

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

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Forename(s)

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Candidate signature

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I declare this is my own work.

# A-level PHYSICS

## Paper 3 Section B Astrophysics

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
- a protractor.

### 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.

### 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	
<b>TOTAL</b>	



## Section B

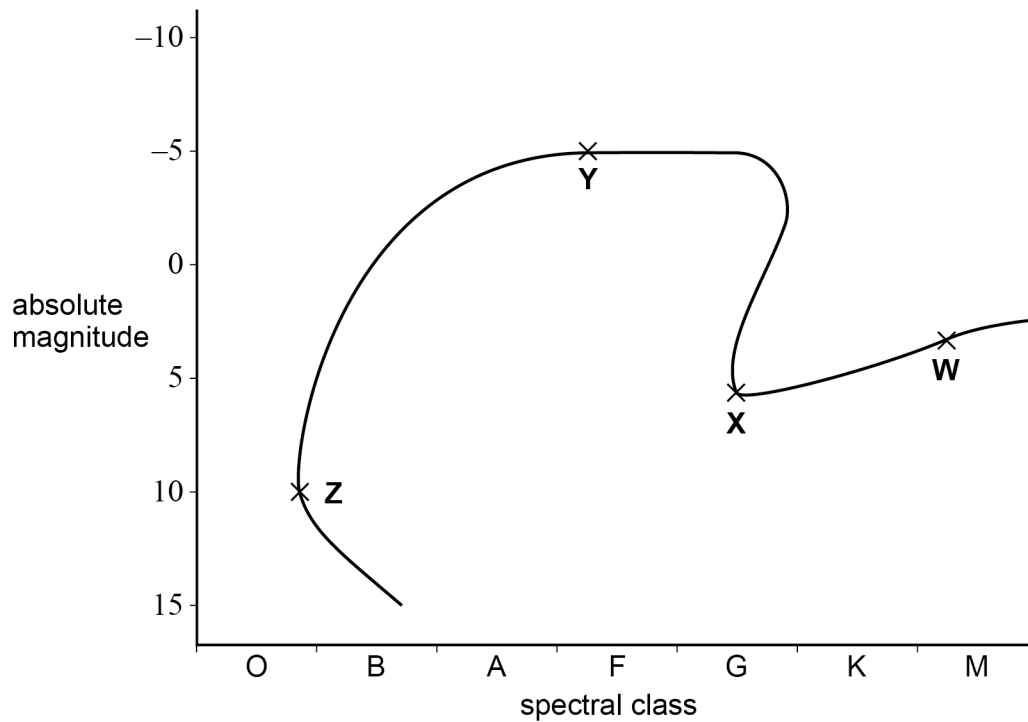
Answer **all** questions in this section.

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outside the  
box

0 1

**Figure 1** shows the evolution of a star similar to the Sun on a Hertzsprung-Russell (HR) diagram.

**Figure 1**



0 1 . 1

State the evolutionary stage of the star at each of the points **W**, **X**, **Y** and **Z**.

[3 marks]

- W** \_\_\_\_\_
- X** \_\_\_\_\_
- Y** \_\_\_\_\_
- Z** \_\_\_\_\_

Theta Carinae is a star with a radius five times that of the Sun. It has a surface temperature of 31 000 K.

0 1 . 2

Annotate **Figure 1** with a **T** to show the position of Theta Carinae.

[1 mark]



An astronomer suggests that an Earth-sized planet orbits Theta Carinae.

0 1 . 3

Explain **one** difficulty with using the transit method to detect this planet.

[2 marks]

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0 1 . 4

The astronomer suggests that the Earth-sized planet receives a similar amount of power from Theta Carinae as the Earth does from the Sun.

The average power output of the Sun is  $3.8 \times 10^{26}$  W.

Determine the orbital radius of the Earth-sized planet orbiting Theta Carinae.

