

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

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.

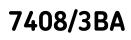
Information

- 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.

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.

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





	Section B	Do not writ outside the box
	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	
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 $3.2 \times 10^{-4} \mbox{ rad}$	
	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	

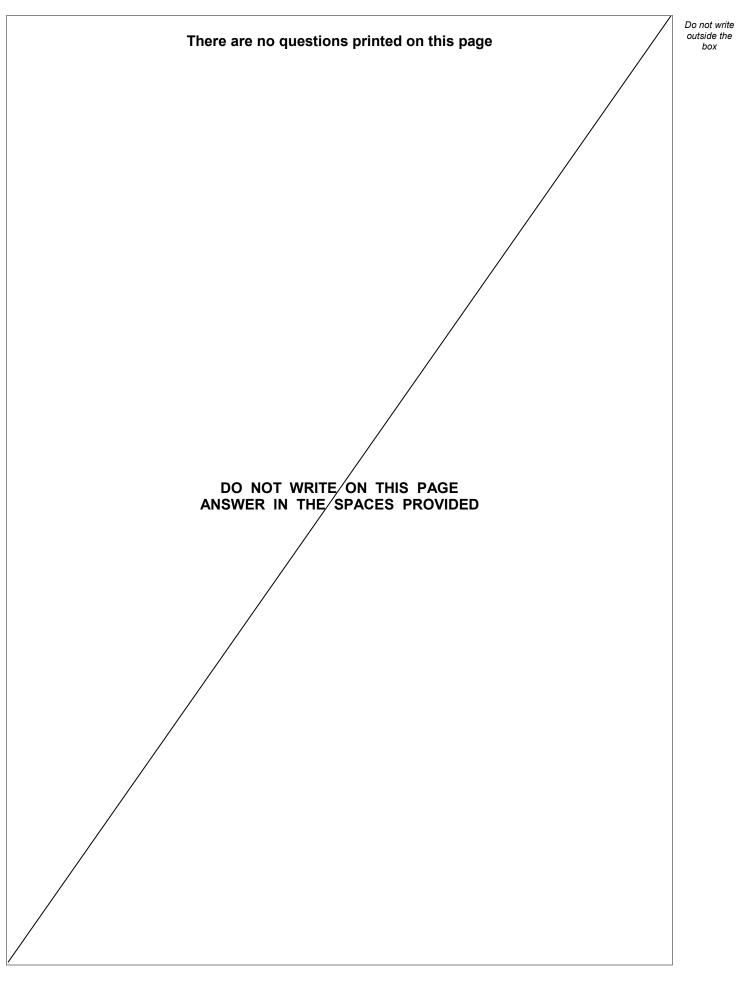


0 1.3	The asteroid Apophis has a diameter of 325 m	Do not write outside the box
	It has been calculated that, in 2029, its distance of closest approach to the Earth's surface will be $3.0\times 10^4~km$	
	The Griffith telescope may be used to view Apophis using the eyepiece calculated in question 01.2	
	Deduce whether this telescope is suitable to obtain a detailed view of Apophis. Support your answer with a calculation. [3 marks]	
		8
	Turn over ►	



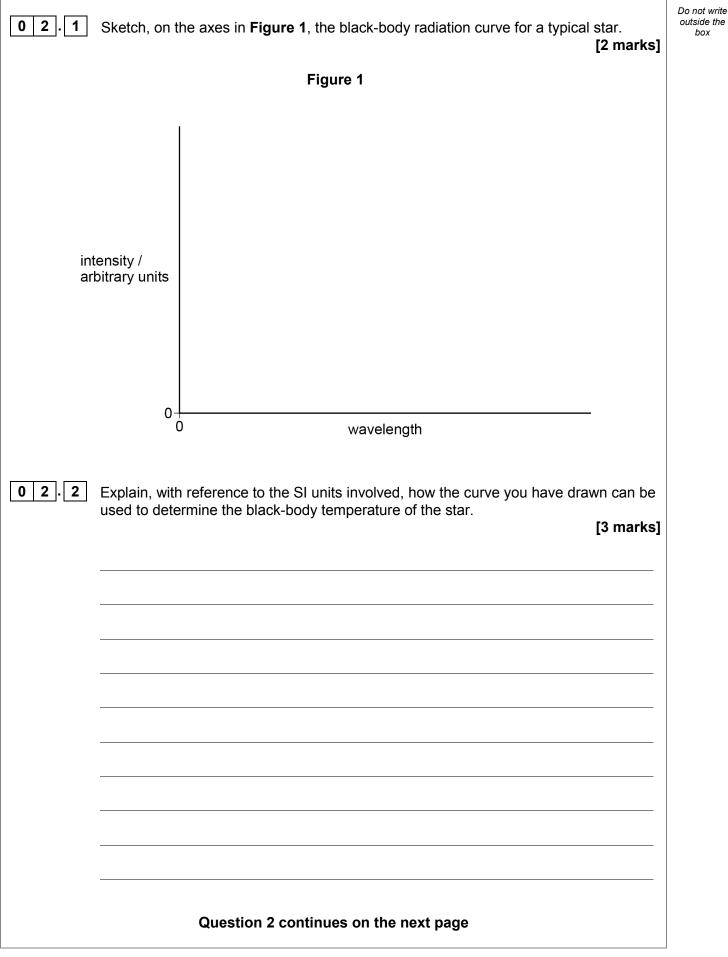
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0 2.3

