First, compute D, the number of days and fraction (+ or –) from the epoch referred to as "J2000.0", which is 2000 January 1.5, Julian date 2451545.0:

D = JD – 2451545.0

where JD is the Julian date of interest. Then compute

|  |  |
| --- | --- |
| Mean anomaly of the Sun: | g = 357.529 + 0.98560028 D |
| Mean longitude of the Sun: | q = 280.459 + 0.98564736 D |
| Geocentric apparent ecliptic longitude of the Sun (adjusted for aberration): | L = q + 1.915 sin g + 0.020 sin 2g |

where all the constants (therefore g, q, and L) are in degrees. It may be necessary or desirable to reduce g, q, and L to the range 0° to 360°.

The Sun's ecliptic latitude, b, can be approximated by b=0. The distance of the Sun from the Earth, R, in astronomical units (AU), can be approximated by

R = 1.00014 – 0.01671 cos g – 0.00014 cos 2g

Once the Sun's apparent ecliptic longitude, L, has been computed, the Sun's right ascension and declination can be obtained. First compute the mean obliquity of the ecliptic, in degrees:

e = 23.439 – 0.00000036 D

Then the Sun's right ascension, RA, and declination, d, can be obtained from

tan RA = cos e sin L / cos L  
sin d = sin e sin L

RA is always in the same quadrant as L. If the numerator and denominator on the right side of the expression for RA are used in a double-argument arctangent function (e.g., "atan2"), the proper quadrant will be obtained. If RA is obtained in degrees, it can be converted to hours simply by dividing by 15. RA is conventionally reduced to the range 0h to 24h.

Other quantities can also be obtained. [The Equation of Time](https://aa.usno.navy.mil/faq/eqtime), EqT, apparent solar time minus mean solar time, can be computed from

EqT = q/15 – RA

Declination: -2.1866138700789683 degrees (astropy) -2° 11' 11.81"

Equation of Time: 9.527158448822206 minutes (manual)