Examiners' Report
Principal Examiner Feedback

January 2022

Pearson Edexcel International Advanced Level
In Physics (WPH15) Paper 01

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Introduction

The assessment structure of WPH15 mirrors that of WPH14. It consists of 10 multiple choice questions, a number of short answer questions and some longer, less structured questions. As it is 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.

The paper includes the use of specific command words as detailed in the specification, Appendix 9: Taxonomy. It is recommended that centres ensure that their students understand what is required when responding to such questions. In this paper where the command word was deduced, evaluated, or assessed, the final mark could sometimes not be awarded on otherwise good responses because a final appropriate comment was missing.

Some of the questions on this paper required candidates to analyse graphical data to inform their response. This was often done incompletely, and sometimes ignored completely. Candidates should be aware that the context of the physics in which the question is set and all supplementary information provided are essential for a complete response that could gain full marks. Candidates should be encouraged to read questions carefully to ensure that their responses take into account all the relevant information.

The space allowed for responses was usually sufficient. Candidates should be encouraged to consider the number of marks available for a question, and to use this to inform their response. If candidates either need more space or want to replace an answer, they should indicate clearly where that response is to be found.

Candidates 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.

SECTION A: Multiple Choice Questions

In general candidates' performance in this section of the paper was similar to candidates' performance in previous series.

In Q7 the correct answer key is the factor that would **not** affect the student's value for the background count rate. In this type of question, it is important that candidates read the responses carefully, as it is possible to forget that the correct statement to choose is the one that does **not** affect the background rate.

Q8 relied upon candidates being able to deal with ratios confidently. This is a skill that candidates often struggle with.

In Q9 candidates had to understand that there is no change in the wavelengths that are emitted, but the radiation is detected with wavelengths that are longer than expected.

In Q10 the distractors may express correct physics, although the statements cannot be deduced from the graph.

SECTION B

Q11

This question assessed candidates' ability to interpret information presented to them graphically, and to represent this information by drawing a sketch graph. Most candidates realised that the required response was a sinusoidal graph, and many added a value for the amplitude to the displacement axis of their graph. Disappointingly, most candidates did not realise that they were expected to calculate the period and show a value for this on the time axis of their sketch graph. Of those candidates who realised that they could calculate a value for T, most performed this calculation correctly.

Q12

Many candidates scored marks for the use of the specific heat capacity and specific latent heat equations. However, a sizeable number of candidates did not seem to have understood the energy transfer that was required to take place, leading to incorrect comparisons of energy. As this question is really about energy conservation, those candidates who started with an energy transfer equation in their heads were more likely to make a valid comparison.

Common errors that were seen were included mixing up the specific heat capacity values. Adding specific heat capacity values or using incorrect masses.

Q13a

This question was generally done well. Some candidates realised that N was constant and so they could use pV/T = a constant to obtain the answer.

Many candidates explicitly calculated N using $pV = NkT$, and then used their value of N in this equation again to obtain the final answer. When using this method, the wrong value of k was sometimes used. A few candidates tried to use $pV = nRT$, although a value for R is not provided for this unit.

Some candidates forgot to convert temperature into kelvin. Others did not take temperature into account at all, and so tried to use pV = a constant to calculate a value for V.

Q13b

This was not as well attempted as part (a). Often candidates calculated an energy but not necessarily an energy *change*.

Q14

Despite two graphs being given to candidates in this question, many candidates made little attempt to take any meaningful information from these. It was relatively common for candidates to read an energy value from the first graph. However, many candidates read the most common energy rather than the maximum energy. Those candidates who did attempt to read the correct energy often did so incorrectly, rounding their value to 5.5 MeV.

The second graph was often read in reverse, if at all. Many candidates selected a random range, few tried to link the range with the energy that they had obtained from the first graph. Some candidates struggled to interpret the log scales, which possibly led some candidates into selecting a point on the line for which the co-ordinates were easily read. Quite a few candidates tried to find a gradient of the log graph.

Lots of candidates calculated some variation of 250 × 15.6 eV but did nothing meaningful with their calculated value. Some words to describe what is actually being calculated might have helped some candidates to be awarded marks, as multiplying the two numbers given in the question is quite a random calculation without any explanation.

Candidates who were struggling with how to approach the question often converted between units (cm to m, or eV to J) with no actual calculation.

Q15

Most candidates correctly read a wavelength from the graph and used this value in Wien's Law. Very rarely the maximum value of the wavelength axis was use, but 450 nm was the most common wavelength value seen. There were occasional calculation errors, with some candidates mistaking nm for μm.

Stefan's Law was generally applied correctly. Occasionally the area calculation used πr^2 rather than $4\pi r^2$. Candidates who missed out on the final mark despite having carried out all the calculations correctly often did so by comparing r with d or not making a comparison at all.

Unfortunately, it was not uncommon to see the solar radius being used to calculate a luminosity to compare with the quoted value. A significant number of responses attempted to apply the inverse square law.

Q16ai

This question was poorly understood by the vast majority of candidates. A handful of responses were seen in which it was clear that the candidate had understood the distribution of mass within the galaxy, but most responses that attempted to use the equation asserted that GM is a constant. Many candidates who didn't understand the question tended to describe the graph, rather than explain it

Q16aii

Dark matter was often identified, though occasionally dark energy was quoted. The identification of more mass or force was less common. The Doppler effect was often referred to by candidates who were unsure how to interpret the graph.

