



A-LEVEL PHYSICS

7408/3BA: Paper 3B Astrophysics
Report on the Examination

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General Comments

The Astrophysics paper consisted of questions designed to assess knowledge and understanding across the usual range of topics. The style of questions was similar to those set in previous years, with opportunities to demonstrate a range of skills including recall, straightforward tasks and application of knowledge and understanding. There were opportunities to show mathematical skills in several contexts and many students excelled in this. Many students had difficulty with questions testing Assessment Objective 3 where they are tested on their ability to reason and form a judgement. There was a full range of marks, with some good answers given to all questions.

Question 1

This question tested knowledge about telescopes.

- 1.1 Just under 50% of students scored the mark. Rays were often poorly drawn (a ruler is recommended), or colours were incorrectly labelled or unlabelled.
- 1.2 Most students knew the mirrors used in a Cassegrain telescope.
- 1.3 This question was the most discriminating, with the full range of marks seen. Only a small percentage of students scored no marks. Most students could describe the structure of both types of telescope and positioning was also often well discussed. Some made no distinction between the two telescopes in terms of positioning and structure; for example, they planned to put both telescopes in space. It was common to find students who did not distinguish between nm and mm and so thought telescope B was better because it could access a wider range of wavelengths. There was no direct mention of a need for calculations in the question. It is not possible to discuss the detail of an image without calculations of resolution, but many students did not offer this. Many students failed to gain marks because they answered a different question from that asked. Some discussed radio and optical telescopes in general, so, for example, planned to put a telescope in space despite its 40m diameter. There was much discussion of putting radio telescopes in arrays which again is not relevant to this telescope. Students need to read the question carefully and decide what they need to do to answer it.

Question 2

This question was about the properties of stars.

- 2.1 Few students gained full marks on this question, though many scored at least one mark. The main reason for many students failing to gain marks was that they were not familiar with the Hipparcos scale. There were also some students who did not know the magnitude scale so thought the larger numbers were brighter. Also, a surprisingly large number of students thought that the two stars of similar magnitude would blend into one.
- 2.2 Most students had learnt about the absorption lines found in the different spectral classes and most students chose the right star. Few, however, were clear about the reason why B-class stars produce Balmer lines.
- 2.3 This question scored the full range of marks, with some very well-argued answers. Many students were able to state that the two stars had similar temperatures due to being the

same spectral class. Some students used the $m = M - 5 \log \frac{d}{10}$ equation to work out d , thinking this was the diameter of the star. There were issues with statements about absolute and apparent magnitude. It is difficult to describe this due to the reverse nature of the scale, so students should take care to express themselves clearly. A brighter magnitude takes a smaller (more negative) value.

- 2.4 There were some students who gave excellent answers to this question. They clearly understood the method very well. Others did not understand and, for example, wrote about the star 'wobbling'. Some students appeared to think that the light which was being studied originated on the planet. A significant number of students described (often quite well) the transit method. This is another example where careful reading of the question is important.
- 2.5 This was a well answered question, with around 70% of students scoring full marks. Common reasons for failing to gain marks included the use of natural logarithms instead of base 10 in the equation and the choice of incorrect units. The symbol for parsec is pc.

Question 3

It was surprising that marks for this question, based on an essential part of the specification, were not higher.

- 3.1 Less than 30% of students scored this mark. The most common reason for not being awarded the mark was assigning the positive and negative ends of the axis the wrong way around.
- 3.2 Almost all students placed the Sun correctly on the absolute magnitude scale but many could not recall the correct temperature.
- 3.3 Most students knew what the future holds for a Sun-like star, but few showed correctly what happened before it joined the main sequence.
- 3.4 Another very well-done question, with 70% of students getting the mark.
- 3.5 Most students attempted this question and around half scored at least 2 marks. The reason for missing the third mark was either because they only considered temperature or absolute magnitude, or because they considered only one of the two objects.

Question 4

This question was about quasars and galaxies.

- 4.1 This question was answered well, with a wide variety of ways found to answer it. Those with the best understanding showed algebraically that $\frac{z}{d}$ should be constant and then showed that the data did not confirm this; this was the most elegant answer. It was more common to see two different values of H calculated and then a statement that they were not the same; this was also awarded full marks.

- 4.2 This was the most challenging question on the paper with only a few students scoring both marks and only around 20% scoring one mark. Many students talked about how bright quasars are, though the relevant point here is that they are very dim when observed from Earth. The most effective answers referred to the accelerating expansion of the universe meaning that Hubble is not valid at those distances.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the [Results Statistics](#) page of the AQA Website.