[5 marks]

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

11

Turn over ►

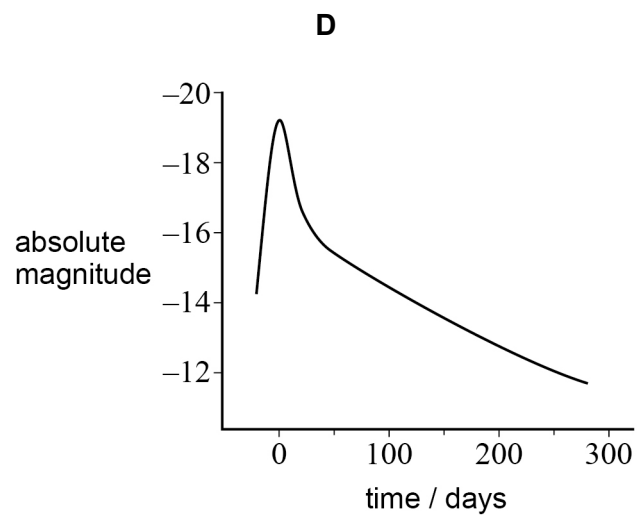
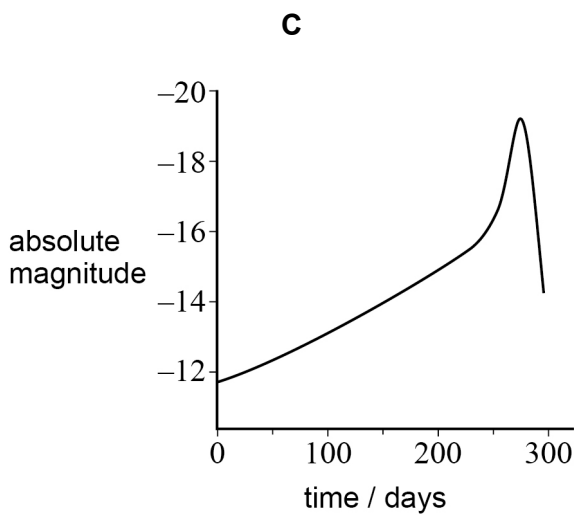
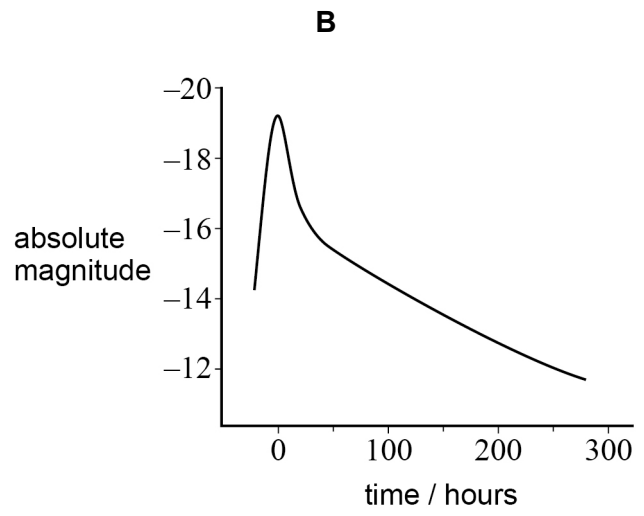
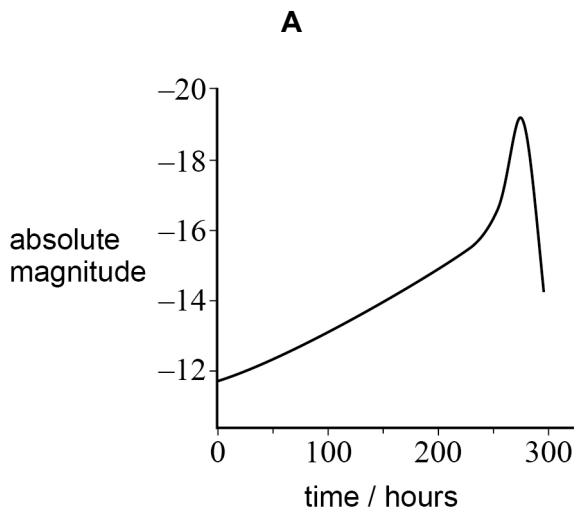


0 2 . 1

Which graph shows the light curve for a typical type 1a supernova?

Tick (✓) **one** box.

[1 mark]



- A
- B
- C
- D



0 2 . 2

The Andromeda galaxy is approximately  $7.7 \times 10^5$  pc from Earth.

