Examiners' Report
Principal Examiner Feedback

October 2023

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

Section A

The multiple-choice questions discriminated well, with performance improving with 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	87
2	56
3	70
4	63
5	54
6	78
7	56
8	50
9	68
10	47

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

Q11 The specification requires an understanding of how a pulse echo technique can provide information about the position of an object. In this case we were looking to see some idea of how an animal could use this method to determine where an object would be or the distance to the object. The animal could do this by detecting the reflection of an emitted pulse and determining its position or distance based on the time taken for the pulse t return. The first marking point was awarded often but some candidates used synonyms such as bounce and lost the mark. Some candidates did not recognise that time was an important factor but still scored the third marking point for mention of distance or position. Some answers suggested that a stopwatch was used to measure time but this was not penalised in this case,

Q12 There is an expectation that candidates should be able to derive equations for combining resistances and how this is related to the charge and energy within the circuit. Unfortunately the majority of candidates scored only the third marking point as they started from the parallel resistor equation and used it to arrive at the required equation. The first marking point was more common than the second. What was needed was a demonstration of how the parallel resistor equation was related to the voltage and current distribution across the components in a circuit.

Q13(a) It was evident from candidates responses that there was confusion about how the cross sectional area of the resistivity paper should have been calculated. Looking at the diagram if should have been obvious that the cross sectional area was the width multiplied by the thickness and that this should therefore have been substituted into the resistivity equation. The majority of candidates however simply multiplied the length by the width and could therefore only score the first marking

point. It was common to see power of ten errors as cm values were not converted to metres. Others mistakenly multiplied length by width by height to produce a volume instead of an area.

Q13(b)(i) Most candidates were able to access the first marking point as they used Ohm's law to calculate a current but a common mistake was to use 1.5V in the calculation when it should have been 1.4V, and this limited the marks available.

Q13(b)(ii) Correct answers here were rarely seen and common responses included 1.4V and 0V. Some candidates tried to use the resistivity equation again with l = 3cm and some though that the fraction 3/12 was equivalent to 1/3.

Q14(a) The first 4 marks were very accessible to the majority of candidates but many stopped at the calculation or failed to reach a sensible conclusion. Some candidates read the resistance from the graph incorrectly but went on to score the second, third and fifth marking points. A common mistake was to use 15Ω in the calculation instead of adding the 2Ω to make 17Ω and so scored only the third marking point. For marking point five it was necessary to recognise that as the temperature decreased the resistance of the thermistor would decrease and as a consequence the potential difference across it would increase. It is important to note that although the candidates calculated the potential difference across the thermistor at 10^0C they were expected to explain what would happen below that temperature unfortunately many candidates failed to recognise this.

Q14(b) As is commonly the case in this style of question, the use of the word "change" in the question is to elicit a response where the candidate tells us about a specific change. Unfortunately, a significant number of candidates simply wrote about a change in temperature leading to a change in the number of free electrons, so changing the resistance, without ever giving an example of the sort of change that would be involved. The dependency of the second mark on the first often meant that no marks were scored.

Q15(a) There were two aspects to this question which were a conclusion about how electrons behave when entering the graphite and a conclusion about the structure of graphite. It should have been clear that the graphite is acting like a diffraction grating which would imply that electrons are behaving as a wave and therefore diffract. This must mean that the structure of the graphite is such that it is layered, regular or ordered and that the spacing between layer must be similar to the de Broglie wavelength. Many candidates overlooked what was happening at the diffraction grating and discussed destructive and constructive interference which was not relevant here. However, the first and second marking points were commonly awarded but some candidates recognised that diffraction was taking place but did not mention that it was the electrons that were diffracting so did not gain credit. For the third marking point some candidates referred to gaps being present in the graphite but this was insufficient. It was very rare for marking point four to be awarded.

Q15(b)(i) Generally this was very well answered as you would expect from a straightforward calculation.

Q15(b)(ii) This was again well answered but some candidates omitted the unit an lost marking point 2. There were also some obvious calculator errors and some neglected to square the velocity.

Q15(b)(iii) The first marking point was commonly awarded but marking point two being rarely awarded as many candidates were discussing things in terms of energy and relating this to photon energy in terms of the wave equation. So even those discussing wavelength did do in the wrong context. Marking point three was not awarded often as many answers simply stated that thee pattern would be brighter .

16(a) The responses to this question were universally poor. There was a diagram in the question which clearly showed an incident ray taking two different paths which should have prompted a discussion of path difference, leading to the idea of destructive interference. Many candidates attempted to explain the absence of certain wavelengths in terms of total internal reflection or the absorption of waves by the film and this was given no credit.

16(b) In the vast majority of cases the candidates scored the third marking point only. As the concept of path difference was not understood in part a this was not applied here. Most candidates did not understand that a minimum would occur at half wavelength and could not determine the wavelength in the coating or in air or in the coating.

Q16(c) Most candidates could calculate a power incident onto the solar array but this was not always the correct power as many candidates did not account for the angle of incidence of the solar radiation being 60 degrees. The consequence of this is that in the majority of cases the efficiency value calculated was half the actual value achieving a maximum of three marks. In some cases candidates calculated the efficiency value incorrectly as they divided output power by input power, but overall this question was answered reasonably well.

Q17(a) This indicative content question was based on the photoelectric effect, a topic which should be very familiar to the majority of candidates scored only two marks which tended to be from the first three marking points. Many candidates answered the question by stating that it was both the magnesium and the copper that were emitting electrons when it should have been obvious that it was only magnesium that was undergoing the photoelectric effect. A significant number of candidate mentioned threshold frequency or work function but did not specifically link this to magnesium and failed to score the fourth marking point. Some of the more detailed answers achieved the fifth marking point but marking point six was rarely awarded as most candidates incorrectly thought that electrostatic repulsion was responsible for the lack of current when the terminals were reversed.

Q17(b)(i) Most commonly the third marking point was awarded but many candidates failed to recognise that a lamp of greater intensity would lead to an increase in the rate of photon emission an therefore increase the rate of electron release. As a consequence many responses included reference photons and electrons but were not sufficiently detailed to merit the award of a mark.

Q17(b)(ii) Generally this question presented little difficulty to well-prepared candidates with a significant number scoring all four marks. However, many candidates failed to score the fourth marking point as they did not make a relevant comment as to whether or not the photelectric effect would occur.

Q18(a) A high percentage of candidates failed to score any marks on this question. Answers were expected to be in terms of wavefronts but the majority of candidates answered in terms of waves. There was often confusion over the angle of incidence of the wavefront travelling along the normal but many candidates scored the third alternative of the second marking point. It was very rare to se the award of the fourth marking point.

Q18(b) This was well answered with a significant number of candidates scoring full marks. However, some candidates failed to recognise that at the critical angle the angle of refraction is ninety degrees and could therefore score nothing more than the first marking point.

Q18(c) In the previous part candidates were told that the critical angle was sixty degrees and it should have been evident that the angle of incidence in this question was greater than that. However, many candidates simply drew a refracted ray between the glass block and the layer of water and did not score any marks. Some other candidates correctly drew a reflected ray but then showed this as being refracted when leaving the glass block and therefore lost the third marking point.

18(d) The majority of candidates did not score any marks in this question. Although the context of the question was perhaps unfamiliar a good deal of information could be obtained from both the image and the diagram. Attempts to answer were generally poorly constructed and many confused light and dark areas or reflection and transmission. It was common to see answers that tried to discuss interference effects due to the size of the fingerprints. Quite a few answers seemed to indicate that light entered the air gaps and became trapped resulting in these regions appearing dark.