Examiners' Report
Principal Examiner Feedback

January 2024

Pearson Edexcel International Advanced Subsidiary Level in Physics (WPH12)
Paper 01 Waves and Electricity

Section A

The multiple-choice questions discriminated well, with consistent performance across the ability range for all items. The percentages with correct responses for the whole cohort are shown in the table.

Question	Percentage of Correct Responses
1	52
2	79
3	84
4	52
5	64
6	66
7	80
8	54
9	64
10	56

More details on the rationale behind the incorrect answers for each multiple-choice question can be found in the published mark scheme.

Q11(a) A little over half the candidates answered this correctly. We were looking for the idea of a constant phase relationship or difference but often the word “same” was used and this was not sufficient. Other incorrect answers referred to phase difference, frequency or wavelength.

Q11(b) Again only half the candidates score this mark as many understood that the wave reflected but then neglected to mention anything about superposition or interference.

Q12 The vast majority of candidates score all three marks in this question. However, some common mistakes were putting the Ohm’s Law equation the wrong way round, for example R = I/V, or an incorrect rearrangement of Q = It. Some candidates omitted the unit and others tried to multiply y the charge on an electron.

Q13(a) Answering this well proved to be a challenge for the majority of candidates. Many answers were poorly structures and not well expressed. Marking point one was awarded much more commonly than marking point two as a significant percentage of candidates failed to mention anything related to the speed of the waves in the two media.

Q13(b)(i) A very well answered question, but as is often the case candidate lost the second marking point by failing to add a unit.

Q13(b)(ii) Less than a third of candidates scored all three marks in this question. The easiest way to arrive at the answer was to use the critical angle equation. However, some candidates used the Snell’s Law equation and became confused upon realising that it would give a value larger than 1. Marking points one and two were nonetheless scored often. The third marking point was missed because many candidates either didn’t draw a line or drew the line at an angle that was not equal to the angle of incidence.

Q14(a) Only around ten percent of candidates scored any marks on this question. The most common answer was a statement that as there were no other components connected to the battery there would be no emf. This clearly scored no marks and it would be prudent for candidates to gain a better understanding of the role of emf in a circuit for future examination series.

Q14(b) There were some surprisingly poor responses to this question and around sixty percent of candidates scored only one mark, usually the first marking point, Diagrams were often badly drawn and many incorrect symbols were used. Often the variable resistor was missing from the diagram and a significant number of candidates drew a thermistor. Care needs to be taken when answering these types of questions.

Q14(c)(i) This question has appeared on several papers in the past and most candidates understood that the y intercept gave the emf value and the gradient gave the internal resistance. However, some candidates, instead of taking a gradient, just divided a potential difference by a current and could only score a maximum of one mark. As is often the case, a number of candidates found the correct values but neglected to add a unit and lost two marks.

Q14(c)(ii) It was rare to find anything credit worthy in the responses to this question. Candidates did not understand what would happen to the internal resistance in this case and just made incorrect or irrelevant points about current and resistance in the circuit. Some responses were in terms of heating effects and how this would alter resistance. Linking the effect of current increase to potential difference across the internal resistor was not well understood.

Q15(a) This is another concept that has been tested on several occasions over the years, and it is a fairly standard definition. We needed to see the word direction in the answer and this was often missing. It was common to see responses that made no reference to oscillations which is always disappointing.

Q15(c) This question is a good example to demonstrate the importance of paying attention to the information that is provided. Candidates were told that the wavelength of the wave was 0.72m and therefore no further processing was required. This value should have been substituted in to the wave equation to calculate the velocity. However, many candidates double this value, or in some cases halved the value, thus limiting themselves to a maximum of two marks. The first and second marking points were frequently awarded but many candidates used the value of 0.72 when calculating the mass per unit length, despite being told this value in the question stem. A number of candidates gave the answer in kilograms but this mark was only awarded if a correct unit was given. Overall, this question was well understood and provided many full mark responses.

16(a) Over two thirds of candidates scored full marks here. When marks were lost it was usually for use of a diameter instead of a radius and for an incorrect rearrangement of the resistivity equation. The radius of a wire is not measured directly so in these types of questions a diameter is provided. It is worth mentioning that there were a significant number of responses that suggested that the length of the cable was, for example, 63mm or 63km and it should have been obvious that these answers were wrong and working should have been checked for errors.

