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Examiners' Report
Principal Examiner Feedback

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Pearson Edexcel Advanced Subsidiary
In Physics (8PH0) Paper 02 Core Physics II

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General Comment

This paper assessed topic 4 materials, topic 5 waves and particle nature of light. Section A totalled at 60 marks, consisting of 8 multiple-choice questions which included questions of differing styles and lengths and drawing on a range of different concepts. Section B a totalled at 20 marks, consisting of two synoptic questions whilst drawing on content from the whole of the AS specification.

Students demonstrated progression from GCSE. This paper provided students with the opportunity to consolidate their knowledge at the end of the first year of the AL qualification. There was a range of mathematical skills assessed. Q10(c) proved a challenge in dealing with small angles in a trigonometric problem and using angles in degrees and radians. Q11(b) gave students the opportunity to use mathematics to justify a statement in the context of vibrating strings. Q12(b) provided difficulty for some, despite the equation being given, and was assessing a student’s ability to determine and substitute correct values.

Questions requiring a longer written response included Q11(a). This was a fairly standard style of question on standing waves. Many students had benefitted from answering similar question whilst using language to a good standard. The photoelectric effect was assessed in Q16, in a longer written response question. Practical skills were assessed throughout, including Q12 and Q14. Also, knowledge of core practical’s, including core practical 4 (Q12), core practical 6 (Q6 and 7), core practical 7 (Q11) and core practical 8 (Q13).

	comment	common incorrect response
Q1	Assessing the students' understanding of the elastic limit as the point beyond which the steel becomes permanently deformed	B Illustrates confusion between the elastic limit and the limit of proportionality
Q2	Using a pulse-echo technique, this is an application of distance = speed x time where the time is half *t*, since *t* is the time taken to travel there and back.	A This response has the factor of two incorrectly applied
Q3	Emission of electromagnetic radiation occurs with a decrease in energy as the electron falls back down the energy levels. The shortest wavelength is emitted with the greatest change in energy.	C Indicates that students realised this would be the greatest change in energy but were less confident in choosing the direction of the arrow.
Q4	Required students to rearrange the equation and substitute for the units.	D Students choosing this option knew that $k=F/x$ but did not realise that N is not a base unit so that further work was needed to complete the question.
Q5	TIR might take place when light is travelling in one medium towards another medium in which it would travel faster, for example, light travelling in glass and incident at a glass-air interface. The refractive index of the medium in which light travels faster is smaller.	C This response was a complete opposite to the correct response. Students can often recite that "TIR occurs for light travelling from a more dense to less dense medium" but are less able to link this statement to the speed of the light and the refractive index of the two mediums.
Q6	Both Q6 and Q7 were assessing the methodology of core practical 6	D A quick check, (although not a definitive check) is to determine whether the equation is dimensionally correct: f/t would give units of s^{-2} which is dimensionally incorrect for phase difference in response D.
Q7	The microphone has been moved one wavelength as indicated in the question by the signals starting and ending in phase. So, $d = \lambda$. This can then be substituted into the formula $v = f\lambda$	A This incorrect response included a factor of two, indicating that some students treated this a pulse-echo. However, the wave is not reflecting.
Q8	Answered correctly by most students.	

Q9(a)
Students were able to choose and use the correct equations. However, the use of the relevant equations contained different aspects that students had to tackle. Mistakes included not converting diameter into radius to calculate the cross sectional area, and using an incorrect value for strain.

Q9 (b)
This was a 2 mark calculation most students got the correct value. Some students were not confident with determining a value for Δx from the information found in the question. A few students successfully answered this by calculating the spring constant and using an alternative equation for the energy.

Q9(c)
Most students realised that this was about creating the greatest extension. Some students only referred to decreasing the uncertainty in the measurement. The uncertainty is not dependent on the length but if the extension is greater the *percentage* uncertainty will decrease.

