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Examiners' Report/ Principal Examiner Feedback

January 2016

Pearson Edexcel International Advanced Level in Physics (WPH05)

Paper 01: Physics from Creation to Collapse

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General

The assessment structure of WPH05 mirrors that of other units in the specification. It consists of 10 multiple choice questions, a number of short answer questions and some longer, less structured questions. As an A2 level assessment unit, synoptic elements are incorporated into this paper. There is overlap with circular motion and exponential variation in paper 4, but also overlap with some of the AS content from papers 1 and 2.

This paper gave students the opportunity to demonstrate their understanding of a wide range of topics from this unit, with all of the questions eliciting responses across the range of marks. In particular, questions 15a, 15b, and 18b were well answered. However marks for questions 11, 13b, 14aii, 14b, 15c, 16, 17a,18bi, 18c, 18d, and 18e tended to be clustered at the lower end of the scale.

Calculation and 'show that' questions gave students an opportunity to demonstrate their problem solving skills to good effect. In general students were able to give correct units for quantities that they calculated.

As in previous series students sometimes disadvantaged themselves by not answering the question posed, or by not expressing themselves using suitably precise language. This was particularly the case in extended answer questions such as 14b, 15c, and 17c. Students could most improve their performance by ensuring they describe all aspects in sufficient detail and always use appropriate specialist terminology when giving descriptive answers.

In some questions it was necessary to make a comparison between two situations e.g in 11a and 18e. Students often did not gain all the marks because they did not make this comparison clearly.

There was some evidence of students learning previous schemes in the expectation of gaining marks. This was true in 13a and 18e, where answers were seen that related to the topic but not the context in which the question was set. Although students should be encouraged to work with mark schemes in preparation for their exam, it is important that they understand that such schemes are written for examiners, and so do not always give a complete answer.

The space allowed for responses was usually sufficient. Students should be encouraged to consider the number of marks available for a question, and to use this to inform their response.

Section A – Multiple Choice

The responses to the multiple choice questions were not as good as in previous examination series, with only 4 of the questions having 60% or more correct responses and 1 question with less than 40% correct responses. In order of highest percentage correct they were:

Q7 & Q9 (74%), Q4 (67%), Q1 (64%), Q6 (53%), Q10 (51%), Q3 (50%), Q8 (45%), Q5 (44%), and Q2 (26%).

Section B

Question 11
This question was not answered well by many students who did not read the graphical data carefully enough, and who then used imprecise language in their answer.
(a) It was common to see references to binding energy rather than binding energy per nucleon, and the idea of a comparison between the helium nucleus and other small nuclei was often missing.
(b) It was rare to see a correct reference to the graph, or indeed any reference to the graph, despite the specific direction in the question. Many students seemed to think that the large binding energy of the uranium nucleus was key, even though it is the binding energy per nucleon compared with other nuclei that is important for the fission process. The marking point awarded most often was marking point 3.

Question 12
This question was well answered by many students.
(a) Most students were able to obtain the correct answer, although a number of students added 273 to the temperature difference before substituting into the equation.
(b) Most students were able to gain the first 2 marks, either by attempting a calculation of a temperature rise or a time interval. For those who had completed the first two parts of the solution the final mark was likely to be awarded, although some students who correctly calculated the temperature rise of the meat forgot to add the initial temperature to the temperature rise to obtain the final temperature. Some students were not awarded the final mark as they omitted to comment on how the final answer calculated related to the risk in eating the meat.

Question 13
This question attempted to link the effect of resonance from unit 5 with standing waves from unit 2. However, many students failed to make this connection.
(a) Most students knew the basic conditions for resonance, although students' use of language often let them down in answering this question. Some found it difficult to convey the concept of the people making the bridge oscillate, whereas others repeated what was already given in the question instead of explaining why the amplitude is large.
(b) A large number of students thought that this was a simple application of the GCSE equation distance = speed × time. Only a minority of students realised that a standing wave had been set up on the bridge. Even amongst these students the relationship between the length of the bridge and the wavelength of the wave under the conditions described was sometimes wrongly applied.