Q16(b) A very straightforward calculation in which the vast majority of candidates scored both marks. Once again, many responses failed to include a unit or there was a power of ten error as many candidates could not convert micro seconds to seconds.

Q16(c) The first thing to mention here is that there was a considerable amount of information in the question, much of which was repeated in the responses. Marks will never be awarded for rewriting

information given in the question stem. The first and second marking points were quite often provided as many candidates were able to link the lower resistivity of copper to lower resistance and hence greater current. The third marking point was very rarely awarded as the majority of candidates could not provide an explanation involving a scenario where there are two variables that could affect the outcome.

Q17(a) A large percentage of candidates scored zero marks in this question. It is important to note that in Huygens Construction it is points on a wavefront and not the wavefront itself that produce the secondary wavelets. Many candidates failed to score the second marking point as it was not clear what exactly was interfering.

Q17(b) This indicative content question, although containing an unfamiliar context, should have been accessible to the majority of candidates as the superposition and interference of waves is a common theme. The first three indicative content marks were frequently award. It is worth noting that if a candidate referred to constructive interference at A, they achieved the first and third indicative content marks. Many candidates lost marks here because they tried to give a generic answer about waves meeting, without making any reference to boat A and B and scored only the first mark. The second point was often lost as candidates describe phase difference in terms of wavelength instead of pi. For indicative content four to be awarded it was necessary to link a phase difference to varying wavelength and this was rarely seen. For the last two points we needed a correct reference to path/phase, destructive/constructive interference and amplitude, but often one of these was missing from the response.

Q18(a)(i) Generally well attempted although a number of candidates simply wrote down some equations and failed to make any attempt to process them into the required formula.

Q18(a)(ii) The most common 2 marks response was to divide the resistance by 4, add it to the original resistance and use this value with the power across the resistor in the power equation. Common 1-mark answers involved using the reading from the graph and the power in the question with the power equation, though it wasn't uncommon to multiply the resistance from the graph by 4. In fully correct answers the student often unnecessarily calculated the current.

Q18(bi) Most candidates scored both marks but often seen were responses that included reference to electrons moving faster. In some cases, the first marking point was scored but the candidate would state that resistance decreases instead of stating that current increases.

Q18(b)(ii) The first marking point was commonly awarded but the second slightly less so. Often candidates would mention an increase in electrons colliding with each other rather than the lattice. The third marking point was often seen but many candidates failed to score the fourth marking point. It was not common to award the fifth marking point. Explanations sometimes lacked clarity and it was not always clear whether or not the resistor or the thermistor was being discussed.

Q19(a) This was a straight forward calculation that required the provided work function to be divided by h. However, many candidates over complicated the problem by including a calculation of kinetic energy despite the question effectively asking for the threshold frequency. Some other candidates failed to convert between electron volts and joules despite this conversion being asked regularly on this paper.

Q19(b) There was a lot of information to process here and this proved to be a challenge for the majority of candidates. The first line of the question explained that intensity was constant. This should have been sufficient for candidates to recognise the number of photons being emitted by the

source per second would not change, but this proved not to be the case. The majority of responses suggest that this would increase with the removal of layer 1. Having a larger work function, photons not absorbed by layer 1 initially would be those with the greater frequency of the source but this point was largely missed and the second marking point rarely scored. The third marking point was not often given but the fourth was the common, and frequently only mark scored. The majority of candidates though that the rate of electron release would increase upon the removal of layer 1. As mentioned previously, many responses simply repeated much of the information that had been provided and sored zero marks.

Q19(c) This was not well understood by many candidates. The suggestion was to connect the cells in parallel but often this was not attempted and in that case many of those candidates could only score the fourth marking point, many of the candidates who put the cells into a parallel circuit and attempted to calculate the combined resistance added a third resistance into the formula and could not score the first and second marking points. For the fourth marking point a number of candidates tried to work back from 13W and scored zero. However, a power equation with reasonable values from the question or a value of current or potential difference calculated by the candidate allowed the fourth marking point to be awarded.