| Centre Number | | | | | | Candidate Number | | | | |
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| For Examiner's Use | |
|---|---|
| Examiner's Initials | |
| Question | Mark |
| 1 | |
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| TOTAL | |

General Certificate of Education
Advanced Level Examination
June 2014

# Physics A PHYA5/2A

**Unit 5A Astrophysics**
**Section B**

Thursday 19 June 2014 9.00 am to 10.45 am

**For this paper you must have:**
- a calculator
- a ruler
- a Data and Formulae Booklet (enclosed).

**Time allowed**
- The total time for both sections of this paper is 1 hour 45 minutes. You are advised to spend approximately 50 minutes on this section.

**Instructions**
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Show all your working.

**Information**
- The marks for questions are shown in brackets.
- The maximum mark for this section is 35.
- You are expected to use a calculator where appropriate.
- A *Data and Formulae Booklet* is provided as a loose insert.
- You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

Do not write outside the box

## Section B

The maximum mark for this section is 35. You are advised to spend approximately 50 minutes on this section.

**1 (a)** Draw a ray diagram for an astronomical refracting telescope in normal adjustment. Your diagram should show the paths of **three** non-axial rays passing through both lenses. Label the principal foci of the two lenses.

**[3 marks]**

**1 (b)** The Treptow Giant Telescope in Berlin is the longest moveable refracting telescope on Earth. Some of its properties are summarised below:

distance between the objective lens and eyepiece lens = $21\,\mathrm{m}$

angular magnification = $210$

objective lens diameter = $0.68\,\mathrm{m}$

**1 (b) (i)** Calculate the focal lengths of the eyepiece lens and objective lens of the Treptow Giant Telescope.

**[2 marks]**

eyepiece lens focal length ..... m

objective lens focal length ..... m

*Do not write outside the box*

**1 (b) (ii)** Early telescopes had very small diameter objective lenses. State **two** advantages of using an astronomical telescope that has a large diameter objective lens when making observations.

**[2 marks]**

Advantage 1.....

.....

.....

Advantage 2.....

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.....

**1 (c)** The images formed by refracting telescopes can suffer from chromatic aberration.

Draw a labelled diagram to show how a converging lens causes chromatic aberration.

**[1 mark]**

**8**

*Do not write outside the box*

**2** The term Big Bang was first used in 1949 by the astronomer Fred Hoyle to refer to, what was then, a controversial theory describing the formation of the Universe.

**2 (a)** Explain what is meant by the Big Bang theory.

Your answer should include:

- a description of the main aspects of the theory
- an explanation of the different pieces of evidence that support the theory.

The quality of written communication will be assessed as part of your answer.

**[6 marks]**

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**2 (b)** A more recent discovery is the acceleration in the expansion of the Universe. Evidence for this acceleration comes from the use of type 1a supernovae as standard candles.

**2 (b) (i)** State what is meant by a standard candle.

**[1 mark]**

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**2 (b) (ii)** Explain how measurements of a type 1a supernova can be used to determine how far away it is from the Earth.

**[3 marks]**

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**3 (a)** Define the term absolute magnitude.