Deduce whether a type 1a supernova which occurred in Andromeda can be observed from Earth with the naked eye.

[3 marks]

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Turn over for the next question

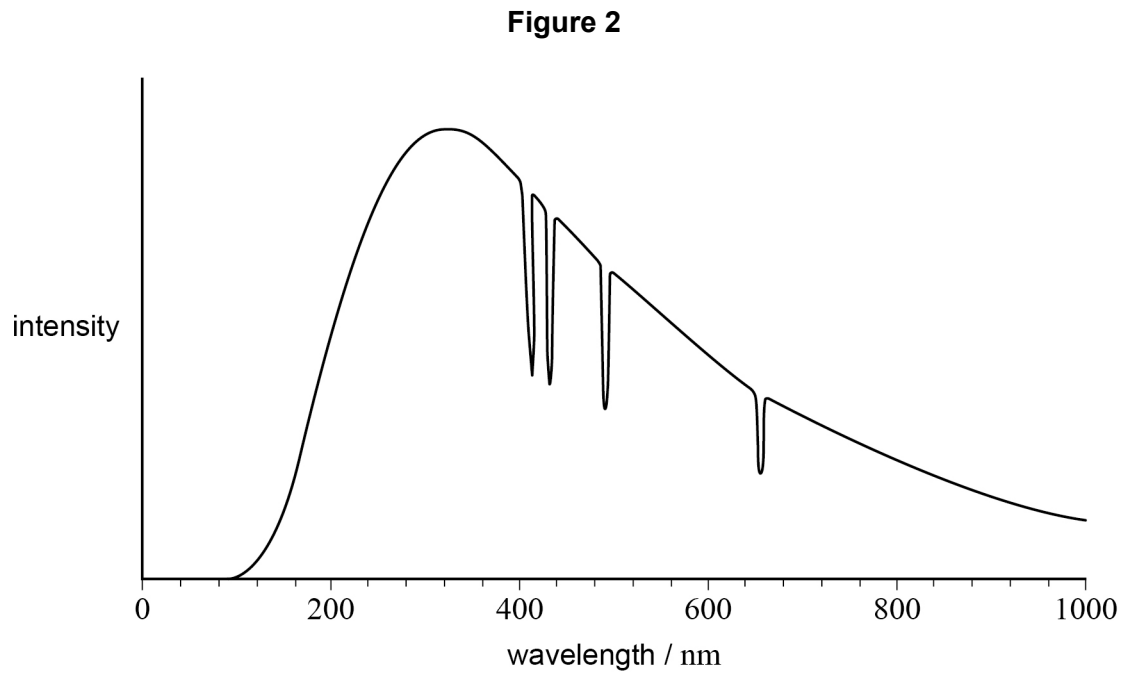
Turn over ►



0 3

Miaplacidus and Avior are two stars in the constellation Carina.  
 Miaplacidus is a class A star.  
 Avior is a class K star.

**Figure 2** shows how the intensity of radiation arriving at the Earth varies with wavelength for **one** of these stars. Only the important features of the variation are shown.



Deduce, with reference to **Figure 2**, the identity of the star.

In your answer you should:

- explain the overall shape of the graph
- describe the processes in the star that lead to the decreases in intensity
- state the identity of the star.

**[6 marks]**

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0 4

IC2497 is a galaxy that contained a quasar. It is believed that the quasar stopped emitting radiation several thousand years ago.

0 4 . 1

Suggest why the quasar stopped emitting radiation.

**[2 marks]**


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0 4 . 2

IC2497 has a red shift of 0.0516

Determine the distance from the Earth to IC2497.  
Give an appropriate unit for your answer.

**[4 marks]**

distance = \_\_\_\_\_ unit = \_\_\_\_\_

6







**0 5 . 3** **Table 1** shows information about two telescopes.

**Table 1**

Telescope	Diameter / m	Dish shape
Arecibo	305	spherical
Lovell	76	parabolic

Each telescope detects radio waves with a wavelength of 21 cm.

Compare the performances of the telescopes in **Table 1** when both are used to observe the same faint radio objects.

**[3 marks]**

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**END OF QUESTIONS**



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1 6



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