Celestial Trigonometry and Pacific Navigation

Trigonometry · Answer Key · 20 Questions

1. In spherical trigonometry, what is the law used by Polynesian wayfinders to calculate the great-circle distance between two Pacific islands using celestial coordinates?

A) Law of Cosines for sides
B) Law of Sines
C) Pythagorean Theorem
D) Law of Tangents

2. The declination of the star Sirius, used by Pacific navigators for latitude determination, is approximately -16.7 degrees. What is its polar distance in a trigonometric coordinate system?

A) 106.7 degrees
B) 73.3 degrees
C) 16.7 degrees
D) 90 degrees

3. When calculating the zenith distance of a star at an island in the South Pacific, what trigonometric function relates the altitude of the star to the observer's latitude?

A) Sine
B) Cosine
C) Tangent
D) Secant

4. The IAU defined the astronomical unit (AU) based on the parallax of the Sun. What trigonometric value is used to calculate the distance to a planet given its parallax angle?

A) sin(p)
B) tan(p)
C) cot(p)
D) csc(p)

5. To determine the true azimuth of a celestial body, Pacific navigators utilized the spherical triangle formed by the pole, the zenith, and the star. Which law resolves this triangle?

A) Napier's Rules
B) Haversine Formula
C) Brahmagupta's Formula
D) Heron's Formula

6. The Earth's orbital eccentricity (e = 0.0167) affects the calculation of the Sun's position. What trigonometric identity is used in the equation of center to relate the true anomaly to the mean anomaly?

A) Taylor series expansion
B) Double angle formula
C) Product-to-sum identity
D) Inverse tangent

7. At the Mauna Kea Observatory, astronomers measure the angular diameter of distant stars. If the angle is theta, what trigonometric relationship calculates the physical diameter D at distance L?

A) D = L sin(theta/2)
B) D = 2L tan(theta/2)
C) D = L cos(theta)
D) D = L sec(theta)

8. In the context of the Pacific's night sky, the Southern Cross (Crux) is used for latitude. If the stars Gacrux and Acrux define a line, what trigonometric function describes the variation of their separation due to atmospheric refraction?

A) Tangent of the altitude
B) Sine of the azimuth
C) Cosine of the zenith
D) Secant of the refraction angle

9. What is the value of the parallax constant used in astronomical trigonometric distance measurements, defined as the angle subtended by one AU at a distance of one parsec?

A) 1 arcsecond
B) 1 radian
C) 1 degree
D) 1 arcminute

10. In planetary motion, Kepler's equation M = E - e sin E requires the conversion of what trigonometric parameter?

A) Eccentric anomaly
B) True anomaly
C) Mean anomaly
D) Phase angle

11. The 'star compass' used by traditional Pacific voyagers divides the horizon into segments. If there are 32 primary points, what is the trigonometric increment in degrees?

A) 11.25
B) 10.5
C) 12.5
D) 9.0

12. When observing a lunar eclipse from a Pacific island, the shadow of the Earth is used to calculate the Moon's distance. Which trigonometric ratio relates the Earth's radius to the shadow cone angle?

A) Sine
B) Cosine
C) Tangent
D) Cotangent

13. The angular separation between two planets viewed from Fiji is calculated using the spherical law of cosines. Given sides a and b and included angle C, what is the formula for side c?

A) cos(c) = cos(a)cos(b) + sin(a)sin(b)cos(C)
B) cos(c) = sin(a)sin(b) + cos(a)cos(b)cos(C)
C) c = a + b - 2ab cos(C)
D) sin(c) = sin(a)cos(b) + cos(a)sin(b)

14. What trigonometric term describes the difference between the geocentric and heliocentric positions of a planet as observed from the Earth?

A) Parallactic angle
B) Phase angle
C) Elongation
D) Inclination

15. In spherical geometry, the sum of the angles of a triangle on a sphere is always greater than 180 degrees. This excess relates to the area of the triangle via which trigonometric function?

A) Sine
B) Cosine
C) Tangent
D) Secant

16. To calculate the solar altitude for a given time and date at a Pacific island, astronomers use the formula sin(h) = sin(phi)sin(delta) + cos(phi)cos(delta)cos(H). What does H represent?

A) Hour angle
B) Declination
C) Latitude
D) Zenith

17. The maximum elongation of Venus is the point where the Earth-Venus-Sun angle is 90 degrees. Using trigonometry, which side of the triangle is the sine of the elongation?

A) Earth-Sun distance
B) Earth-Venus distance
C) Venus-Sun distance
D) Venus radius

18. The obliquity of the ecliptic, approximately 23.4 degrees, requires what trigonometric adjustment when calculating the seasonal solar declination?

A) Sine conversion
B) Cosine integration
C) Tangent projection
D) Secant offset

19. For a stellar object passing through the observer's meridian at a Pacific island, what is the trigonometric relationship between declination (delta), latitude (phi), and zenith distance (z)?

A) z = phi - delta
B) z = phi + delta
C) z = delta - phi
D) z = 90 - (phi + delta)

20. When calculating the aberration of light, the shift in the apparent position of a star is a trigonometric function of the ratio between Earth's orbital velocity and what?

A) Speed of light

B) Escape velocity

C) Escape velocity

D) Angular momentum