Practice Question Set For A-Level
Subject : Physics
Paper-3 Topic: Section B(SECTION 9_ ASTROPHYSICS)

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Name of the Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

Q1.

(a) Draw a ray diagram to show how a converging lens can be used to form a diminished image of a real object. Label the object, image and principal foci of the lens on your diagram.

(3)

(b) A student experimented with a converging lens whose focal length was known to be approximately 50 cm. She placed an object and screen a fixed distance of 200 cm apart. With the lens 128 cm from the object, she observed a sharp image on the screen.

Calculate the focal length of the lens.

focal length _____ cm

(2)

(c) The lens was used as one of the components of a simple refracting astronomical telescope. State whether the lens formed the eyepiece or objective, giving reasons for your answer.

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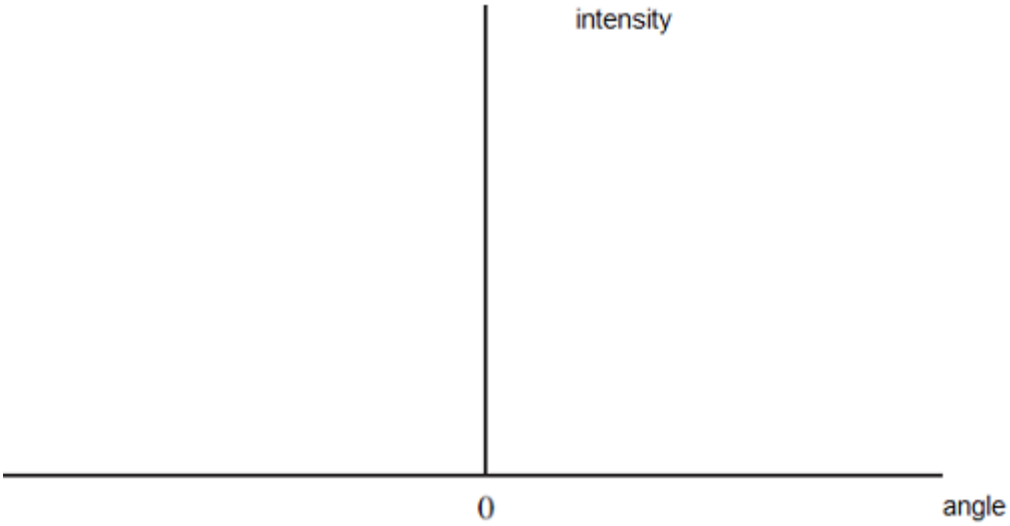
(2)

(Total 7 marks)

Q2.

There is a supermassive black hole at the centre of the Milky Way galaxy. It is difficult to resolve images of the region around this black hole directly.

(a) (i) Sketch, on the axes, the variation in intensity of the diffraction pattern produced when light from a point object passes through a circular aperture.



(2)

(ii) The *Rayleigh criterion* is used to determine the smallest angular separation between two point objects which can be resolved by a telescope. With reference to the diffraction patterns formed, explain what is meant by the Rayleigh criterion. You may draw a diagram to aid your explanation.

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(2)

(b) The supermassive black hole at the centre of the Milky Way galaxy has a mass equal to 4.1 million solar masses.
Calculate the Schwarzschild radius, R_s, for this black hole.
Give your answer to an appropriate number of significant figures.

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R_s _____ m

(3)

(c) Astronomers investigating the supermassive black hole at the centre of the Milky Way galaxy detect radio waves at a frequency of 230 GHz. By correlating the information from several radio telescopes, they can obtain images with the same resolution as a single radio telescope with a diameter of 5000 km.

(i) Calculate the minimum angular separation which could be resolved by a radio telescope of diameter 5000 km detecting waves of frequency 230 GHz.

angular separation _____ rad

(2)

(ii) The centre of the Milky Way galaxy is 25 000 light years from the Earth.

Show that the limit of the resolution of the telescope is approximately five times the angle subtended by the Schwarzschild radius of the black hole at this distance.

(2)

(Total 11 marks)

Q3.

(a) Explain what is meant by a parsec. Draw a labelled diagram in support of your answer.

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(2)

(b) The Hipparcos satellite used the parallax method to measure the distance to more than 100 000 stars with a precision of 0.002 arc seconds.
Calculate, in metres, the maximum distance measurable by Hipparcos.
Give your answer to an appropriate number of significant figures.

distance _____ m

(3)

(c) The star Alpha Capricorni is in fact two stars that appear very close together.
Some data about the two stars are summarised in the following table.

Star	**Distance / pc**	**Apparent magnitude**	**Class**
Alpha-1 capricorni	211	4.3	G
Alpha-2 capricorni	33	3.6	G

(i) Explain how data in the table indicate that the two stars are **not** part of a binary system.

_____

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(1)

(ii) Explain why the angular separation of the two stars changes when observed from the Earth during a 12 month period.

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(1)

(Total 7 marks)

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