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Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

A-level PHYSICS

Paper 3 Section B Astrophysics

Monday 3 June 2019

Afternoon

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.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Show all your working.

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

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.



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Section B

Answer **all** questions in this section.

0 1 . 1 The lenses used in refracting telescopes can cause chromatic aberration.

Complete **Figure 1** to show how a lens produces chromatic aberration.

[1 mark]

Figure 1



0 1 . 2 A Cassegrain telescope uses mirrors.

What are the shapes of the primary and secondary mirrors in a Cassegrain telescope?

Tick (✓) **one** box.

[1 mark]

Primary mirror	Secondary mirror	
concave	concave	<input type="checkbox"/>
concave	convex	<input type="checkbox"/>
convex	concave	<input type="checkbox"/>
convex	convex	<input type="checkbox"/>



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box

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8



0 2

Table 2 shows some properties of the four brightest stars in the constellation Canis Minor.

Table 2

Name	Apparent magnitude	Absolute magnitude	Spectral class
Gamma A	4.46	-0.50	K
Gomeisa	2.89	-0.70	B
HD 66141	4.39	-0.13	K
Procyon	0.34	2.65	F

0 2 . 1

Discuss, with reference to the Hipparcos scale, why many star maps show only two stars in the constellation Canis Minor.

[3 marks]

0 2 . 2

State and explain which star in **Table 2** has the most prominent Hydrogen Balmer absorption lines.

[2 marks]

Question 2 continues on the next page

Turn over ►

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0 2 . 3

Deduce which star, Gamma A or HD 66141, has the larger diameter.

[3 marks]

0 2 . 4

Astronomers recently used the radial velocity method to discover an exoplanet orbiting HD 66141.

Describe the main features of the radial velocity method in the detection of planets.

[2 marks]



0 2 . 5

Calculate the distance from the Earth to Procyon.
Give an appropriate unit for your answer.

[3 marks]

distance = _____ unit _____

13

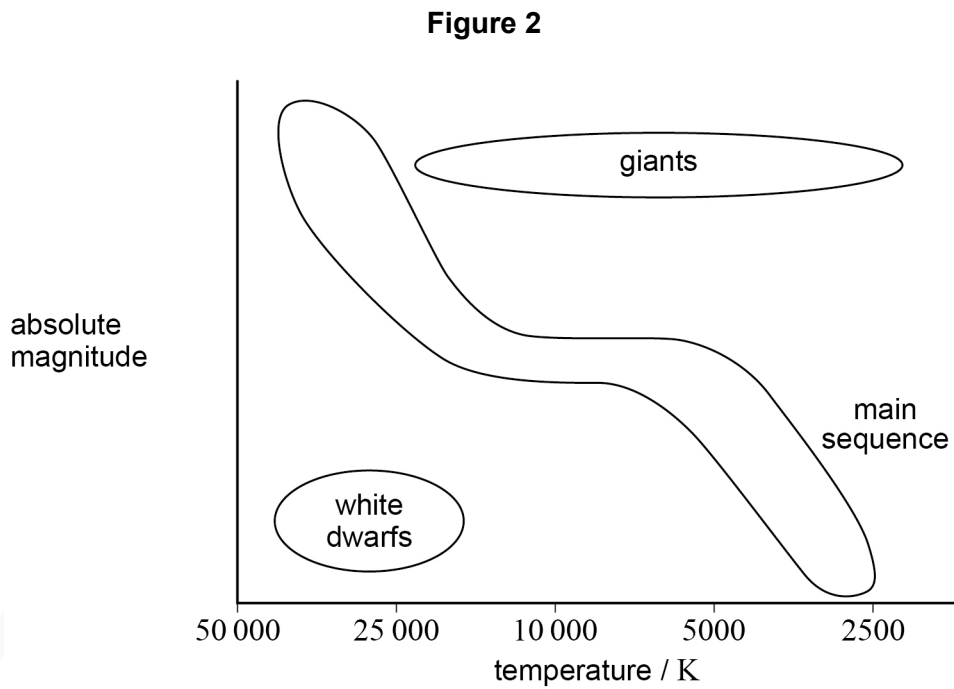
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0 3

Figure 2 is a Hertzsprung-Russell (HR) diagram.



0 3 . 1

Label the absolute magnitude axis with a suitable scale.

[1 mark]

0 3 . 2

Label with an **S** the position of the Sun on the HR diagram.

[2 marks]

0 3 . 3

Draw a line on the HR diagram to show the evolution of a star similar to the Sun from formation to white dwarf.

[2 marks]

0 3 . 4

Label with a **P** the position on the HR diagram of a star much redder, and with a greater power output, than the Sun.

[1 mark]



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0 3 . 5

A star much more massive than the Sun may become a supernova and then a black hole.

Discuss whether supernovae and black holes can be placed on the HR diagram in **Figure 2**.

[3 marks]

9

Turn over for the next question

Turn over ►



0 4 . 1 Table 3 contains information about two galaxies.

Table 3

Galaxy	Red shift, z	Distance from Earth / ly
NGC 936	4.8×10^{-3}	6.8×10^7
NGC 3379	3.0×10^{-3}	3.2×10^7

Discuss whether these data are consistent with Hubble's Law.

[3 marks]



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0 4 . 2

Quasars are the most distant measurable objects.

Discuss **one** problem associated with the determination of the distance from the Earth to a quasar.

[2 marks]

5

END OF QUESTIONS



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ANSWER IN THE SPACES PROVIDED**



