



Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

I declare this is my own work.

A-level

PHYSICS

Paper 3

Section B Astrophysics

7408/3BA

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.

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]



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.
- Answer ALL questions.
- You must answer the questions in the spaces provided. Do not write 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.

DO NOT TURN OVER UNTIL TOLD TO DO SO



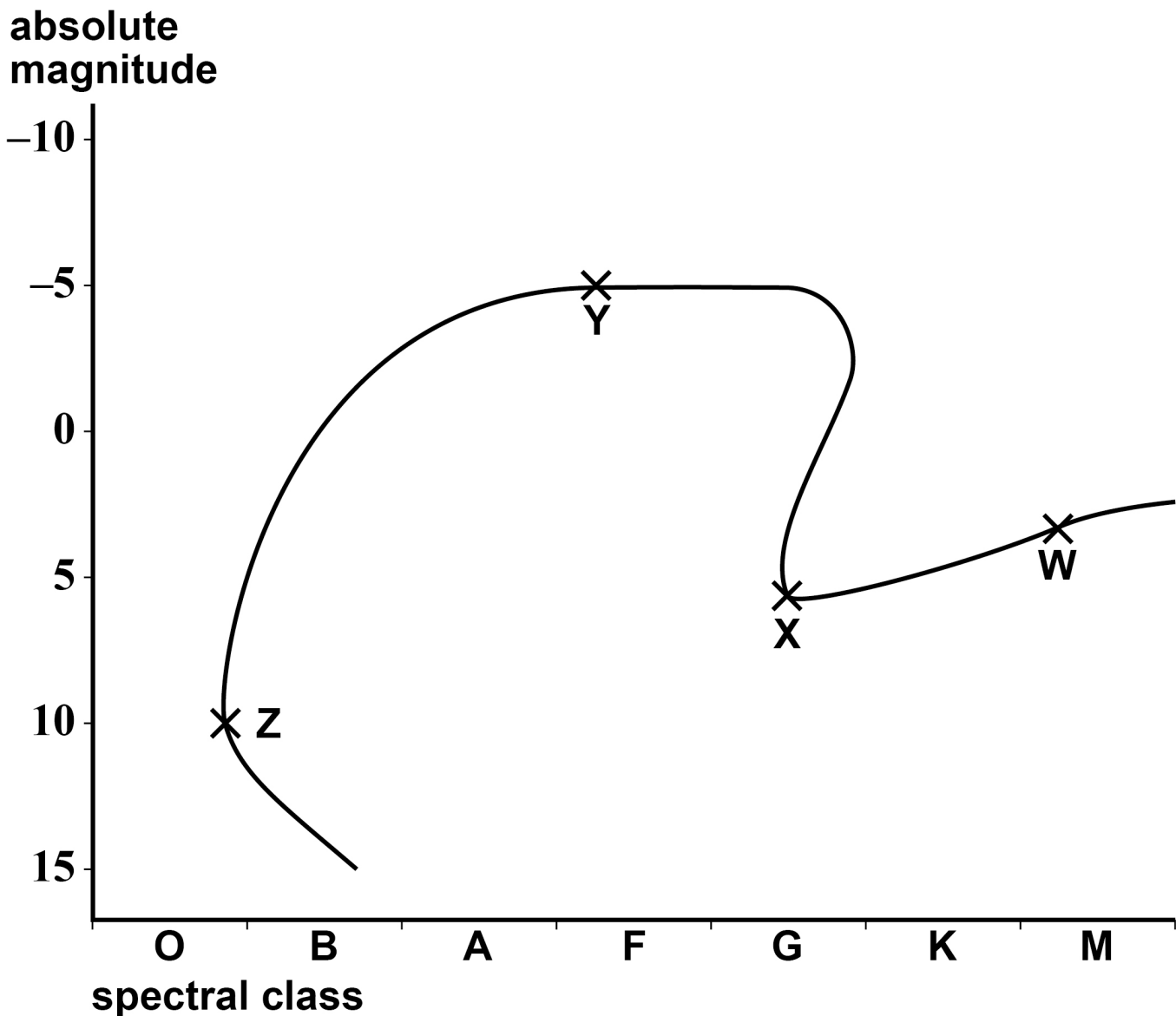
SECTION B

Answer ALL questions in this section.

