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Examiners' Report/ Principal Examiner Feedback

January 2015

Pearson Edexcel International Advanced Subsidiary Level in Physics (WPH02) Paper 01

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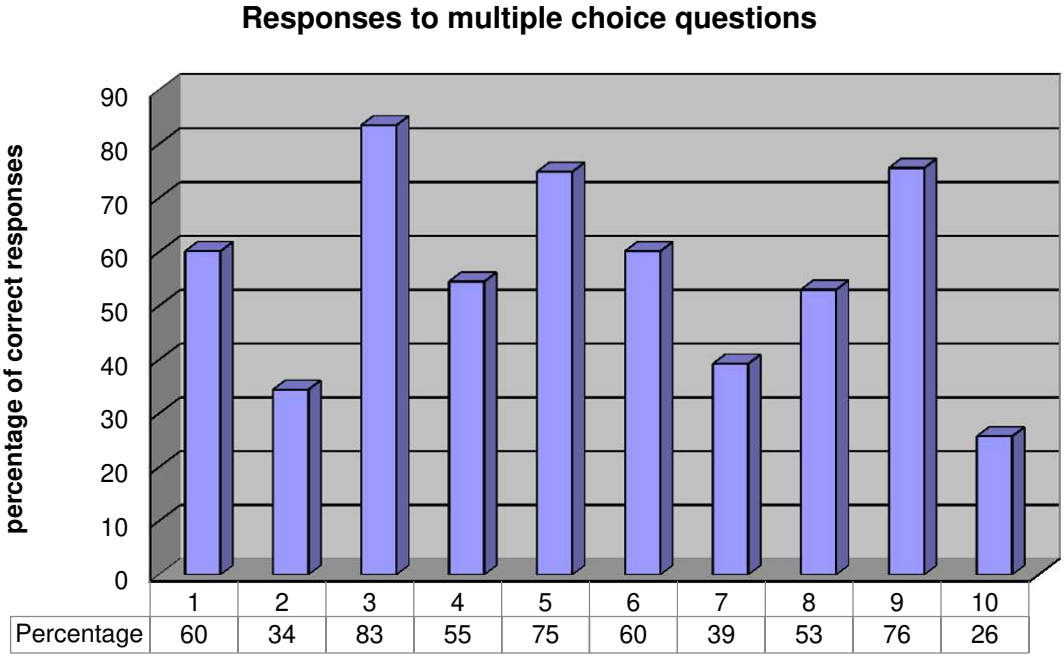
This paper offered opportunities for candidates of all abilities to demonstrate their knowledge and understanding of Physics in a range of applications. It was generally found that questions involving calculations were answered more successfully than longer descriptions.

Section A

The responses to the multiple choice questions are as shown.



	1	2	3	4	5	6	7	8	9	10
Percentage	60	34	83	55	75	60	39	53	76	26

In some answers a certain incorrect response was as or more frequent than the correct response.

Question 2
About the same number of candidates chose D as chose C as the incorrect statement, most realising that A and B were correct descriptions. Consideration of the relative positions of corresponding particles shows that X is undisplaced.

Question 10
Answer B was most common. Students selecting this answer were thinking of the description of transverse waves after seeing reference to ‘perpendicular’. This would work if it said ‘and are’ instead of ‘which is’, but the direction reference is to the plane, not the oscillations.

Section B

Question 11

Candidates were asked to explain the shape of the graph, but often just described features of the graph without explanation or described features of a diode, such as allowing current in only one direction, without reference to the graph. The negative *V* part of the graph was frequently ignored, even if a statement about the direction of current was made, and there was rarely any reference to a high resistance. The most commonly credited statement related to decreasing resistance with increasing potential difference, although many candidates incorrectly equated resistance to the gradient. In all, only about half scored on this question, the most frequent mark being one.

Question 12

(a)
A majority scored two or more marks, usually for stating that there would be a change of wavelength and linking the change correctly to the direction of motion. Using the signal from X as a reference was not often stated explicitly, although it was sometimes implied. A number of candidates missed a second mark because they linked the change in frequency to the position of the person rather than the movement of the person, for example stating that the frequency would be higher for a closer source.

(b)
Only a fifth of the candidates identified a suitable advantage, the usual suggestion being measurement of distance. Many others discussed characteristics of a pulse echo system rather than advantages. Some mentioned measurement of the time taken for a pulse to return, but did not go on to say how this could be used, or stated ‘so one pulse can return before the next is emitted’. Another frequent incorrect response was to suggest that there would be no interference.

Question 13

(a)(i)
While about two thirds gained at least one mark, and over half of them scored two, many more displayed some understanding but did not show sufficient clarity of expression. The angle of incidence was sometimes just referred to as the angle in glass, for example. A common error was to describe the critical angle only in terms of total internal reflection, such as ‘the largest angle before total internal reflection occurs’ or even ‘total internal reflection occurs when the angle of incidence is equal to or greater than the critical angle’. Candidates sometimes referred to an angle of reflection of 90° to the normal rather than an angle of refraction.

(a)(ii)
There were very few problems with calculating the refractive index, with over 90% being successful. The most common error was giving the answer as 1.5 and not stating it to 3 significant figures, as required when the quoted ‘show that’ value has 2 significant figures.

(a)(iii)
A large majority completed the critical angle calculation. Some could not rearrange the equation and some tried to use sin (1.52) and a few tried to find the angle for a sine value greater than 1. Candidates occasionally made a unit error by not giving their answer in degrees.

(b)
About half got one or more marks for this question, often having an idea of the answer but not explaining with sufficient clarity. The mark for the angle of incidence greater than the critical angle, sometimes given as the value from part (a) (iii), was given most often. While total internal reflection was often also mentioned, it was frequently stated as if it occurred once only and without the idea of repetition. Diagram sometimes clarified this point.