**[1 mark]**

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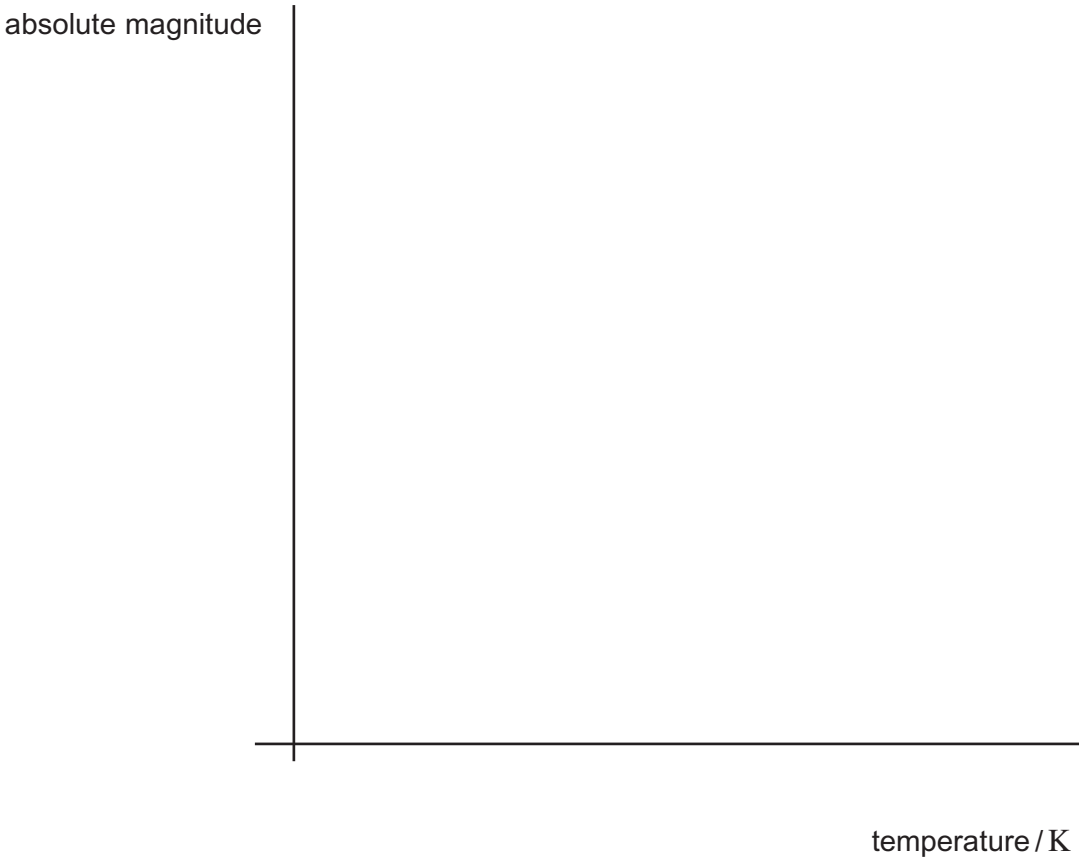
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**3 (b)** **Figure 1** shows the axes of a Hertzsprung-Russell diagram.

Mark suitable scales on the absolute magnitude and temperature axes.

**[2 marks]**

**Figure 1**



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**3 (c)** Label a possible position of each of the following stars on **Figure 1**:

**3 (c) (i)** the Sun

**[1 mark]**

**3 (c) (ii)** star W, which has the same intrinsic brightness as the Sun, but has a significantly higher temperature

**[1 mark]**

**3 (c) (iii)** star X, which has a similar spectrum to the Sun, but is significantly larger

**[1 mark]**

**3 (c) (iv)** star Y, which is significantly larger than the Sun and has prominent absorption lines of neutral atoms and titanium oxide (TiO) in its spectrum.

**[1 mark]**

**3 (d)** How does the diameter of star W, in part 3(c)(ii), compare with the diameter of the Sun? Explain your answer.

**[3 marks]**

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**Turn over for the next question**

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**4 (a)** Explain what is meant by a parsec. Draw a labelled diagram in support of your answer.

**[2 marks]**

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**4 (b)** The Hipparcos satellite used the parallax method to measure the distance to more than 100 000 stars with a precision of 0.002 arc seconds.
Calculate, in metres, the maximum distance measurable by Hipparcos.
Give your answer to an appropriate number of significant figures.

**[3 marks]**

distance ..... m

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**4 (c)** The star Alpha Capricorni is in fact two stars that appear very close together. Some data about the two stars are summarised in **Table 1**.

**Table 1**

| Star | Distance / pc | Apparent magnitude | Class |
|---|---|---|---|
| Alpha-1 capricorni | 211 | 4.3 | G |
| Alpha-2 capricorni | 33 | 3.6 | G |

**4 (c) (i)** Explain how data in the table indicate that the two stars are **not** part of a binary system.

**[1 mark]**

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**4 (c) (ii)** Explain why the angular separation of the two stars changes when observed from the Earth during a 12 month period.

**[1 mark]**

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**END OF QUESTIONS**

7

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