Basic Calculations Pertaining to the Orbit of the Earth with Respect to the Seasons of the Year and the Received Power and Energy of the Sun by the Earth.

A Bit of History

Originally, the people would look up at the Sun, the Moon, the Planets, and the stars in the Celestial Sphere. This was their clock, their calendar, and their sense of wonderment. By day they would observe the rising and the setting of the Sun. By night they would observe the rising and the setting of particular stars. Between the two they would observe the rising and the setting of the Moon along with its day by day distinct phases. They created a “language of the stars” that we still use today, howbeit poetically without real comprehension. They quickly learned that all of the objects in the Celestial Sphere appeared to revolve about a common center in the sky.

Only the Spanish in the late Middle Ages ever imagined the Earth as being flat. It was a case of believe or burn. However, given the arrogance of humanity imagining themselves at the center of creation, it was natural for them to imagine that the Celestial Sphere was revolving about the Earth.

Then along came Copernicus who suggested that the Earth was revolving inside of a fixed Celestial Sphere. This threatened the lucrative operations of the Church.

Following Copernicus, Galileo using the first known telescope, (we obviously have no knowledge of any unknown telescopes), observed the motions of the moons of Jupiter revolving about Jupiter. The Church leaders went postal!

At this time both the adherents of both Copernicus and Galileo still imagined that the planets had perfect circular orbits. This helped to mitigate the fears of the Church to a limited degree. Then along came Johannes Kepler who was followed by Isaac Newton. These two men introduced the horrific idea, to the church, of imperfection in the Celestial Sphere.

Johannes Kepler was 27 Dec 1571 in Weil der Stadt in Germany. He died on 15 Nov 1630 in Regensburg in Germany. These dates may or not be relevant to the calendar at the time of this writing due to the time change in the British Empire in 1752.

In 1609 Kepler published his work entitled ***“Astronomia Nova”*** where he introduced the his two laws of planetary motions. Then in 1619 he published a work entitled ***“Harmonices Mundi”*** where he introduced his third law of planetary motions.

1. Law I (1609): The orbit of a planet is an ellipse with the Sun at one of the foci.
2. Law II (1609): A line segment joining a planet and the Sun sweeps at equal areas during equal intervals of time.
3. Law III (1619): The square of a planet’s orbital period is proportional to the cube of the length of the semi-major axis of the orbit.

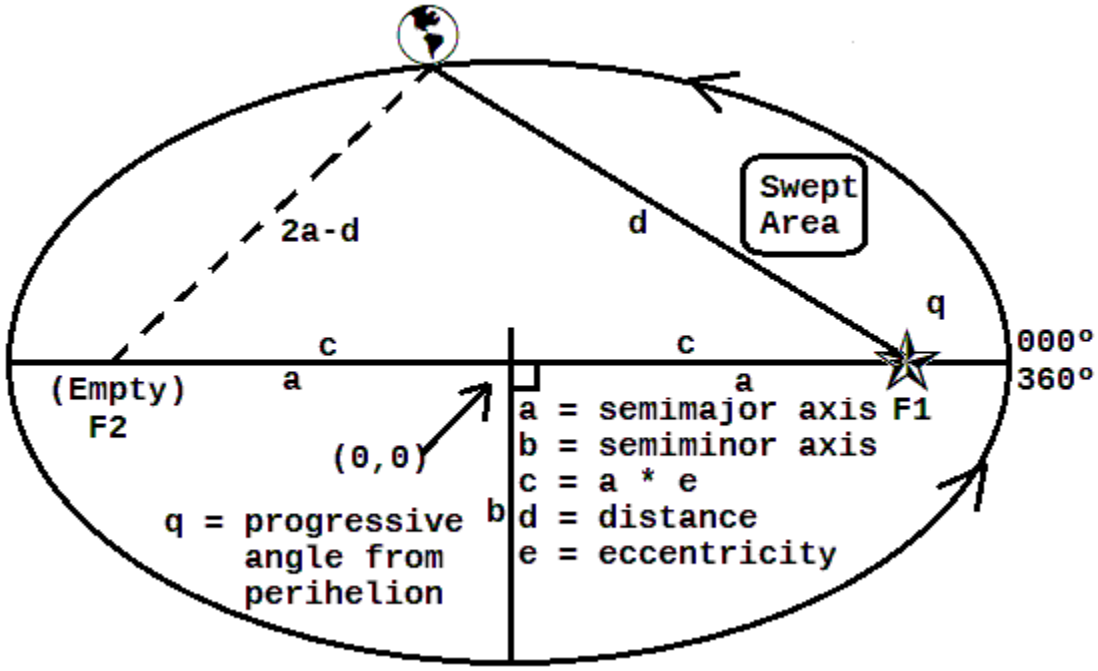
On 04 Jan 1643 by the current reckoning, but by the older reckoning on 25 Dec 1642, Isaac Newton was born in Woolsthorpe-by-Casterworth in Lincolnshire, England. On 31 Mar 1727 by the current reckoning, but by the older reckoning on 20 Mar 1726, he died in Kensington in Middlesex in Great Britain.

Newton’s great work was entitled ***“Philosophiæ Naturalis Principia Mathematica”***, commonly referred to simply as the “Principia”, published in 1687.

Kepler’s three laws assumed that the Sun was fixed in space and that the planets simply revolved about the Sun each in their own independent orbit. Newton’s laws of universal gravitation muddied the pool by suggesting that all of the bodies including the Sun were gravitationally interacting with one another, (it takes two to tango).

The Orbit of the Earth

Let us now consider the mathematics of the orbit of the Earth. We will keep it simple using restricting ourselves to the ideal of the first and second law of Kepler. This modeling will assume a finite point mass for the Sun and a zero point mass for the Earth and all the other planets in accordance with the laws of Newton.



Here is the model that shall be employed in this discussion. The final formulas will be given as well as the fixed constants. For the sake of brevity, the details of intermediate equations may not be shown. The mathematically inclined may wish to confirm the formulas. There will be a bit of integral calculus as well. The latter is not as complicated as it may seem. All integral calculus does is to work out the accumulated area between the [y = 0] and the calculated value of [y] as a function of [x]. This can be done by any means available given the particular situation.

Before going on to the mathematical formulas, the applicable variables need to be defined. Any symbol may act as a variable. In this case, the lower case alphanumeric English symbols will be employed. Single character symbols will be preferred as a matter of convenience. The variables include a number of given parameters and a series of calculated parameters. This list is only an initial set of defined variables. Others will be added as we go along.

