Pearson Edexcel

Examiners' Report

Principal Examiner Feedback

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In Physics (4PH0) Paper 2P

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General Comments

There were some very talented physicists sitting this examination who could give confident written answers and complete challenging calculations successfully. This paper gave several opportunities for more able candidates to show their ability in calculations either due to the need to convert units or set up a mathematical problem to solve. Candidates need to be familiar with the standard system of units used in equations so that they can identify when data needs to be changed before being used. This paper gave an energy in kilojoules and a force in kilonewtons and both needed changing, to joules and newtons respectively, before being used in the calculations. The principle of moments calculation in question 8 was particularly challenging and candidates would benefit from further practise of these. It was especially encouraging this series to see evidence of candidates performing some of the standard experiments and there were some fantastic methods described in question 5 for how to measure the speed of sound. When providing written answers, candidates need to take care to use subject specific language carefully and try to avoid writing vague sentences that lack focus. Question 6 demonstrated this well and only those candidates who wrote in clear, focused sentences scored high marks.

Question 1

85% of all candidates were able to name the force responsible for the orbits of planets and moons in part 1(a). A small minority of candidates were not awarded the mark due to confusing gravitational forces with gravitational potential energy and gravitational field strength. Part 1(b)(i) also proved to be straightforward and most candidates could correctly identify all three astronomical objects in the diagram from their orbits. However, part 1(b)(ii) was more challenging and differentiated well between candidates. Approximately two thirds of all candidates recognised that the time period of the moon would be shorter, but only half of these could give a suitable reason for this to gain the second mark. Some candidates used vague language in their responses, which lost them marks. For example, describing the moon as having a smaller radius, rather than a smaller orbital radius.

Question 2

Candidates performed well in part 2(a) and the majority gained both marks for giving a correct description of a vector quantity. Those candidates who lost marks often did not describe a vector has having magnitude or size and, instead, described it has having mass or force. This was not credited, and candidates should be reminded that the use of the correct terms is important in definitions. Part 2(b) required candidates to mark quantities as being scalars or vectors. Most candidates were awarded two or three marks in this part of the question and the common misconception was thinking that weight is a scalar. This arises from the confusion between mass and weight.

Question 3

It was very pleasing that over half of all candidates correctly identified the positions on the roller coaster where the car experiences the greatest downward acceleration and the greatest kinetic energy in part 3(a). Part 3(b) was also answered to a high standard and over 80% of all candidates were awarded either two or three marks for their calculation. Many candidates did not realise that the energy value should be converted from kilojoules to joules and this was the most common reason for not gaining full marks. A small minority of candidates failed to use *g* in their calculations and, therefore, were not awarded any marks unless they had shown a correct rearrangement of the given equation.

Question 4

The calculations in part 4(a) were answered to a high standard. The most common mistake in part 4(a)(i) was not giving the correct unit and a significant number of candidates gave the unit as kilograms or newtons per kilogram, rather than newtons. Some candidates experienced difficulty rearranging the density equation in part 4(a)(iii) but two thirds of all candidates were able to gain full marks. More than 10% of all candidates did not know the density equation and consequently were not awarded any marks when attempting to use an incorrect equation to perform a calculation.

Although the expected answer in part 4(b)(i) was a bar chart or bar graph, a significant number of candidates named the graph as a column graph, presumably due to its naming in Microsoft Excel. Since this answer was accepted in the mark scheme, the vast majority of candidates were awarded the mark for this part of the question. When asked to compare the densities of steel and granite in part 4(b)(i), most candidates knew that steel had the higher density. However, less than 20% of all candidates could give a further detail to justify this and gain the second mark. This was often due to only referring to the mass of each substance by quoting the mass from the bar chart, rather than calculating the density of each or finding a ratio.

Question 5

It was very encouraging to see that most candidates had conducted an experiment to determine the speed of sound and could describe their method clearly when required in part 5(a). There are several different valid methods that were credited, but most relied upon measuring the time for sound to travel a particular distance and this was the most common approach taken by candidates. The most common mark awarded for this part of the question was four marks, with a normal distribution of marks either side of this up to the maximum mark of six. Candidates were frequently awarded MP1, MP3, MP4 and MP6 for a basic overview of their method. However, only the most able candidates gave important further details such as quoting a suitable distance for their method to be successful (MP2) or the need to take repeats to find an average (MP5). The inherent difficulty with most methods is the need to accurately measure a very small value for time and this can be improved using a data logger or an oscilloscope to remove reaction time from the measurement.

