AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

A-level PHYSICS

Paper 3
Section B Astrophysics

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.

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.
- 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 The Griffith Observatory in Los Angeles includes an astronomical refracting telescope (Griffith telescope) with an objective lens of diameter $305\ \text{mm}$ and focal length $5.03\ \text{m}$

0 1 . 1 Calculate the wavelength of light for which the Griffith telescope has a minimum angular resolution of $1.8 \times 10^{-6}\ \text{rad}$

[2 marks]

wavelength = _____ m

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

The typical human eye has a minimum angular resolution of approximately $3.2 \times 10^{-4}\ \text{rad}$

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

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 3.0×10^4 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]

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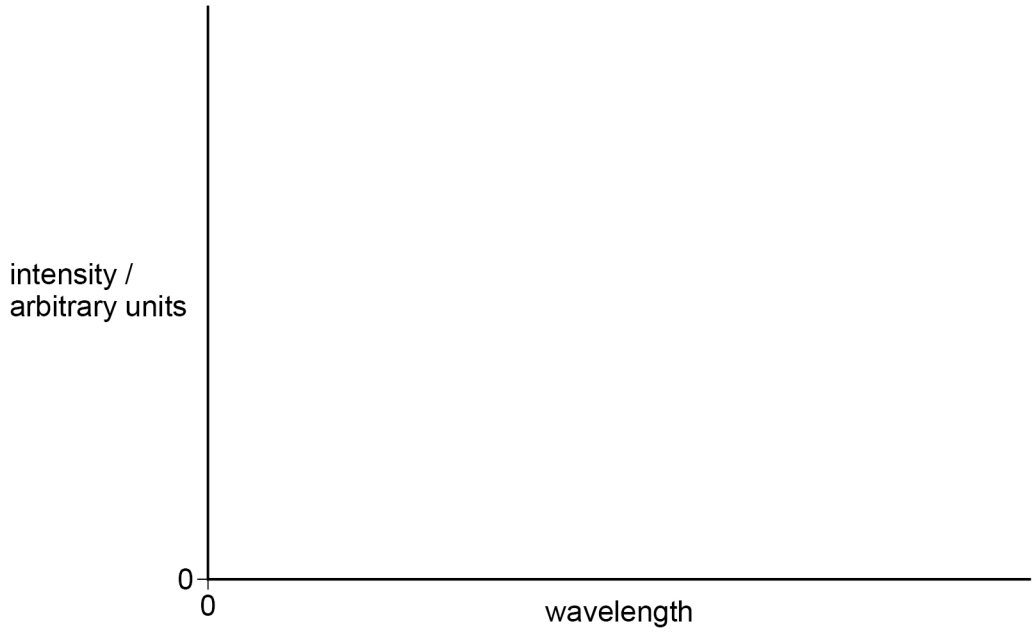
0 2 . 1 Sketch, on the axes in **Figure 1**, the black-body radiation curve for a typical star.

[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]

Question 2 continues on the next page

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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]

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0 2 . 4 What is the spectral class of 61 Cygnus A?
Tick (✓) the correct box.

[1 mark]

A ☐

F ☐

G ☐

K ☐

12

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0 3 . 1 Describe the links between galaxies, black holes and quasars.

[2 marks]

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

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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]

9

Turn over for the next question

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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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0 4 . 2 Explain how the relative abundance of hydrogen and helium supports the Big Bang theory.

[3 marks]

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END OF QUESTIONS

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