RECOGNISING ACHIEVEMENT

GCSE

Physics A

Twenty First Century Science Suite

General Certificate of Secondary Education **J245**

OCR Report to Centres

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J245/R/12J

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This report on the examination provides information on the performance of candidates which it is hoped will be useful to teachers in their preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the specification content, of the operation of the scheme of assessment and of the application of assessment criteria.

Reports should be read in conjunction with the published question papers and mark schemes for the examination.

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Overview

This is the first session of exams for the new Physics A specification. The papers illustrate two key changes from the old specification. The introduction of 6 mark free response questions and the raising of demand, with the inclusion of more challenging questions and greater proportion of questions requiring mathematical skills to complete successfully.

Candidates had clearly been well prepared for the 6 mark free response questions, with nearly all candidates attempting the questions and taking the opportunity to demonstrate their understanding. The quality of communication was generally adequate to the task and often better than the quality of the science being presented.

The more difficult questions often involve novel contexts and the evaluation of data or explanations, this aspect proved challenging even some of the better candidates.

Unfortunately the problem of candidates not having calculators in the exam persists, seriously disadvantaging many. Questions are written based on the assumption that candidates will have access to a calculator.

A181/01 – Twenty First Century Science Physics A (P1, P2, P3) Foundation Tier

General Comments

This is the first session for this paper and specification.

The paper was generally well attempted and produced a satisfactory spread of marks across the mid range for the paper, however no candidates managed to access the top marks, the highest mark being 49 out of 60. It is to be hoped that with increased familiarity with the requirements of this specification, candidates will be able to access the full range of marks in future sessions.

This paper saw the introduction of 6 mark questions, one for each of P1, P2 and P3. These are marked using a level of response mark scheme, with each question targeted at a particular grade range (indicated in the guidance column of the mark scheme).

The vast majority of candidates made a good attempt to tackle these questions and the outcomes produced showed a good level of differentiation.

The majority of candidates showed evidence of using their time well with no evidence of this being an issue with regard to completion of the paper.

Many candidates seemed unprepared for the calculations on this paper, with evidence that a significant number failed to either refer to the formulae at the front of the paper or make use of a calculator in their attempt to answer the question.

Comments on Individual Questions

1 This question considered aspects of the P1 topic including star formation and measuring the distance to stars. Part (a) proved a difficult start for the majority of candidates. Common errors included mistakenly using light years as a unit of time and a lack of awareness of heavier elements forming in stars (many felt they formed underground on the Earth). More able candidates could sometimes identify parallax as a correct method of measuring the distance to stars, but very few new that brightness could also be used. Most candidates could state that the Sun formed from a cloud of dust and gas.

2 This question was a level of response question targeted at grades up to F. This question differentiated well in terms of ability with a considerable number of level 3 responses seen. Some answers well above the targeted range were also present. Most candidates were able to produce a labelled diagram of the Earth although the weakest candidates could not fully label at least the core, mantle and crust and often mixed up the order or did not show the correct number of layers as required. Better candidates showed the path of p and s waves or at least mentioned them in their written response. Some candidates used ideas involving plate tectonics and correct use of such ideas was rewarded.

3 This question proved inaccessible to all but a handful of candidates. The vast majority were unable to process the information and carry out the calculations required in part (a). More able candidates managed to use the formula for wave speed with their own values in part (b) to obtain 2 marks ecf. The next part of the question was supposed to examine the idea that waves transfer energy but not matter. Most candidates felt that the ball would be moved to the shore by the wave or that it was wrong because the ball would go to the opposite shore instead.

4 Most candidates scored half marks or better on this objective style question, although the microwaves and radio waves can be used to carry information and that digital signals are made up of 0's and 1's.

5 Overall, this question differentiated well. Most candidates could interpret the data correctly to answer parts (a) and (b i). The vast majority of candidates struggled to produce a satisfactory response to suggest why Venus is hotter than the Earth as requested. Many did not use the data or failed to isolate the data on carbon dioxide as being the only relevant information required. Only more able candidates managed to score the final marking point on part (c)

6 This question was a level of response question targeted at grades up to C. Responses were therefore in line with expectations for candidates on a foundation tier paper, with the majority of candidates able to produce level 2 responses with a significant number of the more able candidates producing level 3 responses. Even weaker candidates could identify a benefit from sunbathing, most often 'getting a tan', but many failed to link this to a benefit eg 'feeling more confident etc.'. A significant number of candidates attempted to discuss vitamin D production as a possible benefit. These candidates were rewarded although this is not a specification point. Many of these failed to gain a mark for this as they had confused the vitamin being produced as vitamin C. There were a significant number of good higher level responses, recognising UV light as ionising radiation and linking this to an increased chance of skin cancer. Many also discussed mitigating the risk by using sun cream or covering up. Surprisingly few of these used the term benefit outweighs the (perceived) risk as a reason to sunbathe.