Q10(a)
A question that was well tackled although unit errors were not uncommon. A few students calculated *v/u* perhaps confusing focal length and magnification.

Q10(b)
This is a different question to a past question on real/virtual images. What is meant by a real image is an image where the light rays actually pass through the image. Answers such as “is formed on the other side of the lens to the object” and “can be projected on a screen” describe properties of the image.

Q10(c)
Most students did not realise that the student was looking at a projected image of the dots on the whiteboard and so failed to calculate the distance between the dots of the projected image. As a result, MP1 and MP2 were seldom awarded. However, allowance was made for students who assumed the dots were 5 mm apart and used appropriate trigonometry, so that students could still go on to gain MP3 to MP5. There are several routes to solve this:

- Bisect the isosceles triangle into two right angled triangles and then use tan(opposite/adjacent) to calculate the angle subtended at the eye in degrees. Using the small angle approximation (tanθ = θ for small θ in radians), calculating (opposite/adjacent) arrives at an answer in radians which could then be compared with 0.0003 radians.

OR

- Since the angle is very small the isosceles triangle can be approximated as a right-angled triangle and use tan to calculate the angle in degrees. It is also valid to approximate the long side of the isosceles as the hypotenuse and use sin or cos.

Having calculated the angle this then needed to be compared to 0.0003 radians and a conclusion made. Those students who had arrived at an angle in degrees needed to convert 0.0003 radians into degrees or their answer into radians. Many students did not realise this and incorrectly made a comparison between an angle in radians and an angle in degrees. Some attempted to convert between radians and degrees, often aware that this involved π and/or 180° but failed to do this correctly.

Q11(a)
This demonstrated a good understanding of standing waves. Points were missing from student responses rather than incorrect, in particular MP6. Answers that made reference to the path difference were rare. MP3 and MP4 were far more commonly scored linking constructive and destructive interference to the phase between the waves.

Q11 (b)
This question was well answered by students, they were not phased by the command word "justify". MP1 to MP3 were commonly scored. Students tended to attempt the second alternative in the mark scheme although both methods were seen with success.

Q12(a)
In order to fully answer this question students needed to refer to both the student's experiment as well as to lava flow. The question states that the pictures were taken after the fluid had been flowing for the same length of time. This should have lead students to compare the speed of the flow at different temperatures and not just the total area covered.

Q12(b)(i)
Students were confident at calculating the velocity of the sphere. Mistakes occurred when students calculated the volume. They need to be reminded that this is not an equation given in the formula sheet and to be made aware of whether they are dealing with a radius or a diameter. A common mistake made when substituting these into the given formula in the question was to confuse v and V, standard notation for velocity and volume. Some failed to substitute 9.81 for g, or substituted the diameter instead of the calculated radius.

Q12(b)(ii)
Most students understood this although some failed to mention Stoke's law or link this to the speed that the sphere would fall.

Q12(b)(iii)
An answer was required that described the aspect of recording a sphere that couldn't be achieved by other means. Most students who scored the mark referred to being able to playback the recording. It was also necessary to state why this is useful, giving the idea of a measurement of time.

Q13(a)(i)
Incorrect responses failed to include the description of a line, surface or plane. It was not uncommon for descriptions alluding to the wave front being the front edge of a wave.

Q13(a)(ii)
MP1 was awarded to students who demonstrated that they knew how to draw a wavelet. Additional equipment listed on the front of the exam paper included 'drawing compasses' so these should have been made available. They could have been used to draw a circle/semicircle/arc. Some students tried to draw wavelets freehand and were less successful. MP2 was awarded for a minimum of three wavelets of the right size which demonstrated that the student knew how to use Huygens construction. MP3 was for correctly drawing the next wavefront. Since the question was about how to use Huygens construction, students needed to demonstrate some understanding of Huygens construction in order to gain this mark.

Q13(b)(i)
Most students who got this correct referred to the light from a laser as monochromatic.

