

Centre Number						Candidate Number				
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Other Names										
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For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
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.



J U N 1 4 P H Y A 5 2 A 0 1

WMP/Jun14/PHYA5/2A/E6

PHYA5/2A

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 m

angular magnification = 210

objective lens diameter = 0.68 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



- 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.....

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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]



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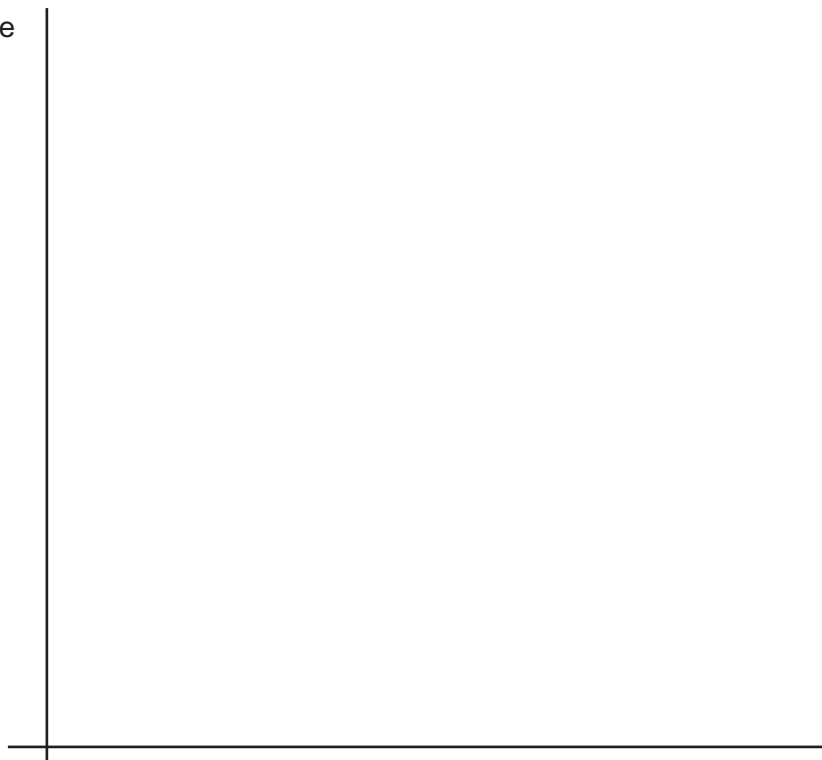
3 (b) **Figure 1** shows the axes of a Hertzsprung-Russell diagram.

Mark suitable scales on the absolute magnitude and temperature axes.

[2 marks]

Figure 1

absolute magnitude



temperature / K

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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10

Turn over for the next question

Turn over ►



- 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



- 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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