

(4)

Or

Examine the effect of refraction on the times of rising and setting of the sun.

- (b) What do you mean by sidereal day and mean solar day? For a star, prove that

$$\text{sidereal time} = \alpha + H$$

where α is the right ascension and H is the hour angle of the star. 2+2=4

6. (a) Define lunar eclipse. With a neat diagram, discuss the commencement of lunar eclipses of different types. 5

- (b) Show that the angle subtended at the earth's centre by the centre of the sun and the moon at the beginning of solar eclipse is

$$D = r_s + r_m + P' - P$$

where r_s and r_m are the angular radii of the sun and the moon respectively and P, P' are their parallaxes. 5

Or

Define geocentric parallax. What is meant by horizontal parallax? Discuss the effects of geocentric parallax on the right ascension and declination of a star. 1+2+7=10

3 (Sem-5) MAT M 3

2019

MATHEMATICS

(Major)

Paper : 5.3

(Spherical Trigonometry and Astronomy)

Full Marks : 60

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Answer the following questions : 1×7=7

- (a) Write down the formula that relates three sides and two angles of a spherical triangle.
- (b) State the Napier's rules to write all formulae of a right-angled spherical triangle.
- (c) What are the approximate right ascension and declination of the sun on 21st March and 21st September?
- (d) Write the limits between which the sum of the three angles of a spherical triangle lie.

(2)

- (e) Which points on the celestial sphere are called cardinal points?
- (f) Distinguish between geocentric and heliocentric conjunction of two planets.
- (g) Explain briefly where must a star be situated as to have no displacement due to annual parallax.

2. Answer the following questions : $2 \times 4 = 8$

- (a) Prove that altitude of celestial pole is equal to the latitude of the place of the observer.
- (b) Describe with a suitable diagram, what is meant by rising and setting of a star.
- (c) Prove that the sides of a polar triangle are supplements of the angles of its primitive triangle.
- (d) If T is the orbital period of a planet, show that a small increase Δa in semimajor axis a will produce an increase $\frac{3T}{2a} \Delta a$ in the period.

3. Answer any *three* parts of the following :

$5 \times 3 = 15$

- (a) The right ascension and declination of a star are given. Explain, how you will find celestial longitude and latitude.

20A/271

(Continued)

(3)

- (b) If a is the sun's altitude in the prime vertical at a place of latitude ϕ and L is the longitude, prove that

$$\phi = \sin^{-1}(\sin \epsilon \sin L \operatorname{cosec} a)$$

ϵ being the obliquity of the ecliptic.

- (c) Show that the velocity of a planet in its elliptic orbit is

$$v^2 = \mu \left(\frac{2}{r} - \frac{1}{a} \right)$$

where $\mu = G(M+m)$ and a is the semimajor axis of the orbit.

- (d) Prove that the apparent path of a star on account of parallax is an ellipse.
- (e) If h and H be the hour angles of a star of declination δ on the prime vertical (west) and at setting respectively, for a place in north latitude, show that

$$\operatorname{cosh} \cos H + \tan^2 \delta = 0$$

4. (a) State and prove the cotangent formula related to a spherical triangle. $1+5=6$

- (b) In a spherical triangle ABC , prove that

$$\frac{\sin(A+B)}{\sin C} = \frac{\cos a + \cos b}{\operatorname{cosec} c} \quad 4$$

5. (a) Derive Cassini's formula for refraction in the form

$$\sin R = \frac{a \sin \zeta}{a+h} \sqrt{\mu^2 - 2\mu \cos R + 1}$$

stating the assumption used. a , h , ζ have their usual meanings. 6

20A/271

(Turn Over)