Question 14
This question required students to link together a number of methods used by astronomers in determining distances to galaxies and what this information reveals about the universe.
(a)(i) The use of the standard candle has been tested in a number of previous series. Most students were able to give the basics of the method, although it was common for students to omit to clarify that astronomers must measure the radiation flux received at the Earth. Similarly, some students confused luminosity and brightness. There were some responses that indicated that students thought that the question was referring to real candles.

(a)(ii) Many students referred back to a previous mark scheme in which dust had been responsible for an inaccurate determination of the distance to galaxies.
(b) Responses to this question would suggest that this is very poorly understood. More students than expected made no attempt to answer the question. Of the ones who made an attempt, many managed to score marking point 1 but some omitted to say what they were using the equation for and so were not awarded the mark. Many who had the idea of recession omitted to say that the nebulae were receding from the Earth, and a number of students started with the Hubble equation $v = Hd$ thinking that Hubble knew values for H and d and so could find v. It was unusual to be able to award a mark for marking point 4. A few students said that all galaxies are moving away, but then missed out that galaxies were moving away from each other.

Question 15

It was again the case that a small number of students attempted to use the equation $pV = n\mathrm{R}T$. Although this approach could have scored full marks, it usually resulted in less marks, as students did not use the Avogadro number to calculate N from n.
It was sometimes the case that students correctly converted temperature to kelvin in part (a), but then left temperatures in Celsius for part (b). However, an incorrect temperature conversion was only penalised once [either in (a) or (b)].
(a) Most students were able to use $pV = N\mathrm{k}T$ correctly, although they sometimes had a power of 10 error in their final answer. Occasionally a substitution of the wrong value of k was seen.
(b) Students seemed reluctant to use the fact that the ratio of pressures is equal to the ratio of the kelvin temperatures. Nonetheless, using the equation pV = NkT twice often resulted in the correct answer.
(c) This question was poorly answered in general. The most common way for students to gain a mark was by stating the first marking point, but a considerable number were not awarded anything for the first marking point as a result of omitting any reference to mean or average. Another common error was to refer to particles rather than molecules or atoms. Despite referring to the rate of change of collisions and gaining the second marking point, many did not then go on to discuss the rate of change of momentum to gain the third marking point. Answers were often vague about where collisions were taking place, with many students believing that it was the collisions between molecules that caused the pressure. It was common for students to omit any reference to force and hence miss out on the fourth marking point. Those students who did refer to force often omitted to say what the force acted upon. Some students did not realise that the question requires an answer based on kinetic theory, which would tend to indicate that they hadn't seen previous mark schemes for similar questions.

Question 16

This question was not so well answered on average, with a number of students leaving whole parts of the question blank in the answer booklet.
(a) This question caused consternation for some students who thought that they needed to be provided with a value for the mass of the Earth. In fact, GM is a constant in this question, and so it will cancel. Students seemed reluctant to use a ratio method, and so many tried to remember a mass for the Earth, or used the field strength equation twice. Either method could provide full marks if carried out correctly. Unfortunately some students left this blank, or substituted into the field strength equation but ignored M.
(b) This is quite a standard derivation, and many students carried it out without

difficulty. Sometimes some of the intermediate steps were hidden in the algebra, which is not a problem as long as the final answer is correct. A common error was to substitute the radius of the earth rather than the distance of the satellite from the centre of the Earth. Those students using a value of g from part (a) that rounded to 8 N kg^{-1} could gain all 4 marks, although students should be aware that if they calculate a value that does not round to the "show that" value given in (a), then they should use the "show that" value in this part of the question.
(c) This question required students to be quite specific about the changes that they would need to make to the orbit. Often students made vague statements such as "the orbital time must be greater" (rather than "the orbital time must be 24 hours") or "the angle to the equatorial plane must be decreased" (rather than "the orbit must be in the equatorial plane"). Where students can reasonably give detail, then they must do so to be awarded marks.