1. **[a]:** This is a given parameter. **[a]** is the variable that represents the semi-major axis of the Keplerian orbit of the planet about its Sun. The value of [a] for the Keplerian orbit of the Earth is **149,570,000 km**.
2. **[b]:** This is a calculated parameter. **[b]** is the variable that represents the semi-minor axis of the Keplerian orbit of the planet about its Sun.
3. **[c]:** This is a calculated parameter. **[c]** is the variable that represents the distance between the center of the ellipse and either one of the two foci. [c] is calculated as the product of the semi-major axis [a] and the eccentricity [e]. It is always given as a positive value. The value of [c] for the Keplerian orbit of the Earth is **2,460,000 km**.
4. **[d]:** This is a calculated variable. **[d]** is the variable that represents the distance between the Planet and its Sun.
5. **[e]:** This is a given parameter. **[e]** is the variable that represents the eccentricity of the Keplerian orbit of the Planet about its Sun. It is always given as a proportion in relation to the semi-major axis [a]. The value of [e] for the Keplerian orbit of the Earth is **0.0167**.
6. **[q]:** This is the independent variable. **[q]** is the variable that represents the angle of the sweep from perihelion. All of the other desired returns are calculated from the angle [q].

7. **[r]:** This is a given parameter. **[r]** is the variable that represents the angle between the ascending node of the inclination of the planet to the ecliptic and perihelion of the orbit of the planet with respect to the Sun. The CRC gives this longitude of perihelion for the Earth as **101.983º** going one way. However, the other way is **78.018º** This latter is the value that will be employed. The data was taken from the 62nd (1981-1982) edition of the CRC Handbook of Chemistry and Physics.
8. **[sm]**: This is a given parameter. **[sm]** is the variable that represents the mean power of the solar radiation for when the Planet is at a distance [d] from the Sun equal to its semi-major axis [a]. The value of [sm] for the Earth is **1.373 kw/m²**. The calculations for [s] require this mean solar constant.
9. **[um]:** This is a given parameter. **[um]** represents the mean equilibrium temperature of the Sun when the Sun is at a distance [d] equal to the semi-major axis [a]. It is expressed with respect to absolute zero. The equilibrium temperature varies as the 4th root of the radiation or the square root of the distance. The value of [um] for the Earth is **394K or 121ºC or 250ºF**. The mean formulas require the **394K** temperature.

Given: semi-major axis [a] = 149,570,000 km
and eccentricity [e] = 0.0167

$c = a \cdot e \quad a^2 = b^2 + c^2 \quad b = \sqrt{a^2 - c^2}$

[c] = 2,460,000 km and [b] = 149,550,000 km

It is from these given and calculated parameters that the essential details regarding the effect of the Sun on the Earth shall be calculated.

The next four variables to be introduced are for the [x] coordinate, the [h] offset of the x-coordinate, the [y] coordinate, the [k] offset of the y-coordinate. Of these four variables, only the x-coordinate is actually employed. This is because for these arguments the (x,y) coordinates at the center of the ellipse given as (h,k) has an assigned value of (0,0) and the y-coordinate is avoided. The x-coordinate itself is only used as an intermediary.

1. **[x]:** This variable is an active independent intermediary. [x] represents the independent orthogonal x-coordinate of the planet. For these arguments [x] is used as an independent intermediary for angle [q].
2. **[h]:** This variable is a given parameter. [h] represents the x-coordinate value of the center of the ellipse. For these arguments [h] is assigned a value of zero.
3. **[y]:** This variable is a dependent variable. [y] represents the dependent orthogonal y-coordinate of the planet as a function of [x].
4. **[k]:** This variable is a given parameter. [k] represents the y-coordinate value of the center of the ellipse. For these arguments [k] is assigned a value of zero.

Here are the standard orthogonal coordinate equations for the ellipse.

$$\frac{(x-h)^2}{a^2}+\frac{(y-k)^2}{b^2}=1 \qquad \begin{matrix} h=0 \\ k=0 \end{matrix} \qquad \frac{x^2}{a^2}+\frac{y^2}{b^2}=1$$

$$y^2=\frac{a^2\cdot b^2-b^2\cdot x^2}{a^2} \qquad y=+/-\frac{b}{a}\cdot\sqrt{a^2-x^2}$$

Distance between Planet and Sun

For doing the calculations it is needful to the distance between the planet and the Sun as a function of the x-coordinate. It is also needful to know the x-coordinate as a function of the distance between the Planet and the Sun.

The semi-minor axis [b] is very sensitive. [c] is not so sensitive. Thus [a] squared minus [c] squared is substituted for [b] squared. The equations are expanded then reduced.

Given $d^2 = (x-c)^2 + y^2$ $\qquad b^2 = a^2 - c^2$

$$y^2 = \frac{b^2 \cdot (a^2 - x^2)}{a^2} = \frac{(a^2 - c^2) \cdot (a^2 - x^2)}{a^2}$$

$$d^2 = (x-c)^2 + \frac{(a^2 - x^2) \cdot (a^2 - c^2)}{a^2}$$

$$d^2 = \frac{a^2 \cdot (x^2 - 2 \cdot c \cdot x + c^2) + (a^2 - x^2) \cdot (a^2 - c^2)}{a^2}$$

$$d^2 = \frac{a^2 \cdot x^2 - a^2 \cdot 2 \cdot c \cdot x + a^2 \cdot c^2 + a^4 - a^2 \cdot c^2 - a^2 \cdot x^2 + c^2 \cdot x^2}{a^2}$$

$$d^2 = \frac{a^4 - a^2 \cdot c \cdot x + c^2 \cdot x^2}{a^2} = a^2 - 2 \cdot c \cdot x + \frac{c^2 \cdot x^2}{a^2} = \left(a - \frac{c \cdot x}{a}\right)^2$$

$$d(x) = a - \frac{c}{a} \cdot x \qquad \cdots\cdots\cdots\cdots \qquad x(d) = \frac{a}{c} \cdot (a - d)$$

There is an issue with this particular reduction. It may be clearly demonstrated that the result is a linear progression with respect to [x]. However, this linear progression only occurs when the distance is rooted to either (-c,0) or (+c,0). All other origins will return a curve.

Calculating x(q) and q(x)

In order to calculate x(q) and q(x), it was first necessary to calculate d(x) and x(d).

The orbit of the Earth is nearly a perfect circle. It varies in radius by a mere 20,000 km. This is about 1.5 times the diameter of the Earth. By contrast, the distance between the Earth and the Sun varies by ±2,460,000 km or collectively by 4,920,000 km. This is nearly 250 times greater. The general plot would show a circular orbit with the Sun clearly off-center. Because of this lesser sensitivity, the value of [c] is preferred to that of semi-minor axis [b] in doing the calculations. Thus it was first necessary to determine the value of [c] from the clearly defined semi-major axis [a] and the eccentricity [e].

