A

Surname ______________________

Other Names ______________________

Centre Number ______________________

Candidate Number ______________________

Candidate Signature ______________________

A-level
PHYSICS

Paper 3 Section B Astrophysics

7408/3BA

Thursday 14 June 2018 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.

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

[Turn over]

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

DO NOT TURN OVER UNTIL TOLD TO DO SO

SECTION B

Answer ALL questions in this section.

0 1 The Griffith Observatory in Los Angeles includes an astronomical refracting telescope (Griffith telescope) with an objective lens of diameter 305 mm and focal length 5.03 m

0 1 . 1 Calculate the wavelength of light for which the Griffith telescope has a minimum angular resolution of 1.8×10^{-6} rad
[2 marks]

wavelength = ________________________ **m**

[Turn over]

0 1 . 2 The Griffith telescope is used to observe two point objects which subtend an angle of 1.8×10^{-6} rad at the unaided eye.

The typical human eye has a minimum angular resolution of approximately 3.2×10^{-4} rad

Calculate the focal length of the eyepiece lens so that an observer can just resolve the two objects when observing them through the Griffith telescope. [3 marks]

focal length = ______________________ m

[Turn over]

0 1 . 3 The asteroid Apophis has a diameter of $325\ m$

It has been calculated that, in 2029, its distance of closest approach to the Earth's surface will be $3.0 \times 10^4\ km$

The Griffith telescope may be used to view Apophis using the eyepiece calculated in question 01.2

Deduce whether this telescope is suitable to obtain a detailed view of Apophis.
Support your answer with a calculation. [3 marks]

There are answer lines on page 11 on which to continue your answer

[Turn over]

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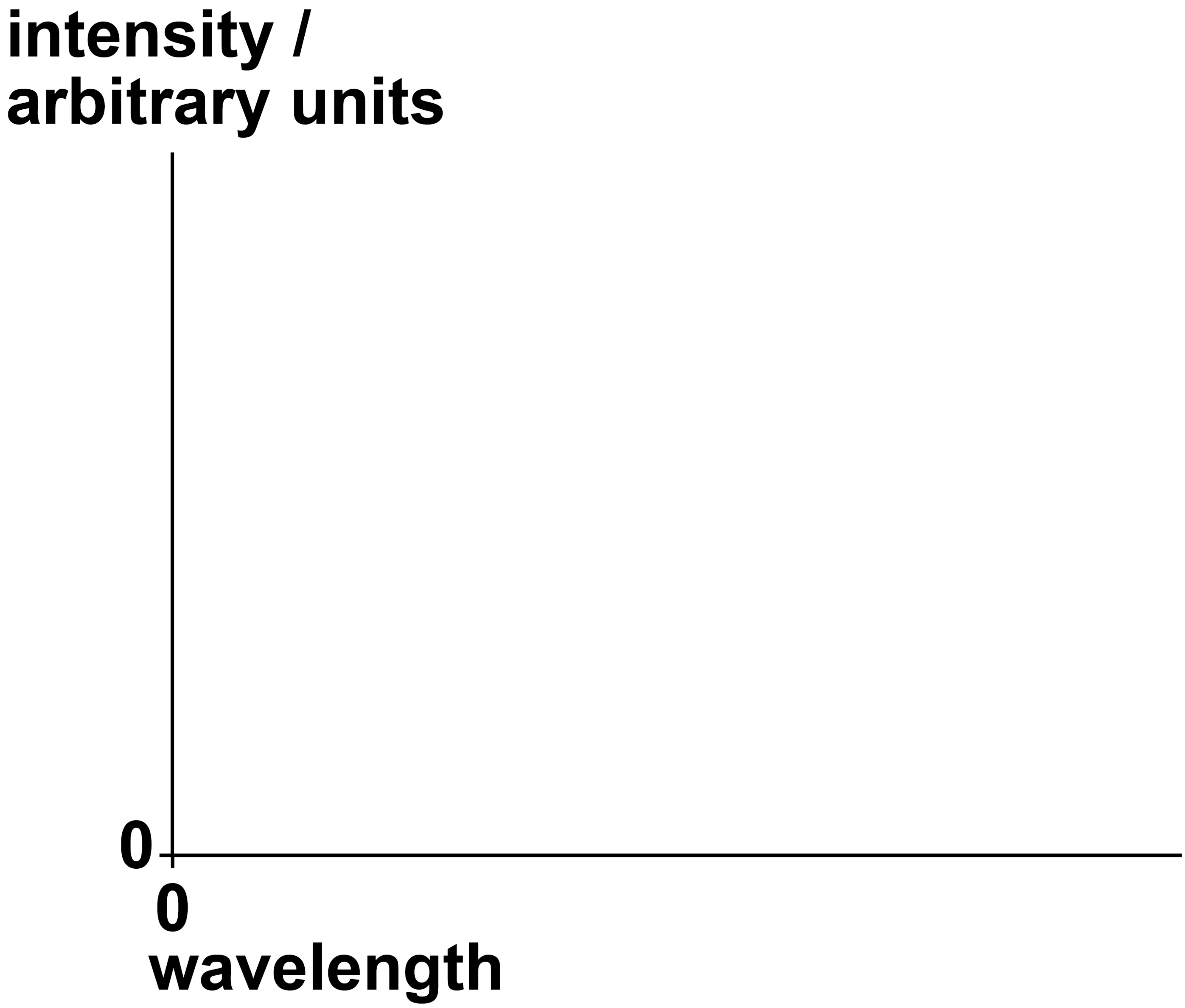
[Turn over]