Question 17
This question reinforced the need for students to look carefully at any numerical and graphical data they are provided with.
(a)(i) Most students were aware that the positioning of the peak around the visible wavelength range was a key factor. However, there were many unclear descriptions of this, with students struggling to convey the idea that the maximum of the intensity curve is in the middle of the visible region of the spectrum. A straight forward way to do this would have been to make reference to λ_{max}. Many students referred to the maximum wavelength, which did not gain a mark. Students should be aware that λ_{max} does not represent the maximum wavelength.
(a)(ii) The majority of students who did not gain the mark recognised that Wein's law is the relevant Physics but they were often unable to express themselves well enough to be awarded the mark. A large number of students thought that the temperature is higher because the peak is higher, effectively mixing up Stefan's law and Wien's law.
(a)(iii) This question was not answered well, because students gave answers that were far too vague. A number of students seemed unsure as to the parts that Wien's and Stefan's laws play in interpreting the graphical data.
(b) This was answered reasonably well by a majority of students, who identified that we must be able to determine the star's luminosity and temperature. Not all of these students went on to refer to Stefan's law. Some students tried to refer to a Hertzsprung-Russell diagram, but they often did so in such vague terms that it was not possible to award marking point 3.
(c) This is a fairly standard question that students should be able to answer without too much difficulty. Many students used a diagram to help them describe the procedure, although these were sometimes poorly drawn and lacking in appropriate annotation. Interestingly a fair number of students who opted to use words and no diagram were able to score 3 or 4 marks here.

Question 18
(a) This was well answered, with nearly all students being able to balance the nuclear equation. However, some students forgot that the beta-particle has a proton number of −1, and some who remembered this struggled to make the proton numbers balance on either side of the equation.
(b)(i) Most answers correctly focused on the activity or number of unstable nuclei falling to half of the starting value, but then didn't get the mark as they omitted to state that it is the mean/average time taken for this to happen. A small number of students referred to the time taken for the mass of the sample to fall to half of its

starting value, or simply omitted any reference to what was decaying. Even if such answers had included the idea of mean/average time, then they would not have gained the mark.

(b)(ii) The most able students were able to score full marks here. Most were able to determine the decay constant from the half-life and then go on to use the exponential equation. Some students used the "show that value" for the decay constant, which allowed them to access 2 out of 4 marks. Some students stopped after their calculation of the decay constant.

(b)(iii) This was a very straighforward calculation, and the vast majority of students were awarded full marks. However, some students forgot to square the speed of light in their calculation, and others tried to apply a spurious conversion to a correct answer.

(c) The most accessible mark here was for reference to an increased activity or count rate from the presence of bismuth in the plant. However, most students were preoccupied with the fact that the bismuth has a shorter half-life than lead which usually led them to a conclusion that the activity will be reduced. It was rare to award marking point 2, as most students seemed to be unaware that alpha-particles from within the plant would not be detected by an external detector.

(d) Those students who knew about the mechanism of fission realised that a material that would absorb neutrons would have a restraining effect on the rate of fission. However, some students seemed to think that the absorption of neutrons by the hafnium would increase the rate of fusion. It is clear from the answers seen that many students have not advanced their knowledge of fission much beyond that included in a GCSE specification.

(e) This question required students to make a comparison between fission and fusion reactors, and then to identify the issues connected with a practical fusion reactor. However, in answering the first part of the question many students made statements about either fission or fusion reactors, and hence did not make the comparison that was required by the question. In answering the second part of the question many students focused on the reasons for the extreme conditions rather than the issues associated with coping with the extreme conditions. Many students reproduced a mark scheme answer for a different question that had been set in a previous paper, and so could not be awarded marks.

Summary

Based on their performance, candidates are offered the following advice:

- Ensure they have a thorough knowledge of the physics for this unit.
- Read the question and answer what is being asked.
- Make a note of the marks for descriptive questions and include that number of different Physics points.
- Show all their workings in calculations.
- Try to base the answer for descriptive questions around a specific equation which is quoted.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
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