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Examiners' Report

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Pearson Edexcel International Advanced Subsidiary level In Physics
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Introduction

This unit assesses student understanding of the topics of Waves and Electricity (specification points 33 to 80). Section A has 10 multiple choice questions, whilst section B contains a mixture of short and long answer questions, calculations, and one 6-mark linkage question.

There is an expectation that students understand both the content and how to apply it to different applications. There is also a need for students to be able to apply their understanding of the core practical tasks within this part of the specification, some of which were tested on this paper.

Section A – Multiple Choice

On average, students scored 7 marks on this section. The best-answered was Question 5, where 90% of the students were correct. The least well-answered was Question 7, which was only correctly selected by 52% of the students. The most common incorrect responses on this question were B and D, suggesting that students had been confused by the difference between phase difference and path difference (where half wavelength path difference leads to destructive interference).

Section B

Q11

This question was well-answered, with the most common mark scored being 4 marks. The majority of students were able to manipulate the data well to calculate that the difference in energy levels was 1.88eV. However, quite a few were unable to identify the correct direction of the transition from the -1.51eV level to the -3.39 eV level. Very few students scored 1 or 2 marks on the question, indicating that those who recognised that the wave equation needed to be used, continued on to score most of the remaining marks. Only a small number failed to take the first step in the calculation, usually assuming that the given wavelength was a frequency and advancing immediately to an incorrect E = hf calculation.

Q12(a)

The key aspect to this question was the understanding that if a pulse was long enough to last for the amount of time taken for the signal to be sent out and return, there would be no way of telling which returned signal corresponded to which sent signal. This would make it impossible to determine the distance to the car. This concept was not well-understood by the students on the whole, with most failing to achieve the mark. The majority of incorrect answers on this question were by students considering interference between the outgoing and returning pulse. Although this is a process that would occur in the air between where the pulse is emitted and received, this would not affect the ability for the signal to return so does not answer the question.

Q12(b)

This style of question has appeared in a number of series before, so it is good to see that the vast majority of students scored all 3 marks here. Just under one in five students failed to appreciate that the pulse would take half of the time travelling to the object and half of the time returning, so these students failed to incorporate a factor of 2 in their answer. A very small number applied a factor of 2 incorrectly (doubling the distance or time instead of halving it).

Q12(c)(i)

Only a third of the students achieved this mark. Most of the incorrect answers did not articulate the answer well enough to establish that the signal simply does not reflect back to the car, so cannot be detected.

Q12(c)(ii)

Only one in five of the students scored this mark. Even those who mentioned that the signal would not reflect failed to achieve the mark as their reasoning to explain this was incorrect. The most common incorrect assumption was that the signal would not return as a result of passing/diffracting through the material of the post instead.

Q13(a)

It is pleasing to see that almost two thirds of the responses here scored all 5 marks. Most students scored at least 1 mark, although a significant proportion failed to understand how to move beyond calculating the angle of refraction for red or violet light. Due to the nature of the data given, correct answers had quite a range, so it was possible to see answers from around 0.06cm up to 0.07cm, all from correct working. It is worth noting that if data is given in the question to 3 significant figures, students should use at least 3 significant figures throughout the interim stages of their calculations.

Q13(b)

A third of students scored full marks on this question, although significant numbers also 2 marks. This occurred due to the fact that, once the critical angle values had been calculated, a number of students incorrectly related the incident angle and critical angle to conclude that the red light underwent total internal reflection and the violet light was refracted. It is also worth noting that, for a conclusion, students need to make a full comparison between the calculated and given values in order to achieve conclusion marks.

Q14(a)

More than 70% of the students scored full marks on this question, with the vast majority of the rest of the students also picking up at least 3 marks. The main failure to move from 3 to 4 marks was in the misreading of the graph scale (on the x-axis one of the small divisions represented 2Ω but many students assumed that it was 1Ω, resulting in a final answer of 32°C). It is important for students to carefully look at the intervals between each of the larger divisions on the graph axes in order to take readings accurately.

Q14(b)

Unfortunately, a significant proportion of the students appeared to miss the context of the question, with many answering it as if this scenario related to a filament bulb circuit. Those who did get the correct idea, many missed out the first marking point, jumping straight to the idea that the temperature increased. Once students had established that temperature had increased, they usually also scored the mark related to resistance of the thermistor decreasing. It is important for students to recognise that when circuits contain more than one component, any discussion of change of resistance must be related to the named component. Although the whole circuit resistance did decrease, the third marking point on this question had to be related to the thermistor. The final marking point was rarely awarded, as students needed to be very specific about the fact that the voltmeter reading would more than double. For questions where a decision has to be made about a student prediction, such as this one, we need to know whether the student is correct or not.

Q15

This question was not well answered at all. Most students did not recognise the fact that, as light is being released in this process, this question was not about the photoelectric effect. More than a third of the responses used terms such as threshold frequency and work function, both of which are related to the photoelectric effect, which is not relevant to this question. As a result, very few students scored more than 3 of the 6 marks available. The most commonly awarded marking points were IC3 and IC4, perhaps as these apply to both the photoelectric effect and to discussions of energy levels in atoms. Even those who had the correct understanding of what was occurring in this phenomenon often only achieved IC2 and IC5, with very few achieving IC6. In the quantum physics section of this unit, there are two main applications: the photoelectric effect and energy levels in atoms. It is really important for students to assess which is being tested in any particular question – the fact that one of them (the photoelectric effect) results in emission of electrons and the other (energy levels in atoms) results in emission of photons, it is very difficult for students who start off in the wrong application to achieve many marks.