The usage of tangents should be avoided. The division by sines and cosines should be avoided unless they have been adjusted to preclude division by zero. Cosines are preferred because of the greater range. Thus, the following equations will employ the cosine of angle [q] with respect to the x-coordinate [x] and the distance between the Planet and its Sun. Here are the equations for q(x) and x(q).

$$\cos(q)(x) = \cos\left(\frac{x-c}{d}\right) = \cos\left(\frac{x-c}{a-\frac{c}{a}\cdot x}\right) = \cos\left[\frac{a\cdot(x-c)}{a^2-c\cdot x}\right]$$

$$q(x) = +/- \operatorname{acos}\left[\frac{a\cdot(x-c)}{a^2-c\cdot x}\right] \qquad x(q) = \frac{a^2\cdot\cos(q)+a\cdot c}{a+c\cdot\cos(q)}$$

Observe that q(x) is limited to an angle of **[0 ≤ q ≤ π]** with respect to perihelion **(0º ≤ q ≤ 180º)**. Thus, q(x) has been given a +/- sign to complete the Circle. x(q) has no such issue. Also observe that x(d) may me inserted in place of [x] in q(x) for q(d).

Calculating for the Solar Constant

The solar constant represents the intensity of the energy inherent in solar radiation for a given distance from the Sun. It is commonly expressed in terms of kilowatt-hours per hour per square meter. This is the expanded view. By convention because the hour is our applicable base unit, this form of expression is “simplified” to kilowatts per square meter. It has also been expressed in other units as well.

The solar constant is not truly constant. It varies inversely as the square of the distance of the planet from its Sun. A baseline constant for the particular Planet must be established in order to calculate the actual solar constant for a particular position in the orbit of the Planet This has already been given as [sm}. The preferred baseline of choice is when the distance [d] between the Planet and its Sun is equal to the semi-major axis [a] of the orbit of the planet. For the Earth this baseline comes to 1.373 kilowatts per square meter at a distance of 149,570,000 km.

Here is a new variable and its assignment.

1. **[s]:** This variable is a calculated value. **[s]** represents the value of the calculated solar constant as a function of [x], [d], or [q].

$$s = sm\cdot\left(\frac{a}{d}\right)^2 = sm\cdot\left(\frac{a}{a-\frac{c}{a}\cdot x}\right)^2 = sm\cdot\left[\frac{a}{\left(a-\frac{c}{a}\cdot\frac{a^2\cdot\cos(q)+a\cdot c}{a+c\cdot\cos(q)}\right)}\right]^2$$

$$d(x) = a-\frac{c}{a}\cdot x \qquad x(q) = \frac{a^2\cdot\cos(q)+a\cdot c}{a+c\cdot\cos(q)}$$

Observe that this value for the solar constant [s] does not make allowances for the variations due to the law of universal gravitation as per Isaac Newton.

Calculating for the Equilibrium Temperature

"What goes up, must come down, spinning wheel, spinning round." These words from the well known song illustrate perfectly the concept of the equilibrium temperature.

Our Sun has a calculated surface temperature of around 5,667 Kelvin at a surface radius of 695,950 km. Kelvin is the Celsius measure of the absolute temperature. It is always positively expressed with respect to absolute zero.

With respect to absolute zero, the power of the radiation will vary as the 4^{th} power of the temperature. Conversely, the temperature will vary as the 4^{th} root of the radiation.

The power of the radiation of the Sun per unit area varies inversely as the square of the distance. The target of the radiation will warm up until it reaches a temperature that will cause it to re-radiate as much radiation as it is receiving. The 4^{th} root of the difference with respect to the baseline [um] generates the equilibrium temperature. At this point a variable [u] will be introduced.

1. **[u]:** This variable is a calculated value. **[u]** represents the equilibrium temperature for a particular position of a Planet in orbit about its Sun with respect to its mean equilibrium temperature [um]. The value of [um] for the Earth is **394K**.

$$u = um \cdot \left(\frac{a}{d}\right)^{\frac{2}{4}} = um \cdot \sqrt{\frac{a}{a - \frac{c}{a} \cdot x}} = um \cdot \sqrt{\frac{a}{\left(a - \frac{c}{a} \cdot \frac{a^2 \cdot \cos(q) + a \cdot c}{a + c \cdot \cos(q)}\right)}}$$

The equilibrium temperature represents an ideal maximum possible value. Its overall effect will be reduced by the albedo and the difference in the surface area compared to the cross-sectional area.

Calculating the Declination of the Sun

The plane of the Terrestrial Equator is inclined by **23.45º** to the plane of the orbit of the Earth. Likewise, the other planets have there own equators inclined to the plane of their own orbits. It is this inclination that causes the seasons as the planet orbits about its Sun.

On the Earth the Sun appears to annually rise and fall and rise again with respect to the Celestial Equator. This is the apparent declination of the Sun. At the start of Spring when the Sun is rising it is also crossing the Celestial Equator. This is the Ascending Node. At the Ascending Node the South to North motion of the Sun is the most pronounced. In the Temperate Zones of the Earth it is also the time that the ground temperatures are at their coldest but starting to rise. This latter presages the planting season. Consequently, the Ascending Node is the traditional index for the Celestial Sphere. Variants of this are true for all the Planets.

Around 1980 the Ascending Node of the Earth occurred about 78.018º after the time of perihelion. This has been previously indicated as variable [r].

Here are two more variables for the following equation.

1. **[i]:** This variable is a given parameter. [i] represents the inclination of the Equator to the plane of the Orbit.
2. **[de]:** This is a calculated variable. [de] represents the apparent Celestial declination of the Sun with respect to the Celestial Equator.

$$de = i \cdot \sin(q - r)$$

For this formula, [r] is positive (+) if the Ascending Node occurs after perihelion. If it occurs before, it is negative (-).

Calculating the Day of the Year

The preceding formulas and equations have been mostly founded of Kepler's 1st law. This next formula for calculating the swept area of the orbit with respect to the Sun employs Kepler's 2nd law as well.

This formula is centered on the integral equation to the y(x) equation. The integral is evident in the right side of the left side of the numerator. However, due to the limited range of the arc-sin, this portion has to be subtracted from one fourth of the area to get the full range as seen on the left side of the left side of the numerator. The right side of the numerator represents a right-triangle rooted to the prime focus. The denominator represents an adjustment to the units of choice.

Two more variables will be introduced here.

1. **[t]:** This is a calculated variable in the units of choice (i.e. years, days, seconds, etc.).
2. **[yr]:** This is a given Parameter. **[yr]** represents the total length of the year in the same units as [t].

Solve for t(x) given area = $a \cdot b \cdot \pi$ AND year in any unit.

$$t(x) = \frac{\left[\frac{a \cdot b \cdot \pi}{4} - \frac{b}{a} \cdot \left[\frac{x \cdot \sqrt{a^2 - x^2}}{2} + \frac{a^2}{2} \cdot \operatorname{asin}\left(\frac{x}{a}\right)\right]\right] - \left[\left(\frac{c - x}{2}\right) \cdot \left(\frac{b}{a} \cdot \sqrt{a^2 - x^2}\right)\right]}{\frac{a \cdot b \cdot \pi}{yr}}$$

The [asin(x/a)] **MUST** be expressed as radians. The return from this formula will be a plus(+) or minus(-) value with a range of [± (yr/2)]. Thus the follow adjustments must apply.

