Surname	
Other Names	
Candidate Signature	

AQA

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.

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 = $21\,\text{m}$

angular magnification = 210

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

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]

8

Turn over ▶

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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Turn over ▶

3 (a) Define the term absolute magnitude.

[1 mark]

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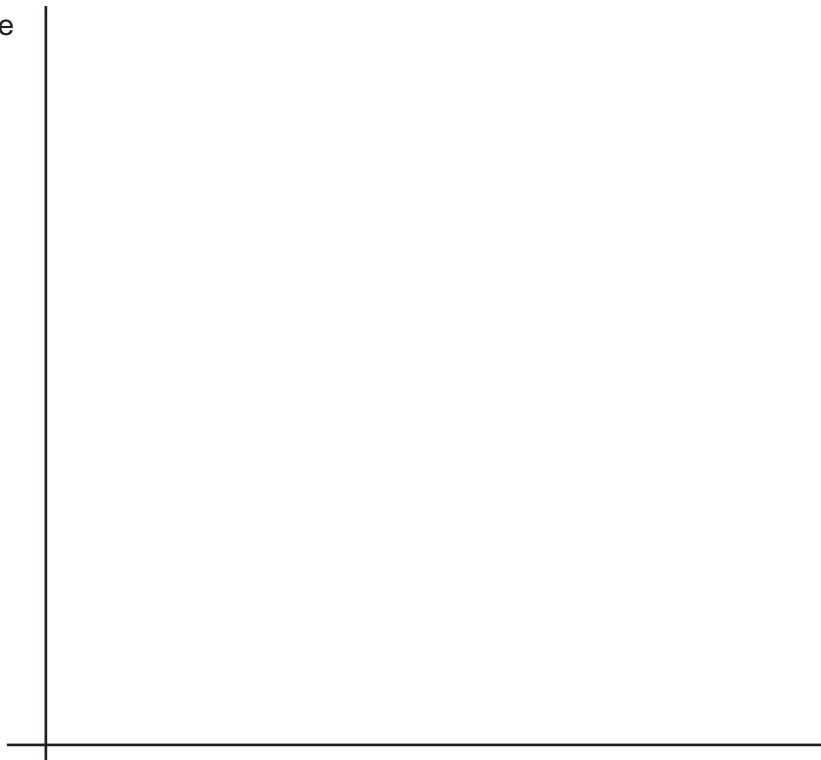...

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

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