

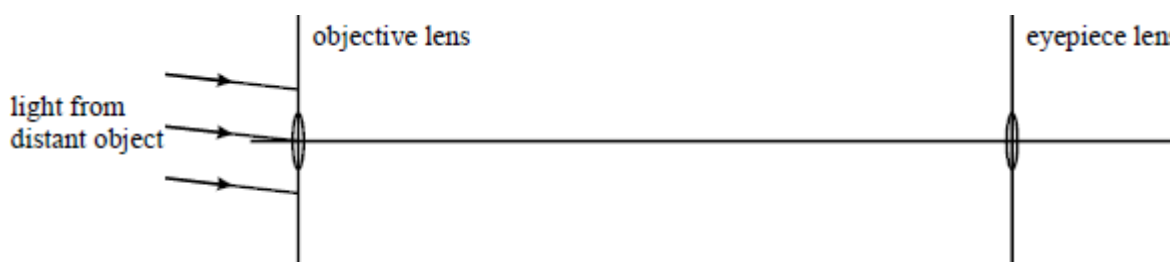
Name of the Student: _____

Max. Marks : 22 Marks

Time : 22 Minutes

Q1.

- (a) Complete the ray diagram for an astronomical refracting telescope in normal adjustment. Your diagram should show the paths of the three non-axial rays, through both lenses. Label the positions of the principal foci of the two lenses.



(3)

- (b) In 1656 Huygens made an astronomical telescope with an angular magnification of approximately 100. The distance between the two lenses was approximately 3.5 m when in normal adjustment.

- (i) Estimate the focal length of the objective lens and the focal length of the eyepiece lens used to make this telescope.

- (ii) Using this telescope, Huygens discovered Titan, a satellite of Saturn. At this angular magnification, the image of Titan subtends an angle 4.0×10^{-3} radians when it is approximately 1.3×10^9 km from the Earth. Calculate the diameter of Titan.

(3)

- (c) Most modern large optical telescopes use mirrors rather than lenses. State and explain **two** optical advantages reflecting telescopes have compared with refracting telescopes.

advantage 1 _____

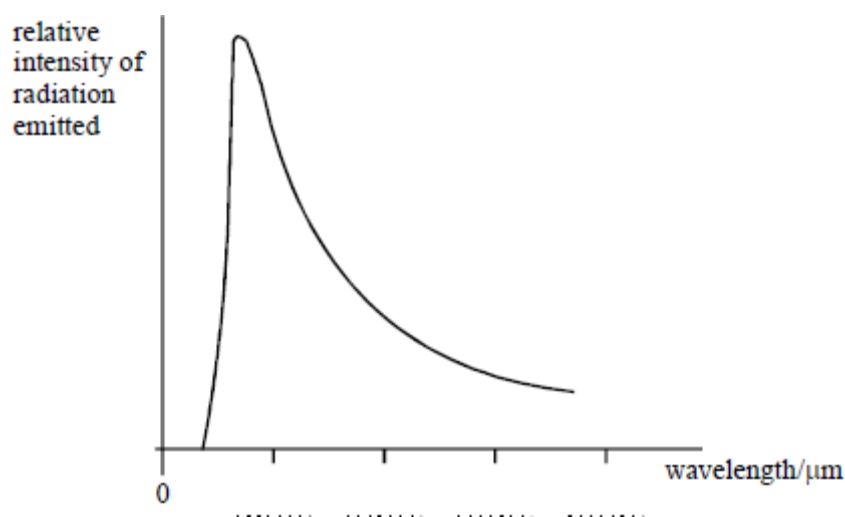
Q2.

The table compares two properties of the Sun with Arcturus, a star in the constellation Bootes.

	Sun	Arcturus
surface temperature/K	6 000	5 000
absolute magnitude	5	0

- (a) (i) Assuming the Sun acts as a black body, calculate the wavelength at which maximum emission occurs in its spectrum.

- (ii) The graph shows the black body radiation curve for the Sun. Use your answer to (i) to enter values on the wavelength axis in the 4 places provided.



- (iii) Without calculation, sketch on the axes above a black body curve for Arcturus.

(4)

- (b) (i) Explain how the information in the table indicates that Arcturus is 100 times brighter than the Sun.

- (ii) Assuming that the power output of Arcturus is 100 times greater than that of the Sun, show that its surface area must be approximately 200 times greater.

(4)
(Total 8 marks)

Q3.

Photographs of lines in the spectrum of the Sun show changes in wavelength due to the Doppler effect. Due to the rotation of the Sun about its axis, one edge of the Sun is approaching the Earth, and the other edge is receding.

(a) Give expressions for the observed change in the wavelength of a line of original wavelength, λ ,

(i) for light coming from the edge which is moving away from the observer at speed v ,

(ii) for light coming from the edge which is moving towards the observer at speed v .

(2)

(b) The apparent wavelength of a line of original wavelength 589 nm is measured from photographs showing opposite ends of the diameter of the Sun. The difference between the readings is 78×10^{-3} nm.

Calculate

(i) the speed, v , of a point on the edge of the Sun,

(ii) the angular speed of rotation of the Sun.
radius of Sun = 7.0×10^8 m

(4)
(Total 6 marks)