1. IF [0≤q≤180°](0≤q≤π) THEN [t(x) = t(x).
2. IF [180°<q<360°](π<q<2π) THEN [t(x) = yr - t(x)].

For this formula, both x(q) and x(d) may be inserted in place of [x]. However, there is an issue with the formula. It is not readily invertable. For precision, two close solutions must be acquired.

The Length of the Apparent Solar Day: Part I

Due to the elliptical orbit of the Earth the apparent length of the solar day varies. When the Earth is at perihelion, the Sun appears to move faster against the backdrop of the fixed stars. Meanwhile the apparent motion of the Stars remains constant. Because both motions are in the same direction, the apparent solar day is longer. When the Sun is at aphelion, this is all reversed and the apparent solar day is shorter and closer to the sidereal day.

$$\text{Sidereal Day} = \frac{31556900 \cdot \frac{s}{yr}}{(365.242 + 1) \cdot \frac{day}{yr}} \cdot 86400 \cdot s = 86164.066\,s$$

$$\text{Perihelion Day} = \frac{1}{\frac{1}{86164.1 \cdot s} - \frac{1 - 0.0167}{31556900 \cdot s}} = 86396.059\,s$$

$$\text{Mean Day} = \frac{1}{\frac{1}{86164.1 \cdot s} - \frac{1 + 0}{31556900 \cdot s}} = 86400.01\,s$$

$$\text{Aphelion Day} = \frac{1}{\frac{1}{86164.1 \cdot s} - \frac{1 + 0.0167}{31556900 \cdot s}} = 86403.96\,s$$

The mean clock day is defined as 86,400 seconds. This is not a random value but a simple matter of mechanical convenience. A circle may be readily divided into 12 parts. This is a common exercise in elementary geometry. The number 12 is equal to 3+4+5, the sum of the sides in a 3:4:5 right-triangle or 3x4, the product of the two orthogonal sides of the 3:4:5 right-triangle. The number 60 is equal to 3x4x5, the product of the sides of the 3:4:5 right-triangle. Two 12 hour periods make one mean solar day. There are 60 minutes in an hour and 60 seconds in a minute. 2X12x60x60 = 86,400 seconds.

The Length of the Apparent Solar Day: Part II

The length of the apparent solar day varies cyclically from perihelion to aphelion and back again to perihelion. The range of the variation is around ±4 seconds. This means that any particular day will have an apparent solar day of 86,400±4 mean seconds.

The mechanical clock with its simple gearing system can only measure the 86,400 seconds in a mean solar day. It is wholly incapable of adjusting for the slight variation. However, this slight variation will accumulate for half of the days of the year before it reverses itself. The slight variation of less that four heartbeats will accumulate to a major error in time by the Sun.

Here is a simple approximation of the actual length of the Solar day. There are 86,164.1 seconds in a sidereal day of the Earth. The Earth requires 31,556,900 seconds to complete an orbit about the Sun. For this formula the previously given parameter of [a] representing the semi-major axis of the orbit of the Earth (149,570,000 km) and the calculated value for the distance [d] between the Earth and the Sun will be employed. A new variable **[dy]** will represent the apparent length of the solar day in mean solar seconds.

$$dy = \frac{1}{\frac{1}{86164.1} - \frac{\left(\frac{a}{d}\right)}{31556900}} = \frac{1}{\frac{1}{86164.1} - \frac{\left[\frac{a}{\left(a - \frac{c}{a}\cdot x\right)}\right]}{31556900}}$$

With the exception of the specific sidereal day 0f 86,164.1 seconds and the year of 31,556,900 seconds for the Earth, this formula can be applied to the other Planets as well.

Next is a table for the Earth using the preceding protocols.

For this table the columns are defined as follows:

1. This is the independent angle [q] from perihelion. It is expressed in terms of degrees.
2. This is the distance between the Earth and the Sun as a function of the independent angle [q] from perihelion. It is expressed in terms of millions of kilometers.
3. This is the solar constant for the Earth as a function of the independent angle [q] from perihelion. It is expressed in terms of kilowatts per square meter.
4. This is the equilibrium temperature for the Earth as a function of the independent angle [q] from perihelion. It is expressed in terms of Kelvin with respect to absolute zero.
5. This is the declination of the Sun as a function of the independent angle [q] from perihelion. It is expressed in terms of degrees with respect to the Celestial Equator. [+] represents North of the Celestial Equator and [-] represents South of the Celestial Equator. It is based upon a c.1980 datum.
6. This is the mean “Clock-Day” of the year as a function of the independent angle [q] from perihelion. It is expressed as mean solar days with respect to perihelion.
7. This is the estimated by calculation length of the solar day as a function of the independent angle [q] from perihelion. It is expressed in terms of mean solar seconds.
8. This is the Celestial longitude of the Sun as a function of the independent angle [q] from perihelion. It is expressed in terms of degrees with respect to the ascending node in the Northern Hemisphere (Spring Equinox). It is based on a c.1980 datum.

{1}	{2}	{3}	{4}	{5}	{6}	{7}	{8}
0	147.072	1.420	397.332	-22.939	0.000	86404.027	281.982
1	147.073	1.420	397.331	-22.851	0.981	86404.027	282.982
2	147.074	1.420	397.330	-22.755	1.962	86404.025	283.982
3	147.075	1.420	397.327	-22.653	2.943	86404.022	284.982
4	147.078	1.420	397.324	-22.544	3.924	86404.018	285.982
5	147.081	1.420	397.319	-22.427	4.906	86404.012	286.982
6	147.085	1.420	397.314	-22.305	5.887	86404.006	287.982
7	147.090	1.420	397.307	-22.175	6.868	86403.998	288.982
8	147.096	1.420	397.300	-22.038	7.850	86403.989	289.982
9	147.102	1.419	397.292	-21.895	8.831	86403.979	290.982
10	147.109	1.419	397.282	-21.745	9.813	86403.967	291.982
11	147.117	1.419	397.272	-21.589	10.794	86403.955	292.982
12	147.125	1.419	397.260	-21.426	11.776	86403.941	293.982
13	147.134	1.419	397.248	-21.256	12.758	86403.926	294.982
14	147.144	1.419	397.235	-21.080	13.740	86403.910	295.982

