

The Celestial Sphere

For the purposes of navigation, we have to assume that the earth is the centre of the universe and that the sun, the moon, the planets and all the stars are situated around the earth equidistantly, making up a large sphere surrounding the earth and known as the celestial sphere.

<i>Celestial Poles</i>	The points on the celestial sphere right above the poles of the earth.
<i>Equinoctial</i>	The projection of the earth's equator onto the celestial sphere. Referred to as the celestial equator.
<i>Celestial Meridians</i>	Semi great circles whose planes pass through the poles cut the equinoctial at a right angle. Referred to as hour circles.
<i>Declination</i>	The arc of the celestial meridian passing through a heavenly body, contained between the body and the equinoctial, measured north or south of equinoctial. Referred as celestial latitude.
<i>Ecliptic</i>	The great circle on the celestial sphere that represents the annual path of the sun, whose plane inclines with the equinoctial at an angle of 23° 27'.
<i>First Point of Aries (Y)</i>	The point on the celestial sphere where the ecliptic cuts the equinoctial when the sun just passes the equinoctial from south to north, also known as the vernal equinox position of the sun, which occurs on 21 st of March.
<i>First Point of Libra</i>	The point on the celestial sphere where the ecliptic cuts the equinoctial when the sun just passes the equinoctial from north to south. Also known as the autumnal equinox position of the sun, which occurs on 23 rd of September.
<i>Sidereal Hour Angle (S.H.A.)</i>	The arc of the equinoctial measured westward, contained between the first point of Aries and the celestial meridian passing through the body. Due to the movement of the first point of Aries, the S.H.A. of the heavenly bodies also changes, but very slightly, not more than 1 minute per year.
<i>Greenwich Hour Angle (G.H.A.)</i>	The arc of the equinoctial measured westward from the meridian of Greenwich to the meridian passing through the body. In the Nautical Almanac, the G.H.A.s of the first point of Aries, the sun, the moon and some planets are given. The G.H.A. for stars can be found by adding the S.H.A. of a particular star to the G.H.A. of the first point of Aries; if it's greater than 360°, then 360° is subtracted.

$$\text{G.H.A.} = \text{S.H.A.} + \text{G.H.A.}_{\text{Aries}}$$

Local Hour Angle (L.H.A.) The arc of the equinoctial measured westward from the observer's meridian to the meridian passing through the celestial body.

$$\text{L.H.A.} = \text{G.H.A.} - \text{West Longitude}$$

$$\text{L.H.A.} = \text{G.H.A.} + \text{East Longitude}$$

Geographical Position of the body (G.P.) The geographical position of the heavenly body is defined by the declination and the G.H.A. of the body.

Zenith The point on the celestial sphere directly above the observer, denoted by Z. The point is also on the celestial sphere, but is opposite from Zenith and is called Nadir; however, nadir is not significant in navigation.

Vertical Circles The great circles on the celestial sphere that pass through the zenith. The observer's meridian is one of the great circles.

Prime Vertical The vertical circle that passes through the East and West points of the horizon.

Zenith Distance The arc of the vertical circle contained between the body and the zenith.

Polar Distance The arc of the celestial meridian contained between the body and the pole.

Circumpolar Bodies The bodies that are visible above the horizon for the full 24 hours. For a body to be circumpolar, two conditions must be met:

1. The declination of the body must have the same name as the observer's latitude.
2. The polar distance of the body must be less than the observer's latitude.