01

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

FIGURE 1



01.1

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.

01.2

Annotate FIGURE 1 with a T to show the position of Theta Carinae. [1 mark]

[Turn over]



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

01.3

Explain ONE difficulty with using the transit method to detect this planet. [2 marks]

0	1	.	4
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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 3.8×10^{26} W.

Determine the orbital radius of the Earth-sized planet orbiting Theta Carinae. [5 marks]

orbital radius = _____ m

[Turn over]

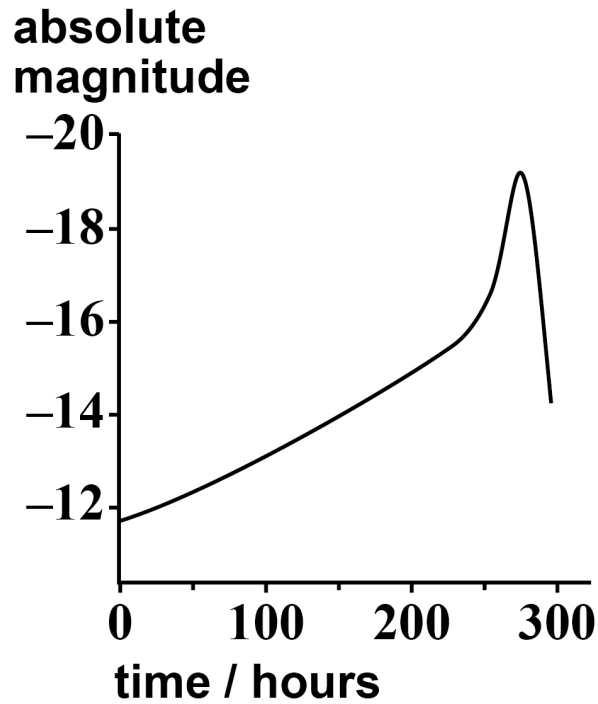
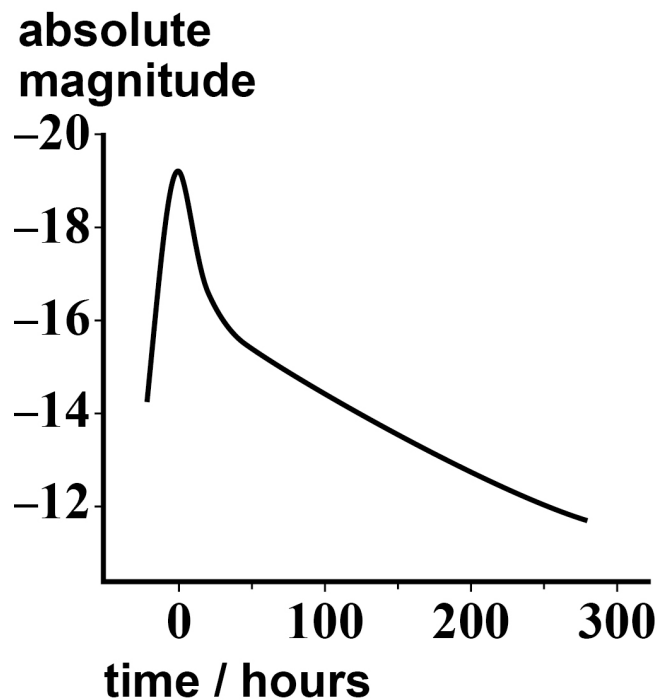
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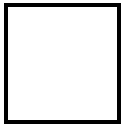
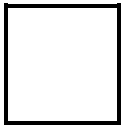
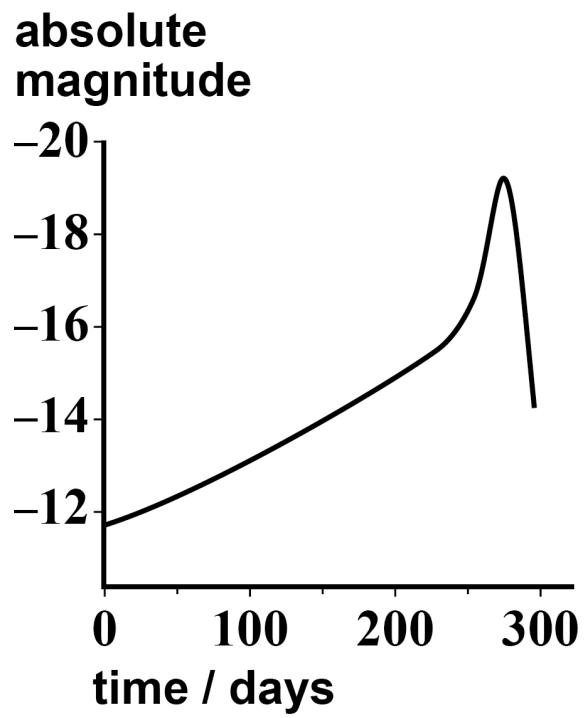
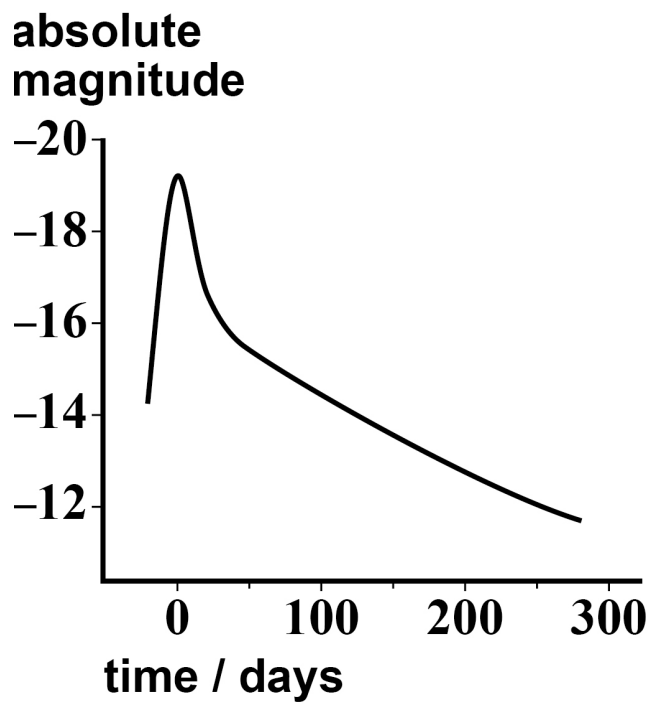