15	147.155	1.418	397.220	-20.897	14.722	86403.893	296.982
16	147.166	1.418	397.205	-20.709	15.704	86403.874	297.982
17	147.178	1.418	397.189	-20.513	16.687	86403.855	298.982
18	147.191	1.418	397.172	-20.312	17.669	86403.834	299.982
19	147.204	1.417	397.154	-20.104	18.652	86403.812	300.982
20	147.218	1.417	397.135	-19.891	19.635	86403.789	301.982
21	147.233	1.417	397.115	-19.671	20.618	86403.765	302.982
22	147.248	1.417	397.094	-19.445	21.601	86403.740	303.982
23	147.264	1.416	397.072	-19.213	22.585	86403.713	304.982
24	147.281	1.416	397.049	-18.976	23.569	86403.686	305.982
25	147.299	1.416	397.026	-18.732	24.553	86403.657	306.982
26	147.317	1.415	397.001	-18.483	25.537	86403.628	307.982
27	147.336	1.415	396.976	-18.229	26.521	86403.597	308.982
28	147.355	1.415	396.950	-17.968	27.506	86403.565	309.982
29	147.376	1.414	396.922	-17.703	28.491	86403.532	310.982
30	147.397	1.414	396.894	-17.432	29.476	86403.498	311.982
31	147.418	1.413	396.865	-17.155	30.462	86403.463	312.982
32	147.440	1.413	396.836	-16.874	31.448	86403.427	313.982
33	147.463	1.413	396.805	-16.587	32.434	86403.390	314.982
34	147.486	1.412	396.773	-16.295	33.420	86403.352	315.982
35	147.510	1.412	396.741	-15.998	34.407	86403.313	316.982
36	147.535	1.411	396.708	-15.697	35.394	86403.273	317.982
37	147.560	1.411	396.674	-15.390	36.382	86403.232	318.982
38	147.586	1.410	396.639	-15.079	37.370	86403.190	319.982
39	147.613	1.410	396.604	-14.763	38.358	86403.147	320.982
40	147.640	1.409	396.568	-14.443	39.346	86403.103	321.982
41	147.667	1.409	396.530	-14.118	40.335	86403.058	322.982
42	147.695	1.408	396.493	-13.790	41.324	86403.012	323.982
43	147.724	1.408	396.454	-13.456	42.314	86402.966	324.982
44	147.753	1.407	396.415	-13.119	43.304	86402.918	325.982
45	147.783	1.406	396.375	-12.778	44.294	86402.870	326.982
46	147.814	1.406	396.334	-12.433	45.285	86402.821	327.982
47	147.844	1.405	396.293	-12.084	46.276	86402.771	328.982
48	147.876	1.405	396.251	-11.731	47.268	86402.720	329.982
49	147.908	1.404	396.208	-11.375	48.260	86402.668	330.982
50	147.940	1.403	396.164	-11.016	49.253	86402.616	331.982
51	147.973	1.403	396.120	-10.653	50.246	86402.563	332.982
52	148.007	1.402	396.076	-10.286	51.239	86402.509	333.982
53	148.040	1.402	396.030	-9.917	52.233	86402.454	334.982
54	148.075	1.401	395.984	-9.545	53.227	86402.398	335.982
55	148.110	1.400	395.938	-9.169	54.222	86402.342	336.982
56	148.145	1.400	395.891	-8.791	55.217	86402.285	337.982
57	148.181	1.399	395.843	-8.411	56.213	86402.228	338.982
58	148.217	1.398	395.795	-8.027	57.209	86402.170	339.982
59	148.253	1.397	395.746	-7.642	58.206	86402.111	340.982

60	148.290	1.397	395.697	-7.253	59.203	86402.052	341.982
61	148.327	1.396	395.647	-6.863	60.200	86401.992	342.982
62	148.365	1.395	395.597	-6.471	61.199	86401.931	343.982
63	148.403	1.395	395.546	-6.076	62.197	86401.870	344.982
64	148.442	1.394	395.495	-5.680	63.196	86401.808	345.982
65	148.480	1.393	395.443	-5.282	64.196	86401.746	346.982
66	148.519	1.392	395.391	-4.883	65.196	86401.683	347.982
67	148.559	1.392	395.339	-4.482	66.197	86401.620	348.982
68	148.599	1.391	395.286	-4.079	67.198	86401.556	349.982
69	148.639	1.390	395.232	-3.676	68.200	86401.492	350.982
70	148.679	1.390	395.179	-3.271	69.203	86401.427	351.982
71	148.720	1.389	395.125	-2.865	70.206	86401.362	352.982
72	148.761	1.388	395.070	-2.459	71.209	86401.297	353.982
73	148.802	1.387	395.016	-2.051	72.213	86401.231	354.982
74	148.843	1.386	394.961	-1.643	73.218	86401.165	355.982
75	148.885	1.386	394.906	-1.235	74.223	86401.098	356.982
76	148.927	1.385	394.850	-0.826	75.228	86401.032	357.982
77	148.969	1.384	394.794	-0.417	76.235	86400.965	358.982
78	149.011	1.383	394.738	-0.007	77.242	86400.897	359.982
79	149.053	1.383	394.682	0.402	78.249	86400.830	0.982
80	149.096	1.382	394.626	0.811	79.257	86400.762	1.982
81	149.139	1.381	394.569	1.220	80.266	86400.694	2.982
82	149.182	1.380	394.513	1.628	81.275	86400.626	3.982
83	149.225	1.379	394.456	2.036	82.284	86400.557	4.982
84	149.268	1.379	394.399	2.444	83.295	86400.489	5.982
85	149.311	1.378	394.342	2.851	84.306	86400.420	6.982
86	149.354	1.377	394.284	3.256	85.317	86400.351	7.982
87	149.398	1.376	394.227	3.661	86.329	86400.283	8.982
88	149.441	1.375	394.170	4.065	87.342	86400.214	9.982
89	149.485	1.375	394.112	4.467	88.355	86400.145	10.982
90	149.528	1.374	394.055	4.868	89.369	86400.076	11.982
91	149.572	1.373	393.998	5.268	90.383	86400.007	12.982
92	149.615	1.372	393.940	5.666	91.398	86399.938	13.982
93	149.659	1.371	393.883	6.062	92.414	86399.869	14.982
94	149.703	1.371	393.825	6.457	93.430	86399.800	15.982
95	149.746	1.370	393.768	6.849	94.447	86399.731	16.982
96	149.790	1.369	393.711	7.239	95.464	86399.663	17.982
97	149.833	1.368	393.654	7.628	96.482	86399.594	18.982
98	149.877	1.367	393.597	8.013	97.501	86399.526	19.982
99	149.920	1.367	393.540	8.397	98.520	86399.458	20.982
100	149.963	1.366	393.483	8.778	99.540	86399.390	21.982
101	150.006	1.365	393.427	9.156	100.560	86399.322	22.982
102	150.049	1.364	393.370	9.531	101.581	86399.254	23.982
103	150.092	1.363	393.314	9.904	102.603	86399.187	24.982
104	150.135	1.363	393.258	10.273	103.625	86399.120	25.982

