A-LEVEL
PHYSICS

7408/3BA Astrophysics
Report on the Examination

7408
Autumn 2021

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General Introduction to the Autumn Series

This has been another unusual exam series in many ways. Entry patterns have been very different from those normally seen in the summer, and students had a very different experience in preparation for these exams. It is therefore more difficult to make meaningful comparisons between the range of student responses seen in this series and those seen in a normal summer series. The smaller entry also means that there is less evidence available for examiners to comment on.

In this report, senior examiners will summarise the performance of students in this series in a way that is as helpful as possible to teachers preparing future cohorts while taking into account the unusual circumstances and limited evidence available.

Overview of Entry

As last year, this was an atypical cohort with a very few able students and many weak students, some of whom showed little sign that they had studied the Astrophysics option at all.

Comments on Individual Questions

Question 1

1.1 The H-R diagram is a familiar topic that has been tested many times. Most students could identify the main sequence but few knew the early evolution of a Sun-like star.

1.2 Theta Carinae is a very bright, class O star. Most students failed to gain the mark because they did not classify the star correctly.

1.3 Those few students who were familiar with the transit method for finding exoplanets were unlikely to link their answer to the earth-sized planet.

1.4 A few students produced an elegant answer to this question. Of those who made an attempt, a number tried to find the radius of Theta Carinae by assuming that its power output was the same as the sun.

Question 2

2.1 Only half of the students got this right. The time scale for a supernova is measured in weeks rather than hours.

2.2 Around a third of students were able to find the apparent magnitude of the supernova (this is a familiar calculation). Few were then able to go on to link this to the Hipparcos scale. Stars are only visible down to magnitude 6 even in near-perfect conditions.

Question 3

There was a full range of marks on this question. Most of those who attempted it realised that the curve was the typical black-body curve. Some went on to find the temperature of the star and to identify the star correctly. Few students could explain the origin of the dips

in the graph and that the dips are caused by hydrogen absorption by atoms in the $n = 2$ state. This was an alternative route to the identification of the star.

Question 4

4.1 This question revealed that few students understand what a quasar is. The specification refers to 'active' supermassive black holes. 'Active' means that matter is falling into the black hole; it is this which leads to energy release.

4.2 More students performed better on this question than on any other in the paper. Some students, however, lost marks through unnecessary attempts to change the unit from Mpc. This unit is usually used and is the easiest to find.

Question 5

5.1 Few students scored marks on this question though versions of it have appeared many times and it is simple recall. One of the key words is 'minimum'; this was often missed.

5.2 Over half of students scored at least one mark on this question. Some thought that water vapour absorbs ultra-violet, though it actually absorbs infra-red radiation.

5.3 Over half of students gained at least one mark on this question. Many failed to make any reference to the fact that the Arecibo telescope has spherical curvature.

Concluding Remarks

This paper was similar in difficulty to those of previous years (including 2020). Questions 1.1 and 4.2 should have been familiar to students. Question 3 approached the topic from an unusual angle, so it was pleasing that a number of students gave good answers.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.