# Sun Position: Declination, Zenith, Altitude, Azimuth and Day Length

Solar declination, hour angle, zenith and altitude angles, solar azimuth, sunrise and sunset times, day length and air mass for any latitude, day and time.

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Latitude (north positive, south negative) | 28.600 | ° |
| Day of the year (1 = 1 January, 365 = 31 December) | 172.00 | |
| Solar time (24-hour clock) | 12.000 | h |
| Site altitude above sea level (for air mass) | 216.00 | m |
| Declination formula | Spencer (1971), more precise | |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Declination | 23.452 | ° |
| Hour angle | 0 | ° |
| Zenith angle | 5.1480 | ° |
| Solar altitude angle | 84.852 | ° |
| Solar azimuth (south 0, west positive) | 9.6215e-06 | ° |
| Sunset hour angle | 103.68 | ° |
| Day length | 13.824 | h |
| Sunrise (solar time) | 5.0879 | h |
| Sunset (solar time) | 18.912 | h |
| Air mass (Kasten and Young) | 0.97838 | |

**Notes for this case**

- Times are solar time; use the solar time calculator to convert to clock time.

## Formula and method

$$\delta = 23.45^\circ \sin\left(360\frac{284+n}{365}\right)$$

$$\cos\theta_z = \cos\phi\cos\delta\cos\omega + \sin\phi\sin\delta$$

$$\gamma_s = \text{sign}(\omega)\left|\cos^{-1}\frac{\cos\theta_z\sin\phi - \sin\delta}{\sin\theta_z\cos\phi}\right|$$

$$\cos\omega_s = -\tan\phi\tan\delta, \quad N = \frac{2}{15}\omega_s$$

### Variables

| | | |
|---|---|---|
| $\phi$ | Latitude (north positive, south negative) | rad |
| $n$ | Day of the year (1 = 1 January, 365 = 31 December) | - |

| | | |
|---|---|---|
| $t_s$ | Solar time (24-hour clock) | s |
| $h$ | Site altitude above sea level (for air mass) | m |
| $\delta$ formula | Declination formula | - |
| $\delta$ | Declination | rad |
| $\omega$ | Hour angle | rad |
| $\theta_z$ | Zenith angle | rad |
| $\alpha_s$ | Solar altitude angle | rad |
| $\gamma_s$ | Solar azimuth (south 0, west positive) | rad |
| $\omega_s$ | Sunset hour angle | rad |
| $N$ | Day length | s |
| $t_{rise}$ | Sunrise (solar time) | s |
| $t_{set}$ | Sunset (solar time) | s |
| $m$ | Air mass (Kasten and Young) | - |

### Method and standards

Spherical trigonometry of the sun's apparent motion.

### Assumptions and limits

- Geometric sun position without refraction; the declination formulas are good to about 0.5° (Cooper) and 0.05° (Spencer).

## Report details

| | |
|---|---|
| Report reference | FCC-4JMB-PTQX (the same inputs always give the same reference) |
| Generated | 23 November 2026, 17:34 UTC |
| Calculator | Sun Position: Declination, Zenith, Altitude, Azimuth and Day Length |
| Method last reviewed | 17 November 2026 |
| Software release | FireCAD Calc, release of 22 November 2026 |
| Release checks | 5 reference cases of this calculator, computed independently, are checked on every release |

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

### This calculator online

https://calc.firecad.com/environmental/solar-thermal/sun-position-zenith-azimuth

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.