105	150.177	1.362	393.202	10.640	104.647	86399.053	26.982
106	150.220	1.361	393.147	11.003	105.671	86398.987	27.982
107	150.262	1.360	393.092	11.362	106.695	86398.920	28.982
108	150.304	1.360	393.037	11.719	107.719	86398.855	29.982
109	150.346	1.359	392.982	12.071	108.744	86398.789	30.982
110	150.387	1.358	392.928	12.420	109.769	86398.724	31.982
111	150.429	1.357	392.874	12.766	110.796	86398.660	32.982
112	150.470	1.357	392.820	13.107	111.822	86398.595	33.982
113	150.510	1.356	392.767	13.444	112.849	86398.532	34.982
114	150.551	1.355	392.714	13.778	113.877	86398.468	35.982
115	150.591	1.354	392.662	14.107	114.906	86398.406	36.982
116	150.631	1.354	392.610	14.431	115.934	86398.343	37.982
117	150.671	1.353	392.558	14.752	116.964	86398.282	38.982
118	150.710	1.352	392.507	15.068	117.994	86398.221	39.982
119	150.749	1.352	392.457	15.379	119.024	86398.160	40.982
120	150.787	1.351	392.406	15.686	120.055	86398.100	41.982
121	150.826	1.350	392.357	15.987	121.087	86398.041	42.982
122	150.863	1.350	392.307	16.284	122.119	86397.982	43.982
123	150.901	1.349	392.259	16.576	123.151	86397.924	44.982
124	150.938	1.348	392.211	16.863	124.185	86397.866	45.982
125	150.974	1.348	392.163	17.145	125.218	86397.809	46.982
126	151.011	1.347	392.116	17.422	126.252	86397.753	47.982
127	151.046	1.346	392.070	17.693	127.287	86397.698	48.982
128	151.082	1.346	392.024	17.959	128.322	86397.643	49.982
129	151.116	1.345	391.979	18.219	129.358	86397.589	50.982
130	151.151	1.344	391.934	18.474	130.394	86397.536	51.982
131	151.185	1.344	391.890	18.724	131.430	86397.483	52.982
132	151.218	1.343	391.847	18.967	132.467	86397.432	53.982
133	151.251	1.343	391.805	19.205	133.504	86397.381	54.982
134	151.283	1.342	391.763	19.437	134.542	86397.331	55.982
135	151.315	1.342	391.721	19.663	135.581	86397.282	56.982
136	151.346	1.341	391.681	19.883	136.619	86397.233	57.982
137	151.377	1.340	391.641	20.097	137.658	86397.186	58.982
138	151.407	1.340	391.602	20.305	138.698	86397.139	59.982
139	151.437	1.339	391.564	20.506	139.738	86397.094	60.982
140	151.466	1.339	391.526	20.702	140.778	86397.049	61.982
141	151.494	1.338	391.490	20.891	141.819	86397.005	62.982
142	151.522	1.338	391.454	21.073	142.860	86396.962	63.982
143	151.550	1.337	391.418	21.250	143.902	86396.920	64.982
144	151.576	1.337	391.384	21.420	144.944	86396.879	65.982
145	151.602	1.336	391.350	21.583	145.986	86396.839	66.982
146	151.628	1.336	391.318	21.740	147.029	86396.800	67.982
147	151.652	1.336	391.286	21.890	148.072	86396.762	68.982
148	151.676	1.335	391.255	22.033	149.115	86396.725	69.982
149	151.700	1.335	391.224	22.170	150.159	86396.689	70.982

150	151.723	1.334	391.195	22.300	151.203	86396.654	71.982
151	151.745	1.334	391.167	22.423	152.247	86396.620	72.982
152	151.766	1.334	391.139	22.540	153.292	86396.587	73.982
153	151.787	1.333	391.112	22.649	154.336	86396.555	74.982
154	151.807	1.333	391.086	22.752	155.382	86396.524	75.982
155	151.826	1.332	391.062	22.847	156.427	86396.494	76.982
156	151.845	1.332	391.038	22.936	157.473	86396.466	77.982
157	151.863	1.332	391.014	23.018	158.519	86396.438	78.982
158	151.880	1.332	390.992	23.092	159.565	86396.412	79.982
159	151.896	1.331	390.971	23.160	160.611	86396.387	80.982
160	151.912	1.331	390.951	23.221	161.658	86396.363	81.982
161	151.927	1.331	390.931	23.274	162.705	86396.340	82.982
162	151.942	1.330	390.913	23.321	163.752	86396.318	83.982
163	151.955	1.330	390.896	23.360	164.799	86396.297	84.982
164	151.968	1.330	390.879	23.392	165.846	86396.277	85.982
165	151.980	1.330	390.864	23.417	166.894	86396.259	86.982
166	151.991	1.330	390.849	23.435	167.942	86396.242	87.982
167	152.002	1.329	390.836	23.446	168.989	86396.226	88.982
168	152.011	1.329	390.823	23.450	170.038	86396.211	89.982
169	152.020	1.329	390.812	23.447	171.086	86396.197	90.982
170	152.029	1.329	390.801	23.436	172.134	86396.184	91.982
171	152.036	1.329	390.792	23.418	173.182	86396.173	92.982
172	152.043	1.329	390.783	23.393	174.231	86396.163	93.982
173	152.049	1.329	390.775	23.361	175.279	86396.154	94.982
174	152.054	1.329	390.769	23.322	176.328	86396.146	95.982
175	152.058	1.328	390.763	23.276	177.377	86396.139	96.982
176	152.062	1.328	390.759	23.223	178.426	86396.134	97.982
177	152.064	1.328	390.755	23.162	179.474	86396.130	98.982
178	152.066	1.328	390.753	23.095	180.523	86396.127	99.982
179	152.067	1.328	390.751	23.021	181.572	86396.125	100.982
180	152.068	1.328	390.751	22.939	182.621	86396.124	101.982
181	152.067	1.328	390.751	22.851	183.670	86396.125	102.982
182	152.066	1.328	390.753	22.755	184.719	86396.127	103.982
183	152.064	1.328	390.755	22.653	185.767	86396.130	104.982
184	152.062	1.328	390.759	22.544	186.816	86396.134	105.982
185	152.058	1.328	390.763	22.428	187.865	86396.139	106.982
186	152.054	1.329	390.769	22.305	188.914	86396.146	107.982
187	152.049	1.329	390.775	22.175	189.962	86396.154	108.982
188	152.043	1.329	390.783	22.038	191.011	86396.163	109.982
189	152.036	1.329	390.792	21.895	192.059	86396.173	110.982
190	152.029	1.329	390.801	21.745	193.108	86396.184	111.982
191	152.020	1.329	390.812	21.589	194.156	86396.197	112.982
192	152.011	1.329	390.823	21.426	195.204	86396.211	113.982
193	152.002	1.329	390.836	21.256	196.252	86396.226	114.982
194	151.991	1.330	390.849	21.080	197.300	86396.242	115.982

