Examiners' Report
Principal Examiner Feedback

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Pearson Edexcel International Advanced Level in Physics (WPH15)
Paper 01 Thermodynamics, Radiation, Oscillations and Cosmology

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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 question in which 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.

Candidates should be encouraged to read questions carefully to ensure that their responses take into account all the relevant information.

Section B questions are set in context. 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 work with mark schemes in preparation for their exam. However, it is important that they understand that mark schemes do not provide model answers to questions. 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. The mean mark for this section was 7 out of 10, with only Q6 and Q8 having a facility less than 0.7

Q6 required candidates to select a ratio of molecular masses. The use of ratios often provides an extra level of challenge.

Q8 was based on the oscillation of a simple pendulum with damping. This may be a scenario that candidates were not familiar with.

SECTION B: Extended Response Questions

Q11

This was a straightforward introduction to the section B questions, with the majority of responses seen scoring full marks. Those responses that did not score full marks tended to stop after calculating the total mass, forgetting that we question required the added mass. Most solutions used the mass-spring period expression twice. First to calculate k, and then to calculate the total mass. Few responses used a ratio method.

Q12

The majority of responses read a pair of values from the graph and substituted into the gravitational potential expression to obtain a correct value for the mass. The calculated value is 5.997×10^{24} kg, which many candidates gave as their answer, scoring full marks. However, 6.0×10^{24} kg or 6.00×10^{24} kg are the correct 2 sf or 3 sf answers, not 5.9×10^{24} kg or 5.99×10^{24} kg.

Q13

(a) This was very well answered. Most gave their final answer as a percentage, with a % symbol. About half used powers in the efficiency equation and the other half used energies. In a small fraction of responses wasted power (energy) rather than useful power (energy) was used in the efficiency equation.

(b) In general this was poorly answered, with the most common mark awarded being MP2 (less energy transfer to the surroundings). Surprisingly few responses made any mention of the steam, and the idea that steam returns energy as it condenses at the lid was hardly seen at all.

Q14

(a) This is a question format that has been used a number of times before, and most candidates were able to work through each step to obtain a correct final answer.

(b) This involved a straightforward calculation, which was completed successfully by most. The final mark for a comparison of values and a consistent conclusion was the marking point most likely to be missed.

A typical response that did not score MP3 was "The ratio of the field strengths is 27.7, so the claim is correct", whereas a response gaining MP3 would state "The ratio of the field strengths is 27.7 which is approximately equal to 28, so the claim is correct".

A few misunderstood the question, and calculated the gravitational field strength at the position of the Earth due to the Sun and compared it with the gravitational field strength at the surface of the Sun, due to the Sun.

Q15

The mean mark for this question was quite low, although some encouraging responses were seen. The main ways in which candidates did not meet the criteria for an IC point

were by omitting important detail. For example, in some responses candidates repeated "large swaying motion", when "large amplitude of oscillation" was required. As this is an example of resonance it is important to be clear what is driving/forcing, and what is being drive/forced. Similarly, when referring to the dampers it needed to be clear that energy was being transferred from the bridge to the dampers. It was encouraging that fewer blank scripts were seen for this item than is sometimes the case for a linkage question.

Q16(a)
Surprisingly almost a quarter of responses seen did not score this mark. This is a standard definition that candidates should learn.

Q16(b)
A fair proportion of responses score all 6 marks for this question. Although errors were seen in (ii) by rearranging the equation, forgetting to take the square root, or more rarely forgetting to give a unit, most responses scored full marks.

A common way not to score full marks in (i) was either to use only 1 cycle to determine the period, or to mis-read the scale on the log plot. Candidates should be familiar with reading values from logarithmic graph scales. Some odd responses were seen in which it was attempted to find the gradient of a tangent to the log graph. In addition, mathematical contortions to try to manipulate the figures to get the show that value were also seen.

Q17(a)
Responses seen were disappointing, with more than half of responses scoring just a single mark or less. The key wording in the question that was missed by many candidates is "explain how the graph shows". Many responses just reproduced a leaned definition of simple harmonic motion, without any reference to the graph. The mark scheme allowed such responses to gain some credit, but for full credit it had to be clear in the candidate's response that the statements made related to the graph provided.

