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ASSESSMENT and QUALIFICATIONS ALLIANCE

## General Certificate of Education

# Physics 6451

*Specification A*

## PHA5/W Astrophysics

# Report on the Examination

*2007 examination - June series*

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## General Comments

The mixture of questions on this year's paper allowed candidates to show their knowledge and understanding of a wide range of subject content. There was also a balance of mathematical questions and those requiring more extended written responses. It was rare for candidates to achieve full marks on the whole paper, but all marks were accessible and individual questions were answered well.

## Question 1

In part (a), few candidates were able to give a concise statement of the meaning of the decay constant. Most candidates referred to the number of nuclei rather than the fraction or proportion of the nuclei that decay in a given time. Candidates quoted the equation for activity in terms of the number of nuclei often did not define their symbols. In describing two differences, many candidates realised that X has a shorter half life than Y and then went on to write about the differences in terms of the relative numbers of nuclei of X and Y, rather than the activity or the count rate or total count from each source. Candidates who compared their emissions often did not specify if they were comparing the total emissions or the emissions in a given time. Many answers were marred by ambiguities and repetition.

Part (b) (i), saw a good number of candidates score full marks, although a significant number of candidates did not correctly read the logarithmic scale for activity. Candidates who read the time scale for an activity of 100 Bq often made an arithmetical error in reading the time scale.

Most candidates in (b) (ii) scored both marks, although some candidates did not give the answer in days and thereby lost a relatively easy mark.

Many neat solutions were seen in (b) (iii). However, some candidates gave an unnecessarily lengthy calculation as a result of not using the value of the initial activity directly.

## Question 2

This question was generally answered very well with many candidates scoring high marks. The simple calculation in part (a) was answered well by most candidates. Problems still exist with the unit of power (dioptre) despite this appearing many times in past papers, and being referred to in the exam report. It was pleasing to see that most candidates knew which focal length to use and that even more knew the term *chromatic aberration*.

The straight-forward calculation in part (b) caused a few problems. Surprisingly, many candidates correctly calculated the initial angle, but made no attempt to go on and calculated the magnified angle. Several also decided that the telescope made the angle smaller rather than larger. It was fairly common to see answers from first principles, using trigonometrical functions, rather than small angle ideas and $s = r\theta$.

Part (c) was another opportunity for candidates to use a two-step calculation which was frequently only half done. Many candidates correctly calculated the focal length of the eyepiece without going on to calculate the length of the telescope. Several candidates also subtracted rather than added the focal lengths.

## Question 3

There were four marks available for this question, and five marking points were available. Despite this, it was rare to see anyone achieve maximum marks. In part (a), the most common error was for candidates to answer in terms of emission spectra rather than absorption. Less able candidates also tried to answer with no reference to energy levels or the formula E=hf. It was common to see answers referring to electrons or atoms being given out. Another common error was for candidates to suggest that photons were absorbed to put the hydrogen into the n=2 state, rather than from that state to higher energy states. Most candidates correctly made reference to the ‘many directions’ idea of re-emission. This is an important part of the process as, otherwise, the gaps would simply be filled by photons being re-emitted.

In part (b) (i), although it was common to see incorrect answers suggesting that these stars contain no hydrogen, most candidates seemed to understand the link with temperature correctly. Similarly, in part (b) (ii), most candidates appeared to know the key features of star spectra and this question was answered well.

**Question 4**

The Wien’s law equation is a common feature of this option. In part (a) (i), it was pleasing to see that very few candidates misinterpreted the “m” in m K to mean ‘milli’. This question was generally answered well, with only a few candidates making simple algebra errors.

In part (a) (ii), the general shape of the graph was known by most candidates, although it should be emphasised that the LHS needs to be significantly steeper than the RHS. Most candidates seemed to understand the reason for the ‘suitable scale’ question, simply labelling the peak position with the value from q (a) (i).

Part (b) was also a common calculation. Most candidates understood the difference between m and M, and manipulated the equation correctly. There was some confusion with the conversion into light years, and many candidates also made significant figure errors here.

Part (c) was a fairly demanding calculation for two marks. The best answers used Stefan’s law correctly and worked out the ratio of the two powers. There were many opportunities for errors calculating the surface area. Few answers of this kind included the $4\pi$ correctly, or converted the kilometres to metres. Again, there was evidence of candidates trying to calculate backwards as the answer was given.

**Question 5**

In part (a) (i) there was some confusion, with several candidates incorrectly stating that white dwarfs are bright. Clearly, stating that they are small and white obtained no credit. Several good answers made correct reference to the HR diagram. Although there was some attempt to explain the formation of white dwarfs, several candidates did not gain credit for this due to lack of detail, missing out the loss of the outer layers of a red-giant, or making no reference to the ‘core’.

Again, there was confusion in part (ii), with many candidates describing other astronomical phenomena such as neutron stars and supernovae. However, most candidates could state one property of quasars, commonly the large red shift or large distances. References to energy rather than power output did not get credit. Many candidates achieved maximum marks for this section by making reference to the *large power output for its size.*

The common calculation in part (b) was generally correctly done. There was some confusion with the units needed in Hubble’s law. Several candidates did not change the quasar’s velocity to km $s^{-1}$, or did not know the unit for the final distance (Mpc).

**Mark Ranges and Award of Grades**

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