Examiners' Report
Principal Examiner Feedback

January 2018

Pearson Edexcel International Advanced Level
Physics (WPH05)
Unit 5: Physics from Creation to Collapse

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General Introduction

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 assessment unit, synoptic elements are incorporated into this paper. There is overlap with circular motion and exponential variation in Unit 4, but also overlap with some of the AS content from Units 1 and 2.

This paper gave learners 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. However, marks for questions Q12b, Q13, Q14c, and Q16 tended to be clustered at the lower end of the scale.

Calculation and 'show that' questions gave learners an opportunity to demonstrate their problem-solving skills to good effect. Some very good responses were seen for such questions, with accurate solutions which were clearly set out. Occasionally learners made a unit error. This was usually by omitting the unit, but was sometimes due to the addition of a unit for a dimensionless quantity as in Q17bii.

Learners understood the convention that in the "show that" questions it was necessary to give the final answer to at least one more significant figure than the value quoted in the question. Not all learners recognised the importance of showing all stages in their working in this type of question.

The use of imprecise language in questions such as Q12b, Q13a, Q14c and Q16 meant that learners who had knowledge of the topic, did not express it accurately. Equally there was evidence of correct physics not gaining credit because it didn't answer the question. This was particularly apparent in Q13b, and Q14c. Learners could most improve by ensuring they describe all aspects in sufficient detail and always use appropriate specialist terminology when giving descriptive answers.

The space allowed for responses was usually sufficient. Learners should be encouraged to consider the number of marks available for a question, and use this to inform their response. Learners needing more space or wanting to replace an answer with a different one, should indicate clearly where the response is to be found.

Section A – Multiple Choice

The response to the multiple-choice questions was acceptable, with correct responses being selected by at least 50% of learners for all 10 questions. However, the percentage of learners selecting the correct response did vary across the range of multiple choice questions. In order of highest percentage correct they were Q8 (88%), Q1 (81%), Q5 (80%), Q9 (67%), Q10 (62%), Q2 and Q6 (59%), Q3 and Q4 (58%), and Q7 (55%). Grade 'A' learners scored well on each of the multiple-choice items, with over 90% correct answers for 7 out of 10 of these items for such learners.

Learners should be encouraged to work with mark schemes in preparation for their exam. However, it is important that they understand that mark schemes are written for examiners, and so sometimes refer to what examiners expect to see rather than giving a complete answer.

Question	Correct responses for question (%)
1	81%
2	59%
3	58%
4	58%
5	80%
6	59%
7	55%
8	88%
9	67%
10	62%

Section B

Question 11:

Most learners realised that they were required to use the Doppler equation to calculate the velocity of the galaxy. A common error was to mix up the two wavelengths, so that the wavelength of the line in the spectrum of light received from the distant galaxy was substituted into the equation, rather than the wavelength of the line in the spectrum of light from the laboratory source. Only a minority of learners remembered that they were determining the velocity of the distant galaxy, and so MP3 was only rarely awarded.

Question 12:

(a) This calculation was well answered by most learners. Some learners used the equation $pV = NkT$ to calculate a value for *N* and then substituted back into this equation to calculate the new volume. Other learners realised that since *N* is constant, they could use $\frac{pV}{T} = \text{a constant}$. Either method could score full marks. Some learners either forgot to convert the temperature into kelvin, or ignored the temperature variation completely.

(b) Overall the responses seen to this question were disappointing. Only a minority of learners recognised that it would take some time for the air in the bubble to come to thermal equilibrium with the surrounding water. Many responses were seen that referred to energy being transferred to the surroundings. Such responses were too vague, and needed to be linked to temperature differences for credit to be given. Another common response, was to state that air is not an ideal gas. Under the conditions specified in the question air exhibits ideal gas behaviour, and so no marks were awarded for such responses.

Question 13:

(a) This question assesses what should straightforward material from the specification, but with a slightly different twist from other questions that have been set on this topic. Disappointingly there was evidence of poorly learned mark schemes from questions on previous papers, and a lack of precision in the language used. It is to be expected that at this level learners should know that it is the interaction between nuclei that is important. However, there were frequent references to molecules or particles seen. A number of learners understood the need to use magnetic fields to confine the plasma, but many either repeated this from the stem of the question or referred to the need for strong magnetic fields. It was expected that learners would recognise the extreme conditions and qualify their statement by referring to very strong magnetic fields.

(b) In answering this question many learners ignored the instruction to "explain, using the graph", and hence many responses focused on binding energy changes. In (i) is was common for learners to refer to the decrease mass and the increase in energy without reference to the equation $\Delta E = c^2 \Delta m$, or to quote this equation without explaining how mass and energy changes are related. In (ii) MP2 was often awarded, but MP1 was not on account of the learners forgetting to refer to the graph.