02.1

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

Tick (✓) ONE box. [1 mark]

☐**A**☐**B**

**C****D****[Turn over]**

0	2	.	2
---	---	---	---

The Andromeda galaxy is approximately 7.7×10^5 pc from Earth.

Deduce whether a type 1a supernova which occurred in Andromeda can be observed from Earth with the naked eye. [3 marks]



[Turn over]

4



0 3

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

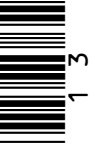
Avior is a class K star.

FIGURE 2, on page 14, 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.



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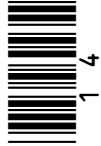
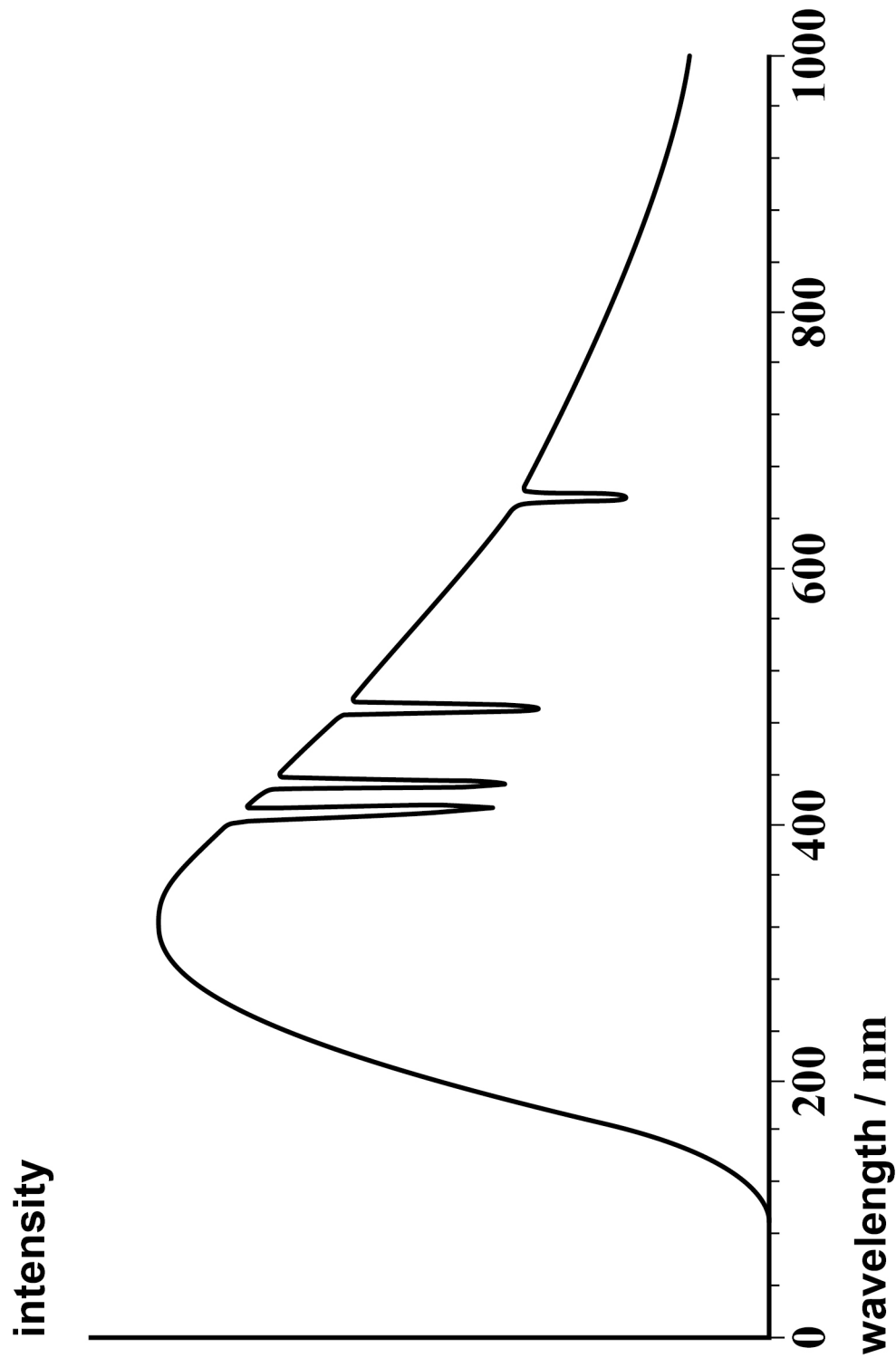


FIGURE 2



Deduce, with reference to FIGURE 2 on page 14, 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]

[Turn over]

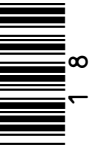
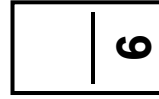


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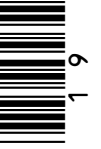
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0	4
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IC2497 is a galaxy that contained a quasar. It is believed that the quasar stopped emitting radiation several thousand years ago.

0	4	.	1
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**Suggest why the quasar stopped emitting radiation.
[2 marks]**

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 = _____

[Turn over]

6



0	5	.	1
---	---	---	---

**Explain what is meant by the Rayleigh criterion.
[2 marks]**



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[Turn over]



0	5	.	2
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A telescope uses wavelengths in the range 90 nm to 120 nm.

Explain why this telescope must be located in space.

Go on to discuss ONE advantage that this telescope has compared to a telescope with the same aperture that uses visible light. [3 marks]

[illegible]

[Turn over]



05.3

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

8



Additional page, if required.

Write the question numbers in the left-hand margin.

[illegible]

Additional page, if required.

Write the question numbers in the left-hand margin.

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Question	Mark
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