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Examiners' Report
Principal Examiner Feedback

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Pearson Edexcel GCSE In Science
(5PH3F) Paper 01

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Paper Introduction

This examination aims to allow candidates to demonstrate that they can accurately recall concepts and phenomena in physics and can communicate their understanding using both qualitative and quantitative models. The specification uses physical principles and links these to medical applications.

The specification is made up of five topics.

- Radiation and treatment in medicine.
- X-rays and ECGs.
- Production uses and risks of ionisation from radioactive sources.
- Motion and particles.
- Kinetic theory of gases.

There are six questions in which the content of the specification is tested. The assessment is through multiple choice questions, short answers, extended writing, calculations and analysis. Candidates need to be able to apply mathematical skills, express their ideas clearly and concisely and interpret scientific data which is presented in a variety of ways.

General comments

The work produced for the examination showed that some candidates lack confidence in their use of mathematical models. Most candidates were able to select and use a simple equation to determine the power of a lens whereas the equation relating temperature and volume of a gas proved to be too difficult for many candidates even to make a correct substitution. It was also apparent from the work produced that the concept of conservation is not understood by many candidates regardless of whether this is related to momentum, kinetic energy or mass energy.

It is important that candidates are able to interpret diagrams which show light rays, noting the direction of the rays with respect to the medium in which the rays are travelling. Surprisingly few candidates were able to interpret a diagram which showed total internal reflection or complete a diagram to show the path of a light ray which strikes a water-air surface at the critical angle.

Most candidates made use of the formulae sheet at the front of the examination paper and were able to quote an equation correctly. Although full marks are given for correct answers to calculations, with or without working, it was pleasing to see that most candidates showed their working. This allowed them to gain marks for a correct substitution even if the final answer was not correct. However, it would be even better if candidates quoted the equation they were using and then showed the substitution.

The significance of subscripts in the gas law equation was not appreciated by many candidates who were unable to link a volume with the associated temperature. All candidates should be supplied with calculators if they do not have the use of their own, as this, together with a ruler is a requirement for the examination. The lack of these pieces of equipment disadvantages candidates in completing calculations and adding to or drawing diagrams.

Question 1

Most candidates were able to identify light as a non-ionising radiation and the majority could give a use for ultrasound scanners. The most common correct answer was related to 'looking a babies in the womb'. Responses such as ' looking a babies' or 'checking babies' gained no credit as it could have referred to any number of tests and not just ultrasound scans. Most candidates noted that Q1b required a description of 'some' risks and gave more than one. The most frequently seen responses were

mutation of cells, destruction of cells and may cause cancer. For 1c many candidates understood that technicians stayed outside a room where patients were receiving radiation treatment in order to reduce their exposure to radiation but very few could explain why this precaution reduced the exposure. Greater distance from source, reduction in intensity or that the radiation would not penetrate the wall were rarely seen. Without an explanation the candidates were limited to one mark. Candidates that wrote their answer from the perspective of being inside the room failed to score any marks. This illustrates the importance of reading the question carefully and understanding the command word that has been used. Q1d also required an explanation and two marks were available and therefore two correct and linking statements need to be made. The most frequently given response was 'short half-life'. The fact that the isotope is radioactive or that positrons are only emitted for a short time was rarely mentioned. Many candidates referred incorrectly to the dangers of transportation and gained no credit.

Question 2

This question focussed on knowledge of the structure of the eye and tested mathematical skills by the use of an equation. Many candidates were able to correctly identify the parts of the eye from the diagram but the position of the near point was less frequently identified. A symptom of short sight could be readily identified by most candidates but the reason for a person being short sighted was less well understood. There were many references to 'genetics' and 'watching too much television' or vague statements such as 'the light does not reach the retina'. Specific correct statements such as 'the eyeball being too long' or 'the image is formed in front of the retina' were quite rare. The majority of candidates were able to select the equation for the power of a lens from the formulae sheet, insert the value for the focal length and produce the correct answer. Only a few candidates substituted correctly and then got the wrong answer but this was worth one mark.

Question 3

The question was concerned with collisions and conservation of various quantities. Some candidates were able to identify that protons bombard stable elements to produce isotopes from the multiple choice Q3a. The answers to Q3b were very muddled, those candidates that realised that the explanation of an inelastic collision had something to do with conservation generally gained one mark for stating that both momentum and kinetic energy were conserved. Candidates were also careless in using 'energy' instead of kinetic energy. Q3ci was very poorly answered with only a few candidates gaining one mark usually for recognising that electrons and positrons have the same mass. Candidates did not use the information that was shown in the diagram, this shows that the electron and positron are travelling in opposite directions. The fact that momentum is a vector quantity and the relevance of direction to this was almost entirely missed. Most candidates were also unable to give the correct answer to Q3cii many gave the answer that the gamma rays have opposite charge rather than no charge. In Q3ciii a few candidates quoted $E=mc^2$ and gained one mark even though this knowledge was not required. The concept of conservation is generally not understood and the idea of the masses of the electron and positron being converted to the energy of the gamma waves so that mass energy is conserved even is partially understood was poorly expressed. If candidates gained a mark it was usually for appreciating that gamma waves have energy. In Q3d the properties of gamma rays for a specific use was required therefore just stating that that the gamma rays are very penetrating was not sufficient it was necessary to state that the rays would penetrate the body.