Q16(a)

The equation $\varepsilon = V + Ir$ is not on the official list of equations for this specification, but many students seem to be aware of it and used it (or its variants) to good effect in this question. More than 80% of students scored both marks. Although very few scored 1 mark, those who did generally failed to make it clear how they had moved from $\varepsilon = V + Ir$ to the given relationship.

Q16(b)

More than half of the students achieved all 3 marks here. It was good to see that there were a large number of students who ensured that there were units on each of the values required, although it was common for those not achieving full marks to miss off one or both of the units. With an e.m.f. of exactly 1.5V via most calculations, it was disappointing to see so many leave their answer as a fraction, which is not accepted on these papers.

Q16(c)

Just about a quarter of the students scored each of the scores (0,1,2,3) available on this question. Although the final marking point was dependent upon awarding the previous mark, it was quite common to see students fail to achieve this mark as they did not use a relevant equation to help with their explanation. It was important on this question to highlight that the power for the internal resistor was calculated using the internal resistance (r) rather than the external resistance (R). As with Q14b (mentioned earlier), it was important for students to identify the part of the circuit when discussing the resistance or potential difference. There was also some confusion where students considered that the p.d. across the internal resistance was the same as the terminal potential difference.

Q16(d)

Another question where just about a quarter of the students scored each of the scores (0,1,2,3) available. However, this time the biggest proportion scored all 3 marks. For some students, the only mark awarded was for having a steeper gradient, whilst others who realised that the gradient would be doubled failed to realise that the y-intercept would also be doubled.

Q17(a)

Yet another question where there was an even spread of students scoring each of the scores possible. The most commonly awarded was the second marking point, which was often seen combined with either marking point 1 or 3 to give a 2-mark total (which was the most common score awarded). For marking point 1, students often missed out key factors such as the waves being reflected, or where they were being reflected from. Perhaps some students also felt that it was not necessary to describe the nodes or antinodes. Either way, it is important for students to recognise that these types of question are usually applied to a particular application, so cannot be answered with a standard answer about how stationary waves are formed in a general way.

Q17(b)

Very few students scored all 3 marks here, generally as there were some words that specifically needed to be mentioned in order to achieve the marks. The final marking point was the one most commonly awarded, and usually with the alternative (At point Y the cable is stationary). The majority of answers mixed up displacement and amplitude correctly, with quite a few suggesting that point Y had a minimum, rather than zero, displacement. It was felt that zero amplitude was an incorrect way of explaining the situation at point Y as there was no displacement to have a maximum value for.

Q17(c)(i)

More than 80% of the responses here scored both marking points. The small percentage of students scoring just 1 mark failed to show their answer to a greater number of significant figures than the value given in the question, which is always necessary for a 'show that' question. The majority of responses scoring 0 marks were from students attempting a much more complicated calculation, using the equation for speed of waves producing a stationary wave. No doubt this was a result of the question asking students to calculate a mass per unit length.

Q17(c)(ii)

Although this was a quite complex calculation, it was generally completed very well by a significant proportion of the students. Only around a third of the responses failed to reach at least 3 marks, whilst almost one in five responses scored full marks. The main area of difficulty encountered was in terms of knowing which numbers should be compared with the values given in the question. Often students failed to realised that the calculated wavelength would be double the length of the cable required, as an oscillating cable fixed at both ends would just have a node at each end. Similarly, students using the wave equation to establish a frequency commonly used the length of the cable rather than double the length of the cable.

Q18(a)

A very successfully completed calculation where more than 40% of students scored all 6 marks. The cohort appeared to be very adept at using the resistors in parallel formula, combined with resistance and power equations to clearly establish the correct power values for all 4 resistors. A common incorrect approach was to assume that resistor A had a p.d. of 10V across it and to directly apply a power equation with the resistance of A. Others calculated the power for the whole circuit without calculating the power for each resistor individually. A surprising number of students calculated the power of A correctly but then went on to make a mistake in their remaining calculations for B, C or D. However, the question on the whole was completed very well.

Q18(b)

This was a very similar type of question to 16c, although it was completed successfully by more than 40% of the students. Many achieved the first marking point by more than one route, although it was surprising that so many failed to achieve the second marking point due to an incorrect conclusion about how the power would change. The majority of such responses implied that changing a circuit that had 4 resistors to one that only had 3 resistors would lead to each resistor having more power.

Q18©

This has been a rather standard question over the last few years and students appear to be getting to grips with the technical detail required. However, as it was the last question on the paper, it did not score as well as might be hoped. Some students clearly felt that this was related to other components such as thermistors, whilst others simply did not describe the situation carefully enough. For example, it is important to say not only that the lattice/ions/atoms vibrate more (rather than just starting to vibrate) but also to mention the names of the particles involved. It is also important for the final marking point to mention the rate at which collisions between the electrons and the lattice/ions/atoms increases, rather than just the number of collisions. Too many students just described particles vibrating more and collisions being more. This is not technical enough to score marks.

Paper Summary

The students taking this paper appeared to show a sound understanding of the principles and concepts given in the questions. Some of the longer calculation questions such as Q17cii and Q18a were answered very well indeed on the whole.

As is often the case, questions requiring answers that were more specific to the scenario were not answered as well. For example, Q12ci, Q12cii, Q15, Q16c and Q17a all had aspects specific to the situation presented.

Some important aspects to consider whilst preparing for these examinations are as follows:

1) Students should always look at the scenario and apply their understanding of the correct Physics to the exact scenario presented.
2) When a question is a ‘show that’, answers need to be given to at least one more significant figure than the value given in the question.
3) Answers to calculations should be in decimals and with units. Fractions are not acceptable unless specifically required in the wording of the question.
4) For questions where a decision is required, a comparison of values is usually expected. If the question relates to a prediction that has been made, there also needs to be a decision about whether that prediction is correct (based upon the value calculated).