195	151.980	1.330	390.864	20.897	198.348	86396.259	116.982
196	151.968	1.330	390.879	20.709	199.395	86396.277	117.982
197	151.955	1.330	390.896	20.513	200.443	86396.297	118.982
198	151.942	1.330	390.913	20.312	201.490	86396.318	119.982
199	151.927	1.331	390.931	20.104	202.537	86396.340	120.982
200	151.912	1.331	390.951	19.891	203.584	86396.363	121.982
201	151.896	1.331	390.971	19.671	204.631	86396.387	122.982
202	151.880	1.332	390.992	19.445	205.677	86396.412	123.982
203	151.863	1.332	391.014	19.213	206.723	86396.438	124.982
204	151.845	1.332	391.038	18.976	207.769	86396.466	125.982
205	151.826	1.332	391.062	18.732	208.815	86396.494	126.982
206	151.807	1.333	391.086	18.483	209.860	86396.524	127.982
207	151.787	1.333	391.112	18.229	210.905	86396.555	128.982
208	151.766	1.334	391.139	17.969	211.950	86396.587	129.982
209	151.745	1.334	391.167	17.703	212.995	86396.620	130.982
210	151.723	1.334	391.195	17.432	214.039	86396.654	131.982
211	151.700	1.335	391.224	17.155	215.083	86396.689	132.982
212	151.676	1.335	391.255	16.874	216.127	86396.725	133.982
213	151.652	1.336	391.286	16.587	217.170	86396.762	134.982
214	151.628	1.336	391.318	16.295	218.213	86396.800	135.982
215	151.602	1.336	391.350	15.998	219.256	86396.839	136.982
216	151.576	1.337	391.384	15.697	220.298	86396.879	137.982
217	151.550	1.337	391.418	15.390	221.340	86396.920	138.982
218	151.522	1.338	391.454	15.079	222.381	86396.962	139.982
219	151.494	1.338	391.490	14.763	223.422	86397.005	140.982
220	151.466	1.339	391.526	14.443	224.463	86397.049	141.982
221	151.437	1.339	391.564	14.118	225.504	86397.093	142.982
222	151.407	1.340	391.602	13.790	226.544	86397.139	143.982
223	151.377	1.340	391.641	13.456	227.583	86397.186	144.982
224	151.346	1.341	391.681	13.119	228.622	86397.233	145.982
225	151.315	1.342	391.721	12.778	229.661	86397.282	146.982
226	151.283	1.342	391.763	12.433	230.699	86397.331	147.982
227	151.251	1.343	391.804	12.084	231.737	86397.381	148.982
228	151.218	1.343	391.847	11.731	232.775	86397.432	149.982
229	151.185	1.344	391.890	11.375	233.812	86397.483	150.982
230	151.151	1.344	391.934	11.016	234.848	86397.536	151.982
231	151.116	1.345	391.979	10.653	235.884	86397.589	152.982
232	151.082	1.346	392.024	10.286	236.920	86397.643	153.982
233	151.046	1.346	392.070	9.917	237.955	86397.698	154.982
234	151.011	1.347	392.116	9.545	238.989	86397.753	155.982
235	150.974	1.348	392.163	9.169	240.023	86397.809	156.982
236	150.938	1.348	392.211	8.791	241.057	86397.866	157.982
237	150.901	1.349	392.259	8.411	242.090	86397.924	158.982
238	150.863	1.350	392.307	8.027	243.123	86397.982	159.982
239	150.826	1.350	392.357	7.642	244.155	86398.041	160.982

240	150.787	1.351	392.406	7.254	245.186	86398.100	161.982
241	150.749	1.352	392.457	6.863	246.217	86398.160	162.982
242	150.710	1.352	392.507	6.471	247.248	86398.221	163.982
243	150.671	1.353	392.558	6.076	248.278	86398.282	164.982
244	150.631	1.354	392.610	5.680	249.307	86398.343	165.982
245	150.591	1.354	392.662	5.282	250.336	86398.406	166.982
246	150.551	1.355	392.714	4.883	251.364	86398.468	167.982
247	150.510	1.356	392.767	4.482	252.392	86398.532	168.982
248	150.470	1.357	392.820	4.079	253.420	86398.595	169.982
249	150.429	1.357	392.874	3.676	254.446	86398.660	170.982
250	150.387	1.358	392.928	3.271	255.472	86398.724	171.982
251	150.346	1.359	392.982	2.865	256.498	86398.789	172.982
252	150.304	1.360	393.037	2.459	257.523	86398.855	173.982
253	150.262	1.360	393.092	2.051	258.547	86398.920	174.982
254	150.220	1.361	393.147	1.643	259.571	86398.986	175.982
255	150.177	1.362	393.202	1.235	260.594	86399.053	176.982
256	150.135	1.363	393.258	0.826	261.617	86399.120	177.982
257	150.092	1.363	393.314	0.417	262.639	86399.187	178.982
258	150.049	1.364	393.370	0.007	263.661	86399.254	179.982
259	150.006	1.365	393.427	-0.402	264.681	86399.322	180.982
260	149.963	1.366	393.483	-0.811	265.702	86399.390	181.982
261	149.920	1.367	393.540	-1.220	266.722	86399.458	182.982
262	149.877	1.367	393.597	-1.628	267.741	86399.526	183.982
263	149.833	1.368	393.654	-2.036	268.759	86399.594	184.982
264	149.790	1.369	393.711	-2.444	269.777	86399.663	185.982
265	149.746	1.370	393.768	-2.850	270.795	86399.731	186.982
266	149.703	1.371	393.825	-3.256	271.811	86399.800	187.982
267	149.659	1.371	393.883	-3.661	272.828	86399.869	188.982
268	149.615	1.372	393.940	-4.065	273.843	86399.938	189.982
269	149.572	1.373	393.998	-4.467	274.858	86400.007	190.982
270	149.528	1.374	394.055	-4.868	275.873	86400.076	191.982
271	149.485	1.375	394.112	-5.268	276.887	86400.145	192.982
272	149.441	1.375	394.170	-5.666	277.900	86400.214	193.982
273	149.398	1.376	394.227	-6.062	278.912	86400.282	194.982
274	149.354	1.377	394.284	-6.457	279.925	86400.351	195.982
275	149.311	1.378	394.342	-6.849	280.936	86400.420	196.982
276	149.268	1.379	394.399	-7.239	281.947	86400.489	197.982
277	149.225	1.379	394.456	-7.628	282.957	86400.557	198.982
278	149.182	1.380	394.513	-8.013	283.967	86400.626	199.982
279	149.139	1.381	394.569	-8.397	284.976	86400.694	200.982
280	149.096	1.382	394.626	-8.778	285.985	86400.762	201.982
281	149.053	1.383	394.682	-9.156	286.993	86400.830	202.982
282	149.011	1.383	394.738	-9.531	288.000	86400.897	203.982
283	148.969	1.384	394.794	-9.904	289.007	86400.965	204.982
284	148.927	1.385	394.850	-10.273	290.013	86401.032	205.982

