

Question 17

17 (a)-About half of the candidates scored full marks

Common incorrect answers were the spiral in the wrong direction which scored one mark. A few candidates either missed the question or failed to draw a complete spiral.

17 (b) About three in ten candidates scored full marks. The most common mistake was candidates not accounting for two Dees and therefore did not divide their answer by 2.

***17 (c)** This question was on a cyclotron, a topic familiar to candidates, so nearly all of them attempted it. However, many approached the question as if it were similar to previous ones, without considering how the protons gain energy. Some candidates failed to mention the electric field, while others did not specify its location. When discussing the magnetic field, many candidates neglected to mention that it causes a force on the protons. Additionally, some candidates were unclear about the polarity change when the protons are in the Dees.

Question 18

18 (a) Most candidates scored one or two marks for correctly stating that a change in flux linkage with the coil causes an induced emf. However, some missed the first mark by failing to clarify that it was the movement of the magnets near the coil, rather than the card moving near the reader, that was important. Additionally, very few candidates recognised that the change in direction of the emf was crucial to answering the main point of the question. There was a lot of discussion about Lenz's law, which was often correct but irrelevant to the question.

18 (b) The majority of students scored 5 marks, and even those who made errors in their calculations typically managed 4 marks by providing a suitable comparison at the end. The 4 marks were often due to an incorrect inclusion of a factor of 2 (for two poles) or a factor of 5 (for five strips). Many students chose to calculate the speed first or performed the entire calculation in one step, as outlined in the mark scheme.

Question 19

19 (a) Unfortunately, many candidates failed to score here. Many discussed friction or gave incorrect descriptions of energy being absorbed but did not explain why or how the rubber increases the time. Candidates who scored well typically recognised that the collision time increases, and most were able to link this clearly to the impulse equation. However, some failed to mention the change in momentum or incorrectly stated that the force decreased because the change in momentum decreased.

19 (b) This question was slightly different from those that appear in nearly every series, but over half of the candidates scored full marks. Some errors included applying the conservation of momentum in the wrong direction. A few candidates mistakenly thought that velocity, rather than momentum, was conserved. While many candidates provided fully correct answers, some missed the last mark by failing to include a comparison of the two values.

Question 20

20 (a)(i) The question was about the current in the circuit. A significant number of candidates explained their answer in terms of what happens to the charges, but without referring to current or potential difference (p.d.), and as a result, scored no marks. Candidates who did score typically linked the increasing p.d. across the capacitor with the decreasing p.d. across the resistor and connected this to the current. Many attempted the final marking point but either failed to mention that the current was at a minimum or did not explain that the capacitor was fully charged.

20 (a)(ii) About four in ten candidates scored full marks. The most common errors included drawing the line crashing into the x-axis, making mistakes with the units for current, and, very commonly, failing to label the axes.

20 (b)(i) Most candidates scored full marks, but some did not know what the time constant was and instead calculated the time when the voltage had decayed by a factor of e, scoring no marks.

20 (b)(ii) Over half of the candidates scored full marks, but some only scored one mark for using the second route. Those who did not score, often failed to recognise that V/V_0 is a fraction or, when multiplied by 100, a percentage.

20 (c) About half of the candidates scored full marks. It was surprising how many failed to recognise that, at the point where the lines cross, V_R and V_C would have the same value and sum to 8V, meaning each would be 4.0 V. Instead, many used convoluted approaches involving discharge equations to prove the same result. In several cases, candidates calculated the time for the potential difference to reach half its original value and then used the discharge equation to find the potential difference at that time, when they could have simply halved the original potential difference.

20 (d) One in five candidates scored full marks. Most earned the first mark by stating that the charge is less. Some referred to voltage or potential difference but did not explain that it is shared or split. Many candidates attempted to answer in terms of capacitance changes rather than potential difference.

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