



Please write clearly in block capitals.

Centre number 

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Candidate number 

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Surname \_\_\_\_\_

Forename(s) \_\_\_\_\_

Candidate signature \_\_\_\_\_

I declare this is my own work.

# A-level PHYSICS

Paper 3  
Section B    Astrophysics

Friday 5 June 2020                      Afternoon

**Materials**  
For this paper you must have:

- a pencil and a ruler
- a scientific calculator
- a Data and Formulae Booklet.

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.

- 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.
  - 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).
  - Do all rough work in this book. Cross through any work you do not want to be marked.
  - Show all your working.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
<b>TOTAL</b>	

- 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.



J U N 2 0 7 4 0 8 3 B A 0 1

Section B

Answer **all** questions in this section.

0 1 . 1

Draw a ray diagram for a Cassegrain telescope.  
Your diagram should show the paths of **two** rays up to the eyepiece lens.  
The rays should initially be parallel to the principal axis.

[2 marks]

\_\_\_\_\_ principal  
axis

0 1 . 2

A spacecraft passes Pluto at a distance of 12 500 km. The telescope on board has  
an aperture of diameter 0.21 m and operates at a wavelength of 450 nm.

Discuss whether this telescope is suitable for studying a crater with a diameter of  
approximately 1 km on Pluto.

[3 marks]

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



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01.3

The Hubble telescope has an aperture of diameter 2.4 m.

Compare the collecting power of the Hubble telescope with the telescope on the spacecraft in Question 01.2.

[2 marks]

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01.4

An astrophysicist had to decide whether to use a reflecting telescope or a refracting telescope on the spacecraft in Question 01.2.

Discuss which type of telescope to use.

[3 marks]

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10

Turn over ►



0 2

**Table 1** summarises some information about four stars in the constellation Cassiopeia.

**Table 1**

Name	Colour	Apparent magnitude	Distance / ly
Caph	white	2.3	55
Ruchbah	blue/white	2.7	99
Schedar	orange	2.2	228
Tsih	blue	2.2	610

0 2 . 1

Which star has the highest surface temperature?  
Tick (✓) **one** box.

[1 mark]

Caph

☐

Ruchbah

☐

Schedar

☐

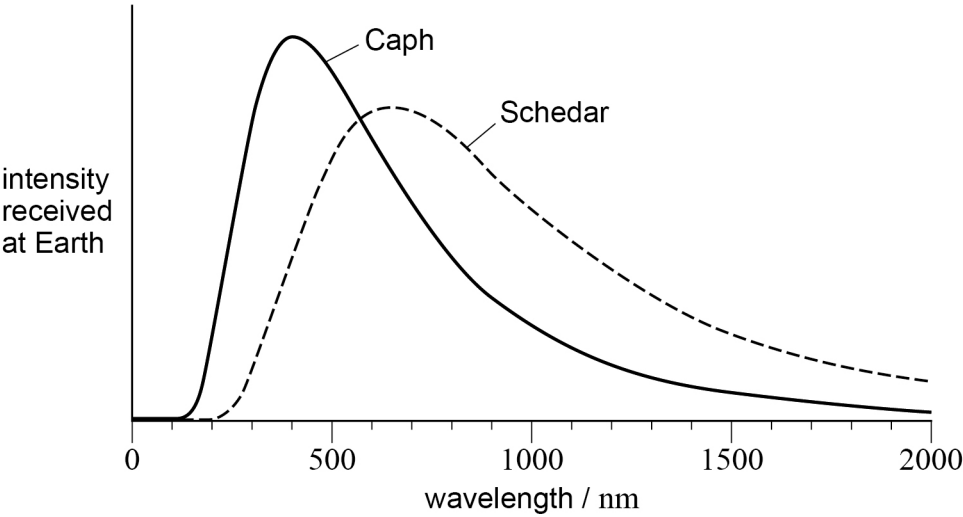
Tsih

☐

0 2 . 2

**Figure 1** shows the intensity received at Earth from two of the stars, plotted against wavelength.  
The effect of absorption by the Earth’s atmosphere is not shown.

**Figure 1**



Discuss what information can be found from **Figure 1** about the temperature and colour of these stars.  
Support your answer with suitable calculations.

**[4 marks]**

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**Question 2 continues on the next page**

**Turn over ►**



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2

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3

State which star in **Table 1** is dimmest on the absolute magnitude scale.

[1 mark]

\_\_\_\_\_

0

2

.

4

Calculate the absolute magnitude of Schedar.

[3 marks]

absolute magnitude = \_\_\_\_\_

0

2

.

5

Tsih has a mass over 15 times the mass of the Sun.  
Tsih may eventually collapse to form a black hole.

Calculate the radius of the event horizon for a black hole with a mass 15 times that of the Sun.

[2 marks]

radius = \_\_\_\_\_ m



0 3

Type 1a supernovae can be used as standard candles.

0 3 . 1

State what is meant by a standard candle.

[1 mark]

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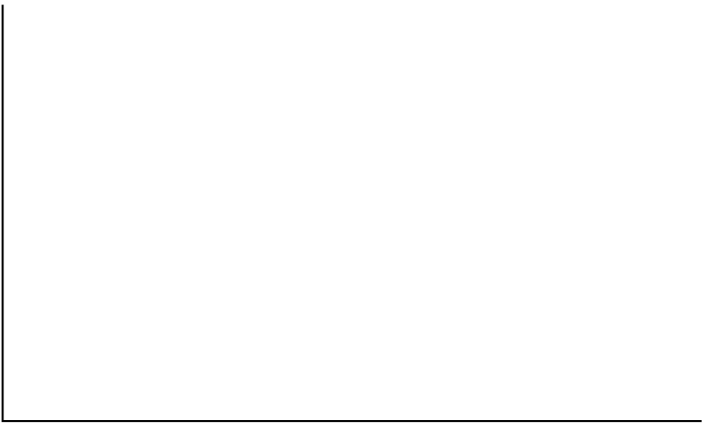
0 3 . 2

Sketch on **Figure 2** the light curve for a type 1a supernova.  
Annotate your graph with suitable scales and a unit for time.

[3 marks]

Figure 2

absolute  
magnitude



time /

Question 3 continues on the next page

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Turn over for the next question

10

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04

Table 2 gives data about the supergiant star Melnick 34 and the Sun.

Table 2

Name	Radius / m	Surface temperature / K
Melnick 34	$1.4 \times 10^{10}$	53 000
Sun	$7.0 \times 10^8$	5 700

04.1

Calculate  $\frac{\text{power output of Melnick 34}}{\text{power output of the Sun}}$ .

[2 marks]

answer = \_\_\_\_\_

04.2

Discuss why the evolution of a supergiant star in the local part of our galaxy could be dangerous for life on Earth.

[2 marks]

4

END OF QUESTIONS



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