Question 14

(a)(i)
About half of the entry gained a single mark, scoring 2 being rare. The marks were fairly evenly split between the *x* and *y* axes although a fair proportion of those labelling the first as displacement used the same label for the second.

(a)(ii)
A fair majority scored 1 or more, but 3 marks were infrequently awarded. The most common mark was for a mention of interference or superposition. Zero amplitude was not often seen. Some candidates missed out on the first mark because they referred to phase change only rather than phase difference. Others just said 'out of phase', which is not sufficient for 'antiphase'. Some discussed path difference which was not relevant in this case. Zero amplitude was not often seen, and reference was often made to 'zero displacement' instead.

(b)
A good majority scored 3 for part b, although a sizeable minority misidentified the wavelength as 35 cm or 17.5 cm. Most of those who got the wavelength wrong used it correctly to score 2 overall. Those who left part (i) blank sometimes multiplied 196 Hz by 35 cm, but this was not treated as an 'error carried forward' because no wavelength had been identified.

Question 15

(a)
About half scored here. Many just said that the electron was unexcited or most stable, and a number stated that it had zero energy.

(b)
A surprisingly large minority – approaching half – scored nothing here, sometimes because they described the photoelectric effect in some way. While 6 marks was very rare, a good majority of those scoring marks gained 3 or more. The most common marks were for electrons moving to higher levels, then moving to lower levels and only certain levels being possible. Candidates who did not mention photons were generally limited to these three marks, for example by saying only that energy is emitted as light. Candidates sometimes said that the energy of a

photon depends on the energy change without saying it equals the energy change. The final mark required a clear use of limited energy differences, but the reference, if any, was usually only to limited numbers of levels.

Question 16

(a)
Candidates were asked to explain how one observation linked to the photoelectric effect – a maximum kinetic energy – provides evidence for the particle nature of light. Many responded by writing everything they knew about the photoelectric effect including factors that were not in the question, such as intensity, or discussing changes in frequency although the question refers to a single frequency. Such responses very often ignored consideration of kinetic energy at all discussed it in terms of intensity for particles or waves. Overall, about a third scored one mark and an additional tenth went on to a second mark. Very few made it to 3 or 4 marks. The mark most often awarded was for the linking one photon to one electron and the other was for the idea of energy provided by waves building up. Most other discussion was not relevant to the question, even though it frequently went over the space provided, which was adequate for a good answer.

(b)
A large majority completed this successfully and scored 4. The most common error was failing to convert eV, although some got the correct answer and then used kinetic energy to calculate velocity, giving the velocity value as their final answer for kinetic energy in joule.

Question 17

(a)
The great majority got at least one mark, but few scored 2. While the general diffraction pattern was usually seen and the wavelength kept constant, the direction was infrequently shown.

(b)
The question asked for an explanation of the shape of the graph, but the link to detector output, the value of the *y*-axis, was often missed entirely. Others described the shape of the graph in great detail, point by point in some cases, but did not mention diffraction at all despite the introduction of the phenomenon in part (a). A surprising number did not even make a clear statement of their estimate of the wavelength. In terms of marks, most scored at least 1, but more than 3 were rarely awarded. The most common marks were for a statement of a reasonable wavelength and for linking maximum output to ‘maximum diffraction’ when the gap size equals the wavelength. The value of zero output for zero gap size was usually ignored. There is little understanding of the situation when the gap size is less than the wavelength and that the angle through which the wave is diffracted remains a maximum while the intensity decreases as the gap gets smaller than the wavelength.
When discussing the distribution of values a mark was sometimes awarded for suggesting that it is uneven, but little else of merit was ever seen.

Question 18

(a)
A good majority of candidates worked through these parts straightforwardly and scored 5 marks. Candidates sometimes reversed the values in the efficiency calculation or used (input – output) as the numerator.

(b)
About a third scored 3 marks, with a majority of the entry getting at least two marks. The common error was to fail to apply the factor of 3 for the three cells. Some applied a factor of 3 twice. Others had difficulty applying the time correctly.

(c)
A large majority did not score on this question, often because they interpreted the question as saying that the current in each cell remains at 6.8 mA rather than that the current in the solar panel remains at 6.8 mA.

Question 19

(a)(i-iii)
A good majority completed the calculations correctly to determine the length, but few made a comment in part (iii) that showed an understanding of the term accuracy. Accuracy denotes the closeness of agreement between a measurement and the true value and the best judgement of accuracy here would be obtained by comparing the value based on resistance with the value obtained by measuring length directly. This comparison was suggested in the stem of the question on the previous page, but it was rarely made. Candidates often made reference to the methods of measurement instead.

(a)(iv)
Candidates often compared numbers of decimal places rather than significant figures and did not see how the measurements shown could be used to compare relative uncertainties. They again sometimes referred to the measuring instruments and the idea was also expressed that diameter, being ‘milli’, was smaller, so it had less effect.

(a)(v)
About half of the candidates scored at least 1 mark, quite frequently making it 2. The first was usually for using potential difference divided by current or describing how a potential difference against current graph could be used. The next was for describing how these values could be obtained, although candidates sometimes referred only to the meters and not what they measured or said to measure potential difference and current but not how. Circuit diagrams were sometimes used successfully. The reason such a method would be more accurate was not often mentioned.

(b)
The great majority calculated the operating current without difficulty, but only about a quarter of candidates completed the calculation with the correct rate of energy transfer. Many candidates used a potential difference of 230 V, as applied to the lawnmower, rather than using the current in the wire in their calculations.

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