Please write clearly in block capitals.

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A-level PHYSICS

Paper 3
Section B Astrophysics

Thursday 29 June 2017 Morning

Time allowed: The total time for both sections of this paper is 2 hours. You are advised to spend approximately 50 minutes on this section.

Materials

For this paper you must have:
- a pencil and a ruler
- a scientific calculator
- a Data and Formulae booklet.

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 paper is 35.
- You are expected to use a scientific calculator where appropriate.
- A Data and Formulae Booklet is provided as a loose insert.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
TOTAL	

Do not write outside the box

Section B

Answer **all** questions in this section.

0 1 Draw the ray diagram for a Cassegrain telescope. Your diagram should show the paths of two rays, initially parallel to the principal axis, as far as the eyepiece.

[2 marks]

2

0 2 The Kielder Observatory in Northumberland includes two optical telescopes attached to the same mount, so that they can be used to view the same object. Some of the properties of these telescopes are summarised in **Table 1**.

Table 1

Telescope	Type	Objective diameter/mm
A	refractor	70
B	reflector	400

0 2 . 1 The telescopes are used to view the same object.

Suggest which telescope in **Table 1** produces the brighter image. Support your answer with a suitable calculation.

[3 marks]

Do not write outside the box

0 2 . 2 The minimum angular resolution of a telescope can be determined using the Rayleigh criterion.

Explain what is meant by the Rayleigh criterion.

[2 marks]

0 2 . 3 Discuss which of the two telescopes in **Table 1** would be better at resolving the images of two objects that are close together.

[2 marks]

7

Turn over for the next question

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0 3 **Table 2** summarises some of the properties of four stars in the constellation Hercules.

Table 2

Star	Distance/pc	Spectral class	Apparent magnitude
Kornephoros	43	G	2.8
Rasalgethi	110	M	3.0
Rutilicus	11	G	2.8
Sarin	23	A	3.1

0 3 . 1 Define the parsec. You may use a diagram as part of your answer.

[2 marks]

0 3 . 2 Deduce which star is larger, Kornephoros or Rutilicus.

[3 marks]

Do not write outside the box

0 3 . 3 One of the four stars has the peak in its black-body radiation curve at a wavelength of $1.0\ \mu m$.

Calculate the corresponding temperature for this curve.

[2 marks]

temperature = _____ K

0 3 . 4 Explain which star produced the black-body radiation curve described in question **03.3**.

[2 marks]

_____

_____

_____

_____

0 3 . 5 Which star has the brightest absolute magnitude?
Tick (✓) the correct box.

[1 mark]

Kornephoros ☐

Rasalgethi ☐

Rutilicus ☐

Sarin ☐

Question 3 continues on the next page

Do not write outside the box

0 3 . 6 Determine the absolute magnitude of Sarin.

[3 marks]

absolute magnitude = _____

13

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Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 4 . 1 Sketch, on the axes in **Figure 1**, the light curve for a typical type 1a supernova. Label the axes with suitable scales.

[3 marks]

Figure 1



0 4 . 2 Type 1a supernovae can be used as standard candles.

Explain what is meant by a standard candle.

[1 mark]

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0 4 . 3 Measurements of type 1a supernovae in 1999 led to a controversy concerning the behaviour of the Universe.

Describe this controversy and how the measurements led to it.

[3 mark]

7

Turn over for the next question

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0 5 According to NASA nearly 2000 exoplanets had been discovered by 2016, and the search continues. One aim of this search is to find an Earth-like planet orbiting a Sun-like star.

Discuss the difficulties associated with the detection of an Earth-like planet orbiting a Sun-like star.
In your answer you should compare the methods that are used in the search and suggest which may be the most successful.

[6 marks]

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6

END OF QUESTIONS

There are no questions printed on this page

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