7 More able candidates attempted a power calculation in part (a), often unsuccessfully however. The comparison in (a ii) was poorly answered, with many candidates producing inconsistent answers or referring to one device having more watts rather than more power or using more energy. Surprisingly few candidates could recall the mains supply voltage as being 230 V, with a seemingly random array of values being stated instead.

8 The majority of more able candidates had little difficulty with this question. Weaker candidates seemed place the labels without much evidence of understanding. A common incorrect response in (a iii) was nuclear. Part (b) of the question produced well differentiated responses, with some well reasoned answers from the most able. Weaker candidates failed to justify their choice just using the data from the table, as was required.

9 This question was a level of response question targeted at grades up to D. A good range of responses were seen, again with many higher level responses from the most able. Weaker candidates failed to produce answers above level 1, often due to poor quality of communication and a lack of structure to their answer. Most candidates could identify some arguments for and against building the power station, although often without any depth to their arguments. The most common group identified in favour was the government and those against, the farmers that owned the land. Only a few candidates managed to consider the wider impact of such a project eg in terms of a possible reduction in greenhouse gas emissions.

A181/02 – Twenty First Century Science Physics A (P1, P2, P3) Higher Tier

General Comments

The candidates covered wide range of abilities. There was a good spread of marks. The majority of candidates made a good attempt at the paper, with nearly all candidates attempting all questions. There was no evidence of candidates running out of time. Very little evidence was seen of candidates 'killing time' in the exam by scribbling or 'doodling' on the paper, so it appeared that they were kept focused on the exam for a large part of the time.

There was clear evidence that candidates were responding to the longer prose style questions with reasonable success, with most filling the available space with writing. Unfortunately this was too often vague and some times consisted of little more than rephrasing the question, rather than demonstrating their knowledge and understanding. The quality of writing was sometimes poor; deciphering their answers was often difficult. Candidates would benefit from taking more care in reading the question, which can be quite short, when answering the longer 6 mark questions. A failure to address the question asked can lose a lot of marks.

The mathematical content was not dealt with well by many candidates. The mathematical content of the exams will continue to be present in future exam series**.** It is worth pointing out the mathematical requirements are found in Appendix C of the specification.

Comments on Individual Questions

1 **(a)** This was correctly answered by most candidates, The most common errors were 'outside the milky way....' and outside the solar system ....'.

(b) This part was poorly done by most candidates. Many candidates simply described the big bang theory. The most commonly scored mark was for reference to redshift, but candidates were often unclear what that meant, often stating that the galaxy became redder as it moved away. Better candidates would relate the distance away to the speed of recession but failed to develop this into an argument supporting the idea of the expanding universe. Weaker candidates felt that the stars or planets were moving apart from each other, instead of galaxies. A number of candidates tried to explain the motion of galaxies by using the concepts used to find the distance to stars, either discussing parallax, or stating that the galaxies would get dimmer over time as they were moving away.

(c) Both parts of c were addressing ideas about science and candidates did not appear well prepared for this particular aspect. In part (i) a very small minority used the idea of imagination or creativity as expected. Quite a few candidates felt that as the Big Bang was a long time ago, we couldn't possibly know what happened. Other common errors were claiming that both theories are plausible at the same time, that scientists have looked at different parts of the universe to come to the different conclusions or that there was not enough evidence. For part (ii) very few suggested doing experiments to look for new data, and almost no candidates suggested the idea of testing a prediction. Many candidates incorrectly stated peer review was a way of separating the two theories. Many suggested that the data existed, and needed to be looked at again to tell which was correct. Some weaker candidates did not appreciate the difference between data and the theory, or the difference between the evidence and the theory.

2 This question differentiated well between those candidates who could remember all the facts about S and P waves and the structure of the Earth but were unable to explain the logic behind the conclusions, and those who could explain the reasoning. There was a lot of confusion of facts, as might be expected in a question requiring a lot of recall. It was clear that many candidates were confused by the contradictory ideas that the mantle flows like a liquid and that lava from volcanoes is liquid, but the mantle is solid, while the core, which is iron, is liquid. It was this liquid/solid problem with the mantle that led to a lot of the confusion in answers. Some candidates muddled up the evidence and conclusion aspects of this question, suggesting that the structure of the Earth tells us about the behaviour of s and p waves. The quality of scientific language was poor for a number of candidates, with imprecise descriptions of the Earth's structure (eg "layers of the Earth" – suggesting horizontal) or the waves (eg "p-waves are stronger"), or of their conclusions (eg "s waves did not travel through the Earth"), losing them marks. Surprisingly few candidates used the opportunity to draw the Earth's structure, which would have helped them gain marks

3 (this was common to both foundation and higher tier papers)

These calculations were poorly done. Very few candidates managed the first two calculations correctly. Few students could calculate the frequency. There were more answers where candidates had calculated the period 1/f. Some candidates seemed to have worked backwards, working out the speed (using incorrect assumptions) and then calculating the wavelength from that.