Most candidates did an excellent job of drawing the line of best fit, extending it to 20°C then reading off the speed of sound in part 5(b). Where candidates failed to read the stem carefully, they drew either a dot to dot line or a curve which then caused an error when

extrapolating the line to 20°C. A small number of candidates read the scale of the graph incorrectly and gave a value for the speed of sound that was outside of the allowed tolerance. Candidates found part 5(b)(iii) more challenging than expected and nearly half of all candidates failed to score a mark. The most common error seen was the idea that air is less dense at cooler temperatures and that this made the wavelength longer. Some candidates correctly wrote about the decrease in wavelength but then did not address the decrease in the speed of sound so did not achieve a second mark. Often candidates simply stated that the wavelength and speed would change but did not intimate in what way.

Question 6

Question 6 was not answered well and nearly 40% of all candidates failed to score any marks at all. A lot of answers were very vague in the phrases uses. For example, candidates describing a nuclear power station as being reliable, efficient, expensive or dangerous. Candidates need to be more specific with these terms to be given credit at GCSE level. Many candidates did know that the generation of electricity via nuclear power did not release CO_2 but could not write about a second advantage. Disadvantages were better known with large numbers knowing that nuclear power produced radioactive waste that is difficult to dispose of and that commissioning/decommissioning of nuclear power stations is expensive. There were a noticeable number of blank responses and others where the candidates wrote very little or confused nuclear power with the disadvantages of other forms of generating electricity. For example, they wrote about the burning of fuel releasing large amounts of carbon dioxide.

Question 7

Two thirds of all candidates knew the construction of a step-down transformer and gave a correct description of the turns ratio in part 7(a). Part 7(b) polarised candidates and those that new the correct equation usually went on to gain full marks in the subsequent calculation. Unfortunately, many candidates gave the equation linking the input and output voltages to the turns ration and, therefore, did not gain any marks. Candidates found part 7(c) very difficult and more than 80% did not score at all. Candidates assumed that as the plug became warmer during use that this increased the resistance of the plug and thus the input power and current would reduce as a result. This question highlighted a basic misunderstanding in conservation of energy for a transformer. Most candidates appeared to treat the heat generated by the transformer as an additional input, rather than an additional output.

Question 8

Two thirds of all candidates knew the name of the missing force in the diagram in part 8(a). A common error was labelling the force as the centre of gravity, whilst other candidates struggled with naming the specific part of the crane, despite it being referred to in the stem of the question and the diagram. The straightforward moment calculation in part 8(b) was answered to a high standard. The main error was not converting kilonewtons to newtons, which resulted in a one-mark penalty.

Part 8(c) assessed candidates' knowledge of the principle of moments and their ability to apply it to the crane context. It was encouraging to see three quarters of all candidates give a clear description of the principle of moments in part 8(c)(i). A common error seen was confusing the word "moment" with "momentum". However, the principle of moments calculation in part 8(c)(ii) proved too difficult for most and more than half of all candidates did not score at all. A third of all candidates were awarded one mark for giving a correct expression for one of the moments in the system but few went any further to complete the calculation. Most candidates did not realise that the weight of the crane arm produced an additional anti-clockwise moment and so did not include it in their calculation. Candidates would benefit from practising principle of moments calculations involving more than two moments.

Question 9

Candidates demonstrated their ability to apply the conservation of momentum to a high standard in part 9(a). Most knew the momentum equation and used it to correctly calculate the momentum of the train. More than two thirds then went on to use this value of momentum to calculate the mass of the truck. However, only a third of all candidates knew to subtract the mass of the train from their total mass to gain full marks in this part of the question. Candidates would benefit from practising similar conservation of momentum problems involving bodies coalescing.

Part 9(b) discriminated well between candidates and approximately a quarter of all candidates gained each mark in the range of zero to three. Most candidates communicated that the mass of the system had increased but there was variability in what effect candidates thought this would have on the trucks' velocity. Some though that the velocity would remain the same because the train exerted the same force on them as before. More able candidates knew that the velocity of the trucks would decrease, but only the most able candidates gave a comprehensive explanation referencing that the momentum after the collision would be the same as before.

Summary Section

Based on the performance shown in this paper, students should:

- Take note of the number of marks given for each question and use this as a guide as to the amount of detail expected in the answer.
- Take note of the command word used in each question to determine how the examiner expects the question to be answered, for instance whether to give a description or an explanation.
- Be familiar with the equations listed in the specification and be able to use them confidently.
- Only use symbols when writing equations if the symbols are correct.
- Recall the units given in the specification and use them appropriately.
- Practise structuring and sequencing longer extended writing questions.
- Show all working so that some credit can still be given for answers that are only partly correct.
- Take care to follow the instructions in the question, for instance when requested to use particular ideas in the answer.
- Take advantage of opportunities to draw labelled diagrams as well as, or instead of, written answers.
- Allow time at the end of the examination to check answers carefully and correct basic slips in wording or calculation.

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