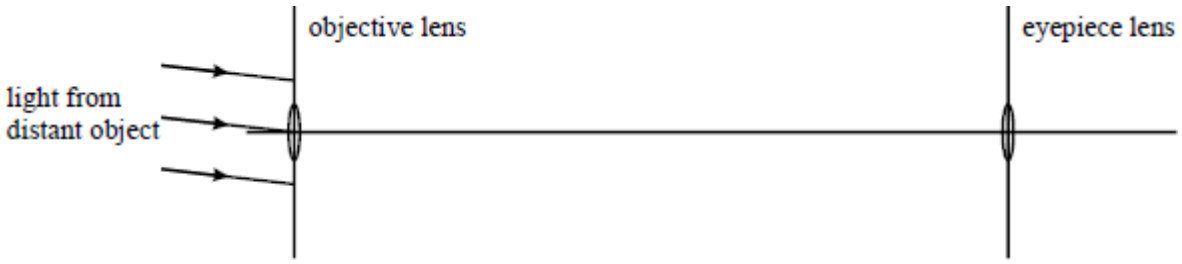
Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

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 _____

_____

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advantage 2 _____

_____

(2)

(Total 8 marks)

Q2.

The charged coupled device (CCD) camera is often used with telescopes because of its high *quantum efficiency*.

(a) State what is meant by quantum efficiency and give a typical value for the quantum efficiency of a CCD.

_____

_____

_____

(2)

(b) Describe the mode of action of a CCD.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(Total 7 marks)

Q3.

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

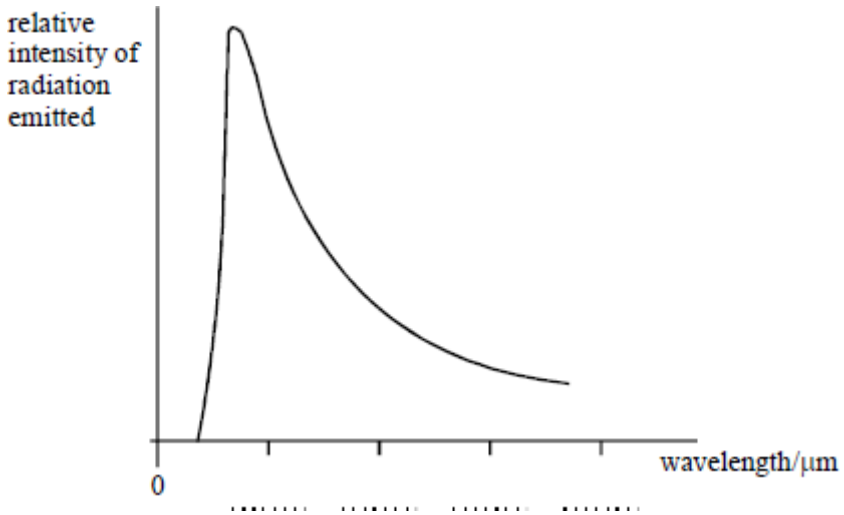
(a) (i) Assuming the Sun acts as a black body, calculate the wavelength at which maximum emission occurs in its spectrum.

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_____

_____

(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)

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