Question 14:

(a) Although this should be a straightforward question, a small number of learners thought that this is a method for determining distance. Some learners thought that the luminosity and distance is known, and other learners gave specific example of how we might determine the luminosity of a standard candle.

(b)(i-ii) Most learners understood how to read the log scale on the graph. Many who could not were still able to score full marks in (ii). Those who did not score full marks in (i) often used 2.7 in their calculation, having misread the y-scale. Misreading the x-scale was less common.

(c) A number of learners thought that stellar parallax would be a suitable method. Some candles ignored the stem of the question and proceeded to describe a method involving a standard candle.

Of those who realised that the redshift of the galaxy must be determined it was very rare to see an answer showing an understanding of how the data needed for the use of the Doppler equation is obtained. Worryingly, several scripts were seen in which the learner thought that a beam of light is sent to the distant galaxy and on its return, the difference of wavelength is measured.

Question 15:

(a) This is a standard definition question which has been assessed on a number of previous papers, and most learners are clear in their statements that a reference to the equilibrium position is required. However, the majority of learners tripped up by not referring to the equilibrium position for both the displacement and the direction of the acceleration/force.

(b)(i) This was well done, although occasionally learners did not quote their answer to at least 2 significant figures in (i).

(b)(ii) In this part, a number of learners wrote down the equation $v = -A\,\omega \sin \omega t$ and substituted number for ω and t into the equation. Learners should know that the maximum velocity is when sin ωt = 1, giving the equation $v_{max} = (-)A\,\omega$.

(b)(iii) In this part, some well accurately sketched sine graphs were seen. Some learners drew a minus sine curve, for which partial credit could be given. Others drew a cosine graph for which no marks were awarded.

Question 16:

(a) A minority of learners were awarded the mark here. Some learners referred to the Hertzsprung-Russell diagram. Many who correctly referred to hydrogen fusion did not specify that this occurs in the core of a main sequence star.

(b) It was common for MP1 to be awarded, but not MP2. Many learners linked the very high temperature with the stars appearing to be white, but did not go on to explain that stars that look "white" are emitting all visible wavelengths of light.

(c) The responses seen from many learners gave no indication that they had thoroughly read, understood or considered the question being asked before launching into their response. Such learners often described the life cycle of a star with little attempt to make a comparison between Sirius A and Sirius B. Only the best learners could put together a reasoned argument with correct physics relevant to the question. MP4 and MP5 were awarded the least often.

Question 17:

(a) Responses to this question often scored full marks, and few were awarded less than 2 marks.

(b)(i) Most learners scored 1 mark here, as the negative sign was usually omitted. Learners should be aware that field strength is a vector quantity and so direction is important. Surprisingly a number of learners could not get either of the two expressions correct, even without considering the signs.

(b)(ii-iii) Although most learners managed to obtain the correct ratio in (ii) they were often less successful with (iii). There were too many learners that could not use the ratio from (ii) correctly. Such learners thought that $R = 7.8 \times 10^8$ and divided this by 32 or 30. A small number of learners got confused with units and calculated an answer in km but gave the unit as m.

(C) For most learners this was a straightforward application of Wien's law leading to a correct numerical answer, although some learners then went on to state a range from the electromagnetic radiation other than infra-red radiation. A minority of learners stated infra-red radiation without giving any supporting evidence. Such responses did not gain any credit.

Question 18:

(a)(i) The vast majority of learners scored full marks for this question.

(a)(ii) It was rare to see both marks awarded for this question. The most common response was that alpha particles are very ionising, although some learners were not awarded this mark on account of their answer referring to radon gas as being very ionising. Of those learners who realised that radon gas was particularly dangerous because it could be breathed in, some expressed this imprecisely by stating that alpha particles could be breathed in.

(b) This question was generally well answered. Those who did not score 3 marks often did the calculation correctly then attempted to subtract a mass for the radon. Some learners attempted to use 931MeV = 1u, usually unsuccessfully.

(c)(i -ii) The mean mark for these two items was just over 4, and more than half the responses seen were awarded full marks. In general (i) was very well done but learners tended to make errors when taking logs in (ii).

(c)(iii) Responses to this question usually gained no credit. The vast majority of learners failed to appreciate that the number of households and the level of risk both contribute to the deaths caused by exposure to radon gas.

(d) Although some learners appreciated that the decay products would be radioactive, it was more common to see responses in which experimental procedure had a role to play. The most common response of this type to be credited was for a reference to background radiation, although some learners did not make it clear that the count rate had to be corrected by subtracting the background count rate from the measured count rate.

Summary

Based on their performance on this paper, learners are offered the following advice:

- Ensure they have a thorough knowledge of the physics for this unit.
- Read the question carefully and answer what is asked.
- For descriptive questions, take note of the marks available and include that number of different physics points.
- In ‘show that’ questions include all substitutions and all stages in the working.
- Show all their workings in calculations.

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