Q13(b)(ii)
A well answered question. A significant number of incorrect answers confused *d* and *n*. Having arrived at an answer, students were confident at choosing the correct colour using their calculated answer.

Q14(a)
The equation for the de-Broglie wavelength was well known. Students were expected to realise that in order to calculate momentum they needed to use the value for the mass of an electron as given in the data sheet at the back of the paper. Those who did not realise this were unable to pick up any further marks.

Q14(b)
Of the 2 marks MP1 was awarded for a simple comparison of wavelengths which followed on from part (a). MP2 was a more demanding idea about diffraction and as expected, less frequently awarded. Most students made a correct comparison for MP1 but very few realised that this was linked to diffraction. Of those who did, some thought that there must be more diffraction with the electron microscope. (It is worth noting that it is more correct to write the wavelengths of light or electron as opposed to the wavelength of the microscope.)

Q14(c)
Students realised that they needed to calculate a mean value from the given results and use this mean value in the magnification equation. Some students found the mean by using all four values, and some treated *1.1* as an anomalous result and ignored it. Both methods were accepted in this case. (A cell is not necessarily a regular circle with a constant radius.)

Q15(a)
It was hoped that students would realise from the passage that there was a change in gravitational potential energy in the hammer which led to the change in energy being proportional to the change in height. Section B is synoptic and so questions can be asked from any part of the specification. Maybe students did not then consider that $E = mg\Delta h$ was relevant to this paper.

Q15(b)
Most students understood the physics here and successfully equated gravitational potential energy and kinetic energy, and then went on to use $p = mv$ to arrive at the correct answer. Some students used equations of motion, but despite arriving at a correct value, failed to score as this is incorrect Physics. The hammer does not move in a straight line with a constant acceleration so the equations of motion should not be used.

Q15(c)
Students were expected to make a conclusion from the graph on the relationship between fracture toughness and temperature, and use this to deduce why this might have led to the steel fracturing. MP1 was most commonly achieved by students. Students who failed to score MP2 and/or MP3 did not link this to the *energy* that was absorbed. It was common to see vague statements, such as “it fractured more easily”, which are insufficient descriptions of the Physics at this level. Some referred to the force of the impact.

Q16(a)
It was pleasing to see a large number of students using the equation $I = \frac{P}{A}$ correctly and not getting I and P confused as has been common in past papers. However, a large number forgot that A is the component of the area perpendicular to the rays and so limited their mark to 1

Q16(b)
This question was answered well, with most students realising that this was linked to the ratio of resistance to potential difference. A significant number incorrectly calculated the p.d. across the 750 Ω resistor. Some students calculated the current in the circuit and used this to calculate the output p.d. Success via this route depended on whether or not they then used 1 kΩ.

Q16(c)
This question was not answered as was hoped as a “compare and contrast” with the similarities described and then the differences. Generally, students embarked on a description of the photoelectric effect which they would have learnt from completing past paper questions, without any reference to this question. Some students attempted to explain it using the particle v wave theory by stating that the LDR demonstrates the wave theory of light. Some did not realise that *light* and *radiation* as mentioned in the question amounted to the same thing. The question describes electrons moving to a higher energy level to become conduction electrons in the LDR. Whilst students were not previously expected to know this about the LDR, they should know that the

photoelectric effect is electrons leaving the surface of a metal and not moving between energy levels. Some student responses illustrated confusion between the photoelectric effect and energy levels.

Summary

Based on their performance on this paper, students should:

- consider a range of applications for each area of physics to get used to applying and explaining the physics in different contexts so they become less reliant on just memorising previous answers.
- revise the photoelectric effect and energy levels to establish the difference between them.
- Memorise the formulae for the area of a circle and the volume of a sphere, and use them with both a radius and a diameter.
- practise longer, multi-step calculations and develop strategies to help them work through the problem, including showing clear working at each stage.
- Establish understanding on the difference between the strain and the extension of a stretched wire, and be able to determine a value of either from given information.