Q17(b)(i)
There were many correct methods seen that led to a correct value for the energy. Not all of these methods are included in the published mark scheme, although all correct methods were given appropriate credit. About half the responses seen score full marks, although a significant minority read the maximum value of acceleration as 0.8 ms^{-2} instead of 0.7 ms^{-2}. These responses missed out on the final mark.

Q17(b)(ii)
Just less than half the responses seen scored full marks for this question. It was expected that some candidates would draw a parabola inverted with respect to the correct graph. However, it was surprisingly that so many responses drew sinusoidal or linear variations in energy, with some including negative as well as positive energy values.

Q18(a)
Responses to this question were very disappointing, This may be due to the question being synoptic and based on specification content from unit 2. In the vast majority of responses seen there was very little evidence that this process is understood. Even those that had some idea that it is to do with transitions between energy levels were not able to describe the mechanism with sufficient clarity or detail.

Candidates should be aware that some questions on both WPH14 and WPH15 will be synoptic in nature and assess work from previous units.

Q18(b)
This was generally well answered in terms of the main processes, although few candidates scored all 5 marks. In the question it states that there is "a difference between the wavelengths of radiation from opposite ends of the Sun rotating about its axis". This was interpreted by most candidates as a Doppler shift equal to the difference in the two wavelengths. In fact there is a Doppler shift at each edge, and so the wavelength difference stated in the question is twice the magnitude of the Doppler shift. This meant that many candidates who understood all the main processes missed out on MP5.

Q19(a)
This was answered well by most candidates. Occasionally the value used for k was the Coulomb constant rather than the Boltzmann constant.

Q19(b)
Responses to this question were generally good. Some candidates were not able to convert between ^{o}C and K for the comparison. Sometimes the conclusion lacked a comparison and so was incomplete.

Q19(c)(i)
Most candidates scored full marks on this question. A few candidates didn't perform a correct conversion from nm to m, and a small number of candidates forgot to raise the temperature to the power 4.

Q19(c)(ii)
It is clear that the vast majority of candidates do not know that there is a difference between real hot radiating bodies and a theoretical black body. A few responses stated that the filament is not a perfect black body radiator, some referred to energy absorbed by the glass of the bulb. Most candidates simply stated that energy was transferred to the surroundings, which doesn't make sense in this context. Less than 10% of the response seen scored a mark for this question,

Q20(a)

This was a well answered question, with the vast majority of candidates scoring full marks. Those candidates who did not score full marks tended to use an incorrect temperature difference, or use the correct temperature difference but then add 273 to it.

Q20(b)

Although the first three MP were frequently seen, only a minority of candidates were able to score full marks. Few candidates included words to indicate what they were doing, and calculations were often quite randomly positioned in the solution. This may indicate a lack of a logical thought process in working through the problem.

Q21(a)(i)

It was common for 1 mark to be scored, but less common for both marks to be scored. The knowledge required to answer the question is little more than higher level GCSE. The issue for many candidates was the vague way in which the absorption of beta radiation was related to the thickness of the paper.

Q21(a)(ii)

Most candidates scored full marks on this question. Only a very small number of candidates did not know the values of A and Z for a beta particle. A small minority had difficulty in balancing the bottom line of the equation, subtracting 1 from the proton number of SM, rather than adding 1.

Q21(a)(ii)

This should have been a straightforward calculation, although less than half scored all 4 marks. The problem for most candidates who did not score full marks was 0.75%. It was relatively common for this to be mistaken for 75%, with $A = 0.75A_0$ rather than $A = 0.0075A_0$ being substituted into the exponential equation.

Q21(b)

This question was not well answered. This may be because it was the last question on the paper. Maybe it was because candidates were asked to calculate the binding energy of a nucleus, whereas in previous series they have been asked to calculated the energy released in a decay. Although most candidates knew that they would need to use the mass-energy equation and also to do a division by 1.60×10^{-19}, reaching these stages with the correct value of Δm proved impossible for many. Sometimes candidates who had calculated the correct value of Δm retained too few significant figures in intermediate values and ended up with an inaccurate final answer.

Paper Summary

Based on their performance on this paper, candidates should:

- ensure they have a thorough knowledge of the physics for this unit,
- read the question carefully and answer what is asked,
- formulate a response that is consistent with the command word used in the question,
- be particularly careful to use appropriate scientific terminology in questions which ask for a description or explanation,
- include all substitutions and all stages in the working in 'show that' questions.