In the third calculation many candidates were able to select and use the correct formula successfully, with the majority of students scoring full marks whilst using two errors carried forward from part a.

In part (b)(ii) most candidates incorrectly thought the wave would move the ball across the pond and tried to explain this in terms of everything from energy to force and momentum. Of those who thought the ball wouldn't move, only a minority explained it in terms of transverse waves, most arguing that the energy would run out or trying calculations with the wave equation. Clearly many candidates are incorrectly convinced that waves move matter.

4 (this was common to both foundation and higher tier papers)

This was generally well answered by most candidates. Nearly all candidates knew that people wanted a tan, but fewer were able to explain why. On the risk side, many candidates were able to point to UV rays or cancer, but a large minority did not link the two. In far too many cases candidates appeared to think that <u>any</u> sunbathing caused cancer. Sun cream was often mentioned as a mechanism for reducing risk. Of the few candidates who explicitly mentioned benefits and risks, a number did this without specific reference to the issue, with out of the blue statements of "the benefit outweighs the risk" or attempted to shoehorn the precautionary principle or ALARA into their arguments, generally unsuccessfully. The aspects sought in the higher-level responses, such as perceived and actual risk, were not often expressed in enough detail. The candidates that lost marks tended to be those that just listed the risks and benefits but then said no more about them. Vitamin D was often referred to as a benefit, although beyond the scope of the course, this was accepted, however many candidates thought sunlight was a source of vitamin D.

5 **(a)** Most knew that carbon dioxide was important although many lost the first mark because they also considered the lack of oxygen or nitrogen as being an important factor. The idea that 96% was exceptionally high and of great significance was usually appreciated. A smaller number then went on to consider the idea that the greenhouse effect was greater. Incorrect ideas included that nitrogen and oxygen actively cooled the Earth (perhaps thinking of liquid nitrogen?), many believed that carbon dioxide itself had a heating effect on the planet, others simply gave an answer which considered the distance from the Sun. A significant number incorrectly referred to carbon dioxide as CO^2. If they are going to use chemical symbols, they do need to be correct. In part (i) most could obtain the mark for green plants but the idea of linking lack of ozone layer to low oxygen content was often not understood.

(b) Part (i) was usually correct. The most common error was 'Photons have more energy when they get to Venus', suggesting that some candidates thought that photons lose energy as they travel. This was also reflected in part (iv). Part (ii) was generally answered well, with the most common error being reversal of increase and decrease in the first and last spaces, which at least demonstrated consistency. Weaker candidates found this very difficult and appeared to put in words almost at random. Part (iii) required the candidates to translate an idea expressed in words into an equivalent mathematical form. The most common errors were $(0.7)^2$ and 1/0.7 which suggests most were happy with the representation of a square or the inverse relationship, but less could combine the square with the inverse relationship to give the correct answer of $1/(0.7)^2$. There were many errors in the challenging part (iv). The idea that some energy would be absorbed by other planets or comets was popular but showed little awareness of the scale of the solar system. Many candidates suggested that energy would be lost or somehow decrease as the photons travelled from the Sun, the same misconception as often seen in part (i). Weaker candidates repeated the idea expressed by the inverse square law.

6 This question had a strong element of decision making from the Ideas about Science strands but this was often not well addressed in answers. A large minority of candidates named no groups. The best candidates were able to discuss the groups and their arguments clearly. In general the arguments for and against nuclear power were surprisingly badly expressed, with few mentioning nuclear waste in any form that was helpful to their answer. Some candidates simply used this as an opportunity to put down everything they knew about nuclear power, without any reference to for and against arguments. A considerable confusion was caused by environmental groups who were found to be both for (no CO_2) and against (nuclear waste). A large number of candidates identified “people living near the site” with economic arguments or perceived risk arguments. Many of these, however, went on to discuss “people who live further away” with arguments about there being more electricity available, or other similar arguments that generally lacked a scientific background. A surprising number of candidates thought that nuclear power was renewable.

7 **(a)** Surprisingly few candidates could complete the block diagram fully. Some candidates did not follow the instructions and lost marks for giving the processes rather than the structures eg “heats water” for the boiler. The boiler seemed to be the one that posed the most difficulties – there were some imaginative alternatives. Unfortunately some candidates moved turbine and generator to the left and added an imaginary structure on the right which lost all the marks. Generator was the most commonly correct of the three.

(b) This was generally well answered by candidates. The weaker candidates often only gave one letter for each part. The 'irradiation' row was most often correct. Common errors were missing out nuclear power from the non renewable sources but including it as not using a boiler, oil powered was missed out of producing carbon dioxide and few had the conviction to list all the power stations as using spinning magnets near a coil.

(c) In part(i) too many candidates simply wrote down answers with no working, reducing them to 2 or 0 marks, more often 0 marks. 378 was a common mistake as was simply adding 10% of 420 onto 420 to obtain 462. Many gave the correct answer in part (ii) although some omitted the word energy and there was sometimes

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