Question 4

In Q4a a large number of candidates selected that that alpha radiation is strongly ionising. For 4b most candidates were able to plot the two points correctly however the curves of best fit were occasionally dot to dot or multiple lines. Candidates need

to practice drawing curves of best fit to keep the curve smooth and close to the plotted points. Most candidates were able to state the relationship shown by the graph to gain the mar for Q4biii. The idea that there was some background radiation or not enough sheets of aluminium was sufficient to get most candidates a mark for Q4biv. Many candidates were able to identify a β^- as an electron and to state that an electron was emitted, this gained a mark. However, very few candidates related the emission of the electron to the neutron changing to a proton so no further mark was awarded. A number of candidates referred to quarks and gave udd goes to uud, this was sufficient for two marks. In Q4d some candidates gained a mark for knowing that beta particles carried a charge but the second mark for realised that the beam of beta particles was a 'flow' of charge was rarely given.

Question 5

The focus of this question was the kinetic theory. In Q5a most candidates were able to estimate the correct value for volume from the graph and suggest correctly what would happen to a real gas when it was cooled to a very low temperature. However, almost half the candidates are still unable to convert °C to Kelvin. Although the rearranged equation was given in Q5bi many candidates could not substitute correctly the relevance of the subscripts were not appreciated. For this calculation candidates must be able to substitute correctly and then use a calculator correctly to get the right answer. Although answers to any number of decimal places were accepted it would be better for candidates to learn to give answers to the same number of significant figures as given in the question unless a specific number of significant figures is required by the question. For 5bii most candidates were able to suggest ways of increasing the pressure on the gas in the cylinder usually by adding weights to the piston. Q5c was answered well, most candidates read all the information in the stem of the question and realised that the explanation of why the tin lid blows off had to be given in terms of particle movement. Many candidates were able to gain Level3, six marks by describing the gas particles moving quickly, colliding with the tin lid and exerting a pressure. Those candidates that did not consider particles but did describe a change of state were limited to Level1.

Question 6

This question requires diagrams to be interpreted and added to. It is also of advantage to candidates if they can produce their own diagrams of optical effects. In 6a most candidate noticed the change in direction of the light ray as it passes from air into water and correctly named this effect as refraction. Most candidates could give a change in density of the mediums or a change in the speed of the light, to gain one mark for the explanation in Q6aii. About half of the candidates were able to give the correct changes in density and speed to gain the second mark. In 6b candidates needed to read the whole stem of the question and look carefully at the direction of the light waves to understand what effect was being shown many candidates identified reflection but a considerably smaller number realised that the diagram showed total internal reflection. For Q6c candidates needed to realise that the ray of light was approaching the water-air boundary through the water and at the critical angle for water. Very few candidates continued the ray of light along the water-air interface. The relevance of the critical angle and total internal reflection was then extended to require a description of an endoscope, how it works and what it is used for. About a third of the candidates were unable to gain marks on this question because they did not know what an endoscope was. However, there were many candidates who could describe the endoscope and draw a diagram showing the optical fibres and the light passing through the fibre by total internal reflection. Candidates were able to achieve Level 2 with this type of diagram and if they described that the endoscope could be used to look inside the body this was sufficient to achieve Level 3.

Summary

The performance of candidates in this examination was similar to the performance in previous years. Although the paper has shown that the candidate find some concepts difficult to explain there is an improvement in setting out of mathematical questions as more candidates are now showing their working.

The performance of candidates in the examination could be improved by:

- Always showing their working for calculations so that a mark can be gained for the substitution.
- Always looking to see how many marks are awarded for a question if a question has two marks then it is necessary to make two points to get both marks
- Using the information provided by diagrams to help answer questions.
- Drawing diagrams or adding to diagrams to help explanations.
- Learning the meanings of scientific terms in physics such as conservation
- Learning to be accurate, for example kinetic energy and energy are not the same
- Learning the names of scientific and medical instruments and what they are used for.
- Reading all questions carefully and taking note of the command words.
- Having a calculator and a ruler with you in the examination
- Practice drawing lines of best fit using a transparent ruler and practice drawing fee hand curves of best fit.

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