7TH BANGLADESH ASTRO-OLYMPIAD

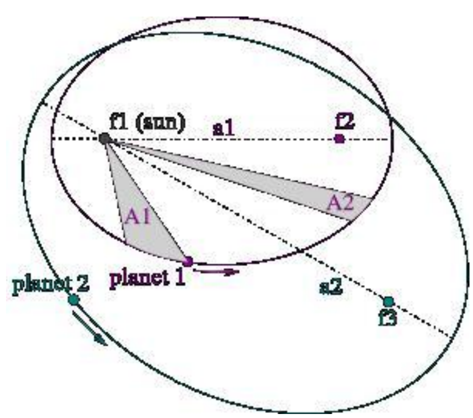
2012

Bangladesh Astro-Olympiad

1. Write down the three Kepler's Laws of Motion?

Solution:

Kepler's laws are:

- The orbit of every planet is an ellipse with the Sun at one of the two foci.
- A line joining a planet and the Sun sweeps out equal areas during equal intervals of time.
- The square of the orbital period of a planet is directly proportional to the cube of the semi-major axis of its orbit.
- 

2. If the square of your age in seconds gives the age of the Universe in seconds, then what is your age?

Solution:

Age of the Universe is about 14 billion years.

If your age in years is Y, then,

$$(Y \times 365.25 \times 86400)^2 = 14 \times 10^9 \times 365.25 \times 86400$$

$$\therefore\ Y^2 = \frac{14 \times 10^9}{365.25 \times 86400}$$

$$\approx \frac{14}{28} \times 10^3 \approx 500$$

$$\therefore Y \approx \sqrt{500} \approx 22\ years\ (Ans.)$$

3. Consider the following statements:

• A central eclipse is the one where central point of lunar disk exactly passes over the central point of solar disk.

• An eclipse is called a total Eclipse if it is seen as total from at least some point on the earth.

• An eclipse is called a partial Eclipse if it is not seen as total / annular from any point on the earth.

Now choose the incorrect statement/s from below:

A. All central eclipses are total.

B. All total eclipses are central.

C. All partial eclipses are non-central

D. All non-central eclipses are partial

Solution:

First one is incorrect as some central eclipses can be annular only. Second one is incorrect as one can get a total eclipse even when the two disks are slightly off-center with respect to each other. Third one is correct. Fourth one is incorrect for the reason explained above regarding the second option.

4. What is Aurora?

Solution:

An aurora (plural: auroras or aurorae) is a natural light display in the sky particularly in the high latitude (Arctic and Antarctic) regions, caused by the collision of energetic charged particles with atoms in the high altitude atmosphere (thermosphere). The charged particles originate in the magnetosphere and solar wind and, on Earth, are directed by the Earth's magnetic field into the atmosphere. Aurora is classified as diffuse or discrete aurora. Most aurorae occur in a band known as the auroral zone which is typically 3° to 6° in latitudinal extent and at all local times or longitudes. The auroral zone is typically 10° to 20° from the magnetic pole defined by the axis of the Earth's magnetic dipole. During a geomagnetic storm, the auroral zone will expand to lower latitudes. The diffuse aurora is a featureless glow in the sky which may not be visible to the naked eye even on a dark night and defines the extent of the auroral zone. The discrete aurora are sharply defined features within the diffuse aurora which vary in brightness from just barely visible to the naked eye to bright enough to read a newspaper at night. Discrete aurorae are usually observed only in the night sky because they are not as bright as the sunlit sky. Aurorae occur occasionally poleward of the auroral zone as diffuse patches or arcs (polar cap arcs) which are generally invisible to the naked eye.

5. Describe different methods to measure the distance to stars?

Solution:

The first technique uses triangulation (a.k.a. parallax). The Earth's orbit around the sun has a diameter of about 186 million miles (300 million kilometers). By looking at a star one day and then looking at it again 6 months later, an astronomer can see a difference in the viewing angle for the star. With a little trigonometry, the different angles yield a distance. This technique works for stars within about 400 light years of earth.

There is no direct method currently available to measure the distance to stars farther than 400 light years from Earth, so astronomers instead use brightness measurements. It turns out that a star's color spectrum is a good indication of its actual brightness. The relationship between color and brightness was proven using the several thousand stars close enough to earth to have their distances measured directly. Astronomers can therefore look at a distant star and determine its color spectrum. From the color, they can determine the star's actual brightness. By knowing the actual brightness and comparing it to the apparent brightness seen from Earth (that is, by looking at how dim the star has become once its light reaches Earth), they can determine the distance to the star.

6. If you hold a magnifying glass of focal length 10 cm in the sunlight and place a piece of paper at its focus, you can burn a hole in the paper. What could be the size of this hole?

Solution:

If the Magnification is given by ***M***, Object Distance by ***u***, Object Size by ***O*, **Image Distance by ***v*** and Image Size by ***I***, then,

$$M = \frac{v}{u} = \frac{I}{O}$$

$$\frac{I}{7 \times 10^8} \approx \frac{f}{500c}$$

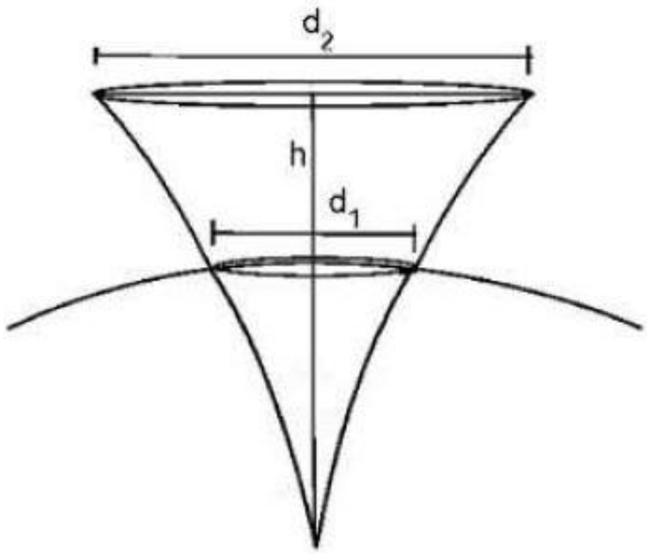
$$\therefore I \approx \frac{0.1 \times 7 \times 10^8}{500 \times 3 \times 10^8}$$

$$\approx \frac{7}{15} \times 10^{-3}\, m \approx 0.5\, mm\ (Ans.)$$

7. Hot solar plasma is emitted from surface of a circular sunspot whose diameter is 10,000 km. When the plasma reaches the height of 16,000 km above the surface of the sun its horizontal cross section is measured to have diameter of 90,000km. Assuming that the edge of the plasma cone is parabolic, find the depth inside the sun from which the plasma started. Assume that the viscosity and magnetic permeability remains same inside and outside the solar surface.

Solution:

$$\begin{aligned} \frac{d_1}{d_2} &= \frac{r^2}{(r+h)^2} \\ \therefore \frac{1}{9} &= \frac{r^2}{(r+h)^2} \\ \therefore \frac{1}{3} &= \frac{r}{(r+16000)} \\ \therefore r &= 8000km \end{aligned}$$



8. Write the Full Form.

a) BAA

b) GRS

c) IR

d) LASER

e) RSA

Solution:

a) Bangladesh/British Astronomical Association
b) Gamma Ray Spectrometer/Great Red Spot
c) InfraRed
d) Light Amplification by Stimulated Emission of Radiation
e) Russian Space Agency