Q16b

Some candidates identified dark matter for the first time here, but without stating that the amount was uncertain. Many candidates came close to scoring a mark by discussing ideas of a closed universe and critical density but without stating what the required relationship actually is. Some candidates thought that the value of the critical density is uncertain. A discussion of redshift and Hubble's law was commonly seen in responses that did not gain any credit.

Q17a

Many candidates had little idea how to answer this question. It was common to see references to Faraday's law and Lenz's law. A discussion of forced oscillations and resonance was also relatively common as a response to this question.

Other weak responses often included a discussion based on an interaction between the electric field and the magnet. Force on the coil was identified fairly often, but many candidates went on to state that this changed without saying it changed direction.

Q17bi

The first two marking points were seen frequently. It was much rarer to see a correct final answer, as most candidates missed the factor of a half and used 3.5 mm for the amplitude.

Some candidates tried to apply a sin ωt term without realising this could simply set to 1.

Q17bii

This was well answered.

Q17c

It was quite common for full marks to be awarded to candidates who mentioned all 3 marking points. However, a number of candidates made little reference to the context of the question and gave a response that was quite general.

Q18a

This was a straightforward calculation for most candidates. However, some candidates missed out on full marks due to truncation errors or rounding to too few significant figures.

Q18b

Most candidates followed the instruction to apply Newton's law of gravitation, and such responses usually scored full marks. Sometimes responses ran out of steam after scoring the first marking point. A minority of responses ignored the instruction given and tried to answer the question by making referencing to Kepler's law.

Q18c

This should have been straightforward but calculation errors such as omitting powers or square roots were seen too often. Despite the question stating that the value of K was not the same as that for planets orbiting the Sun, some candidates used their value of K from a previous part of the question.

As the time period of Ganymede was given in hours, it was expected that candidates would give their answer in hours also. Lots of candidates converted the time period from hours to seconds. Although this was generally done correctly, it was unnecessary in this question.

Q19a

This question was generally well answered, although candidates occasionally missed out on the final mark by not making a comparison and comment. The most common errors were inverting the sides for the trig calculation, or attempting to calculate the radius of the Earth's orbit about the Sun at the quoted distance. Some candidates had calculators set to degrees and then got an answer they did not understand.

Q19b

Most candidates were able to state that a standard candle has a known luminosity. Some went into unnecessary detail in describing how luminosity could be determined for a Cepheid variable star.

A reluctance to define symbols meant that candidates who quoted the equation relating intensity and distance often missed out on the third marking point.

Some candidates were unsure whether the luminosity or the intensity of the candle is known. Some candidates stated that both are known, obscuring the important information that intensity is only known because it is measured on the Earth.

Q19ci

It was surprising that the mark for labelling the axis was not awarded more often. Most responses had some sort of reverse log range for the scale. The low end of the range was problematic for many, sometimes going as low as a few hundred K. 6000K was often absent of in the wrong place.

Quite a few candidates had left this blank, suggesting that they had not read the question carefully.

Q19cii

This should have been a straightforward question. Most candidates scored at least 1 mark here, and many got all 3 marks.

Q19ciii

Some candidates appear to have a good understanding of the basic steps in low mass stellar evolution, but they were often unable to discuss processes in the level of detail expected at Advanced level. There was quite a lot of discussion of either supernovae or the formation of planetary nebula, and quite a lot of candidates stated that the star's mass increases as it evolves to a red giant. The most comment indicative content points seen were IC1, IC3 and IC6.

Q20a

Most candidates scored 2 marks on this question. However, in some responses the proton and nucleon numbers were confused, and in others the numbers appropriate for a beta particle were used.

Q20b

This question was often down well, although some candidates forgot that this was a 'show that'. Truncation and rounding errors were seen in some responses, and some candidates used the mass of a proton rather than the value for the atomic mass unit.

A few candidates calculated the energy in J and then converted 930 MeV to J to compare.

Q20c

Only the best candidates seemed to have much idea how to do this beyond the first marking point. Surprisingly many candidates ignored the calculation that they had carried out in (b) and proceeded to repeat the steps that they had carried out in (b) to calculate the energy released in the decay. Having done this they often went no further, thinking that they had answered the question completely.

For those candidates who went beyond calculating the total energy released, the first alternative in the mark scheme was seen most often in candidates; responses. The second alternative was used well by candidates who were confident in mathematics. However, many of these candidates were limited to 3 marks, as they often didn't make a conclusion.

Q20d

Most candidates made a good attempt at this. The method suggested in the mark scheme was often seen. An equally valid alternative was to use the exponential decay equation to calculate the activity after 7 days and then calculate a value for the number of unstable nuclei. However, quite a few candidates who followed this method thought that they had finished when they had calculated the new activity.

In this question it was possible to calculate the decay constant in units of day^{-1} and to use this with a time in days when applying the exponential equation. However, when using the equation $A = -\lambda N$, A will only have units of Bq if λ has units of s^{-1}. A number of candidates forgot this, and so obtained an incorrect final answer.

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