285	148.885	1.386	394.906	-10.639	291.019	86401.098	206.982
286	148.843	1.386	394.961	-11.003	292.024	86401.165	207.982
287	148.802	1.387	395.016	-11.362	293.029	86401.231	208.982
288	148.761	1.388	395.070	-11.719	294.033	86401.297	209.982
289	148.720	1.389	395.125	-12.071	295.036	86401.362	210.982
290	148.679	1.390	395.179	-12.420	296.039	86401.427	211.982
291	148.639	1.390	395.232	-12.766	297.041	86401.492	212.982
292	148.599	1.391	395.286	-13.107	298.043	86401.556	213.982
293	148.559	1.392	395.338	-13.444	299.045	86401.620	214.982
294	148.519	1.392	395.391	-13.778	300.045	86401.683	215.982
295	148.480	1.393	395.443	-14.107	301.046	86401.746	216.982
296	148.442	1.394	395.495	-14.431	302.045	86401.808	217.982
297	148.403	1.395	395.546	-14.752	303.045	86401.870	218.982
298	148.365	1.395	395.597	-15.068	304.043	86401.931	219.982
299	148.327	1.396	395.647	-15.379	305.041	86401.991	220.982
300	148.290	1.397	395.697	-15.686	306.039	86402.052	221.982
301	148.253	1.397	395.746	-15.987	307.036	86402.111	222.982
302	148.217	1.398	395.795	-16.284	308.033	86402.170	223.982
303	148.181	1.399	395.843	-16.576	309.029	86402.228	224.982
304	148.145	1.400	395.891	-16.863	310.025	86402.285	225.982
305	148.110	1.400	395.938	-17.145	311.020	86402.342	226.982
306	148.075	1.401	395.984	-17.422	312.015	86402.398	227.982
307	148.040	1.402	396.030	-17.693	313.009	86402.454	228.982
308	148.007	1.402	396.076	-17.959	314.003	86402.509	229.982
309	147.973	1.403	396.120	-18.219	314.996	86402.563	230.982
310	147.940	1.403	396.164	-18.474	315.989	86402.616	231.982
311	147.908	1.404	396.208	-18.724	316.982	86402.668	232.982
312	147.876	1.405	396.251	-18.967	317.974	86402.720	233.982
313	147.844	1.405	396.293	-19.205	318.965	86402.771	234.982
314	147.814	1.406	396.334	-19.437	319.957	86402.821	235.982
315	147.783	1.406	396.375	-19.663	320.947	86402.870	236.982
316	147.753	1.407	396.415	-19.883	321.938	86402.918	237.982
317	147.724	1.408	396.454	-20.097	322.928	86402.966	238.982
318	147.695	1.408	396.493	-20.305	323.917	86403.012	239.982
319	147.667	1.409	396.530	-20.506	324.907	86403.058	240.982
320	147.640	1.409	396.567	-20.702	325.895	86403.103	241.982
321	147.613	1.410	396.604	-20.891	326.884	86403.147	242.982
322	147.586	1.410	396.639	-21.073	327.872	86403.190	243.982
323	147.560	1.411	396.674	-21.250	328.860	86403.232	244.982
324	147.535	1.411	396.708	-21.420	329.847	86403.273	245.982
325	147.510	1.412	396.741	-21.583	330.834	86403.313	246.982
326	147.486	1.412	396.773	-21.740	331.821	86403.352	247.982
327	147.463	1.413	396.805	-21.890	332.808	86403.390	248.982
328	147.440	1.413	396.836	-22.033	333.794	86403.427	249.982
329	147.418	1.413	396.865	-22.170	334.780	86403.463	250.982

330	147.397	1.414	396.894	-22.300	335.765	86403.498	251.982
331	147.376	1.414	396.922	-22.423	336.751	86403.532	252.982
332	147.356	1.415	396.950	-22.540	337.736	86403.565	253.982
333	147.336	1.415	396.976	-22.649	338.720	86403.597	254.982
334	147.317	1.415	397.001	-22.752	339.705	86403.627	255.982
335	147.299	1.416	397.026	-22.847	340.689	86403.657	256.982
336	147.281	1.416	397.049	-22.936	341.673	86403.686	257.982
337	147.264	1.416	397.072	-23.018	342.657	86403.713	258.982
338	147.248	1.417	397.094	-23.092	343.640	86403.740	259.982
339	147.233	1.417	397.115	-23.160	344.624	86403.765	260.982
340	147.218	1.417	397.135	-23.221	345.607	86403.789	261.982
341	147.204	1.417	397.154	-23.274	346.590	86403.812	262.982
342	147.191	1.418	397.172	-23.321	347.573	86403.834	263.982
343	147.178	1.418	397.189	-23.360	348.555	86403.855	264.982
344	147.166	1.418	397.205	-23.392	349.538	86403.874	265.982
345	147.155	1.418	397.220	-23.417	350.520	86403.893	266.982
346	147.144	1.419	397.235	-23.435	351.502	86403.910	267.982
347	147.134	1.419	397.248	-23.446	352.484	86403.926	268.982
348	147.125	1.419	397.260	-23.450	353.466	86403.941	269.982
349	147.117	1.419	397.272	-23.447	354.448	86403.955	270.982
350	147.109	1.419	397.282	-23.436	355.429	86403.967	271.982
351	147.102	1.419	397.292	-23.418	356.411	86403.979	272.982
352	147.096	1.420	397.300	-23.393	357.392	86403.989	273.982
353	147.090	1.420	397.307	-23.361	358.374	86403.998	274.982
354	147.085	1.420	397.314	-23.322	359.355	86404.006	275.982
355	147.081	1.420	397.319	-23.276	360.336	86404.012	276.982
356	147.078	1.420	397.324	-23.223	361.317	86404.018	277.982
357	147.075	1.420	397.327	-23.162	362.298	86404.022	278.982
358	147.074	1.420	397.330	-23.095	363.280	86404.025	279.982
359	147.073	1.420	397.331	-23.021	364.261	86404.027	280.982
360	147.072	1.420	397.332	-22.939	365.242	86404.027	281.982

This competes this brief examination of the fundamental orbital mechanics regarding the orbit of the Earth about the Sun and its applications regarding the influence of the Sun on the Earth and the natural measures of time.

The calculated solar constant, the calculated equilibrium temperature, and the calculated length of the day are only approximations. The calculations employed Kepler’s 1st and 2nd laws. Newton’s laws modify these calculations with respect to the always changing position of the Jupiter and Saturn.