0 2 . 1 **Sketch, on the axes in FIGURE 1, the black-body radiation curve for a typical star. [2 marks]**

FIGURE 1



0 2 . 2 **Explain, with reference to the SI units involved, how the curve you have drawn can be used to determine the black-body temperature of the star. [3 marks]**

[Turn over]

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[Turn over]

0 2 . 3 Two stars, 61 Cygnus A and 61 Cygnus B, can be seen very close together in the constellation Cygnus. Early astronomers were unsure whether the two stars form a binary system, or simply appear in the same line of sight.

TABLE 1 shows some of the properties of the two stars.

TABLE 1

	Temperature / K	Radius / km	Apparent magnitude
61 Cygnus A	4500	4.7×10^5	5.2
61 Cygnus B	4100	4.1×10^5	6.1

Evaluate whether the data support the suggestion that the two stars form a binary system.

In your answer you should

- compare the two stars as seen by an observer on Earth
- support your evaluation with suitable calculations.

[6 marks]

[Turn over]

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[Turn over]

[Turn over]

0 2 . 4 **What is the spectral class of 61 Cygnus A?**

Tick (✓) the correct box. [1 mark]

☐ **A**

☐ **F**

☐ **G**

☐ **K**

12

0 3 . 1 Describe the links between galaxies, black holes and quasars. [2 marks]

[Turn over]

0 3 . 2 At a distance of 5.81×10^8 light year, Markarian-231 is the closest known quasar to the Earth.
The red shift z of Markarian-231 is 0.0415

Use these data to estimate an age, in seconds, of the Universe.
[4 marks]

age = ______________________________ s

[Turn over]

0 3 . 3 **A typical quasar is believed to be approximately the size of the solar system, with a power output similar to that of a thousand galaxies.**

Estimate, with reference to the inverse-square law, how much further the most distant visible quasar is likely to be compared to the most distant visible galaxy.
[3 marks]

[Turn over]

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0 4 **Evidence to support the Big Bang theory comes from cosmological microwave background radiation and the relative abundance of hydrogen and helium in the Universe.**

0 4 . 1 **Explain what is meant by cosmological microwave background radiation and how its existence supports the Big Bang theory. [3 marks]**

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[Turn over]

0 4 . 2 **Explain how the relative abundance of hydrogen and helium supports the Big Bang theory. [3 marks]**

END OF QUESTIONS

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There are no questions printed on this page

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

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