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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box

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0 2 . 4	What is the spectral class of 61 Cygnus A?	
	What is the spectral class of 61 Cygnus A? Tick (\checkmark) the correct box.	
		[1 mark]
		[]
	Α	
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	κ	
		Turn over ►



03.1	Describe the links between galaxies, black holes and quasars. [2 marks]
03.2	At a distance of 5.81×10^8 light year, Markarian-231 is the closest known quasar to the Earth. The red shift <i>z</i> of Markarian-231 is 0.0415
	Use these data to estimate an age, in seconds, of the Universe. [4 marks]
	age = s



Do not write outside the box

03.3	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.	Do not write outside the box
	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	
	Turn over ►	

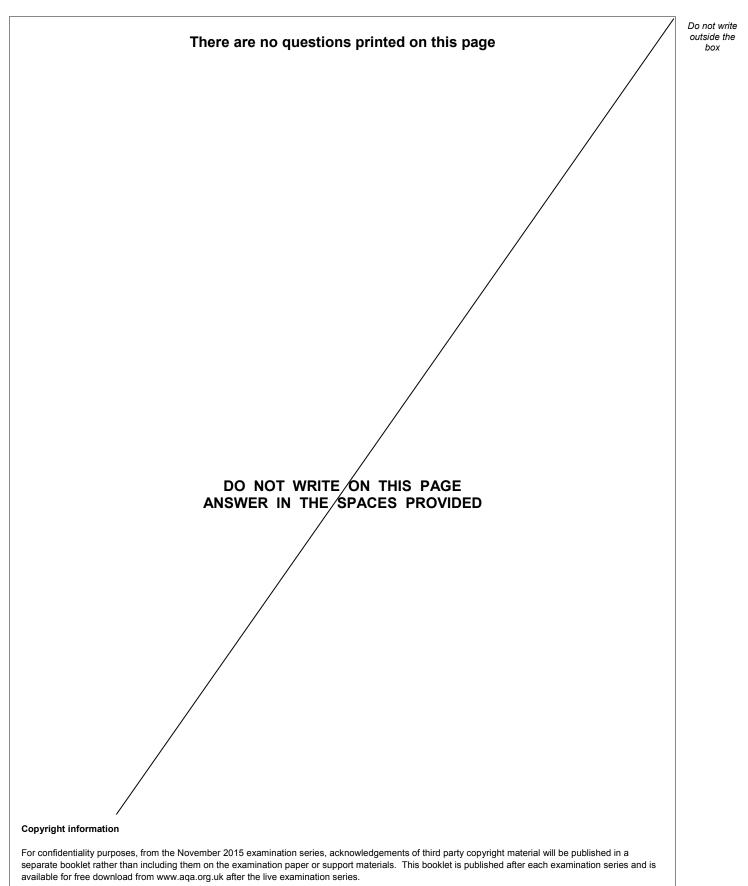
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04	Evidence to support the Big Bang theory comes from cosmological microwave background radiation and the relative abundance of hydrogen and helium in the Universe.	Do not write outside the box
04.1	Explain what is meant by cosmological microwave background radiation and how its existence supports the Big Bang theory. [3 marks]	



04.2	Explain how the relative abundance of hydrogen and helium supports the Big Bang theory. [3 marks]	Do not write outside the box
	END OF QUESTIONS	6





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