PLANETARY CO-ORDINATES

FOR THE YEARS

1960—1980

REFERRED TO THE EQUINOX OF 1950·0

Prepared by

H.M. NAUTICAL ALMANAC OFFICE

Published by Order of

The Lords Commissioners of the Admiralty

LONDON

HER MAJESTY'S STATIONERY OFFICE

1958

michael a minonick Jr.
Dec 13 1961

Published by
HER MAJESTY'S STATIONERY OFFICE

To be purchased from
York House, Kingsway, London W.C.2
423 Oxford Street, London W.1
13A Castle Street, Edinburgh 2
109 St. Mary Street, Cardiff
39 King Street, Manchester 2
Tower Lane, Bristol 1
2 Edmund Street, Birmingham 3
80 Chichester Street, Belfast
or through any bookseller

Price £1 10*s.* 0*d.* net

Printed in Great Britain under the authority of Her Majesty's Stationery Office
by William Clowes and Sons Ltd, London and Beccles. Wt. 4074. K. 6.

S.O. Code No. 20-119-2*

PREFACE

This volume is a continuation of the two previous volumes of PLANETARY CO-ORDINATES REFERRED TO THE EQUINOX OF 1950·0, published for the years 1800–1940 in 1933, and for the years 1940–1960 in 1939; it extends the ephemeral data in those volumes from 1960 to 1980, without substantial alteration of form.

A number of changes of content and presentation, more fully described in the *Explanation of the Tables*, has been made. The attractions of the planets on the Sun are given uniformly for an interval of 10 days independently of the interval of tabulation; those for Jupiter and Saturn are combined, as are also those for Uranus and Neptune. Heliocentric equatorial rectangular co-ordinates of Mercury and Pluto, and of the barycentre of the Sun and the four inner planets are now included; the adopted masses of the planets have been changed slightly and are now the same as those used in the planetary ephemerides. The pages of ephemeral data have been reproduced photographically from copy prepared on a card-controlled typewriter; some of the auxiliary tables have been reproduced photographically from those in the earlier volumes.

A comprehensive investigation into different methods of calculating special perturbations has been carried out, using the material in this volume. The results are briefly referred to in the *Introduction*, and all necessary formulae are given on pages 142 to 160, together with numerical examples of their use; the *Illustration* is, however, restricted to the rectangular co-ordinate methods of Encke and Cowell, which are those most likely to be used by the computer using a desk calculating machine.

This volume has been largely prepared by Dr. J. G. Porter, with the assistance of Dr. G. A. Wilkins and Mr. M. P. Candy, under the direction of Mr. D. H. Sadler, Superintendent of H.M. Nautical Almanac Office. Grateful acknowledgement is made to Mr. H. Q. Rasmusen and Professor S. Herrick for fruitful discussions on the optimum forms of the equations of motion in barycentric co-ordinates.

R. v.d.R. WOOLLEY
Astronomer Royal

H.M. Nautical Almanac Office,
Royal Greenwich Observatory,
Herstmonceux Castle, Sussex
December 1956

CONTENTS

PAGE

INTRODUCTION

1. Comparison of Methods vii
2. Illustration xi
3. Explanation of the Tables xvii

TABLES OF CO-ORDINATES

Julian Date—Calendar Date 1
Co-ordinates of Mercury 2
Co-ordinates of Venus and Earth 10
Co-ordinates of Mars 42
Co-ordinates of the Barycentre S_4 58
Co-ordinates of Jupiter and Saturn 64
Co-ordinates of Uranus and Neptune 96
Co-ordinates of Pluto 104

AUXILIARY TABLES

I—Mean obliquity 106
II—Ecliptic precessional elements 107
III—Equatorial precessional elements 108
IV—Reduction of equatorial rectangular co-ordinates 109
V—Magnitude of attractions 110
VI—Lagrange interpolation coefficients 111
VII—Table of f with argument q 112
VIII—Table of $1/r^3$ with argument r^2 114

COLLECTED FORMULAE AND CONSTANTS

General formulae

1. Numerical integration 142
2. Notation 143

Rectangular co-ordinates

3. The fundamental equations of motion 144
4. Cowell's method 145
5. Encke's method 145
6. Elements, co-ordinates and velocities 146

Variation of elements

7. Fundamental principles 148
8. Standard method 150
9. Strömgren's method 152
10. Oppolzer's method 152
11. Merton's method 154

Variation of parameters: 12. Herrick's method 156

Polar co-ordinates: 13. Hansen's method 158

Constants: Masses and attractions 160

INTRODUCTION

A *Comparison* of the different methods for calculating the perturbations of a comet (or minor planet) is given to assist in the choice of method most suitable for particular conditions. In the *Illustration* which follows a description is given of the Cowell and Encke methods, for which the tables in this volume are more particularly designed; a special feature of this *Illustration* is the use of barycentric co-ordinates throughout. An *Explanation of the Tables* is given in the three pages which immediately precede them. Throughout this volume, all times are expressed in Ephemeris Time (E.T.), which will be used by the national ephemerides as from 1960. The notation used is given on page 143.

1. COMPARISON OF METHODS

The available methods for computing perturbations are of three main types:

methods which give directly the rectangular co-ordinates of the comet;

variation-of-elements methods (or variation of parameters, which are functions of the elements) which give the elements of the osculating orbit at each epoch;

methods which give the cylindrical polar co-ordinates of the comet with respect to an initial osculating orbit; the typical method is that of Hansen.

To obtain results of high precision it is necessary to use methods in which both the theory and its practical application reach the highest standards of accuracy. When approximate results are adequate, as for a finding ephemeris, the rigorous methods may be modified by using fewer figures, by omitting the perturbations of the smaller planets, or by making deliberate approximations in the formulae. It is also possible, particularly in the variation-of-elements method, to adopt a first-order procedure, in which the attractions are calculated on the assumption that the comet is travelling in a fixed orbit about the Sun; the elements thus remain unchanged, and the perturbing forces acting on the comet may be calculated directly for any point in the orbit. The rigorous step-by-step procedure (in which the true position of the comet is estimated at each step from the integration schemes) is thus avoided, and the integrations are reduced to simple quadratures, since the integrands are independent of the integrals. This process is the basis of the tables of Crommelin and Stracke, which use equal intervals of mean anomaly, corresponding to equal intervals of time in the fixed orbit, and of the methods of Oppolzer and Strömgren. The principal objection to these first-order methods is that there is no control over the size of the errors; but greater precision may be obtained, while still avoiding the step-by-step procedure, by one of the devices mentioned on p. ix.

Perturbations of the orbit of a fictitious comet were calculated by methods of each type to afford a comparison of the methods, and to form the basis of the examples given in the *Illustration* and with the *Collected Formulae*. The elements of the initial orbit were chosen to provide an exacting test of the methods; the orbit has a small inclination and its perihelion lies near the Earth's orbit, while heavy perturbations by Jupiter are caused by an approach within 0·6 units.

The conclusion drawn from the comparison is that for rigorous work the rectangular co-ordinate methods of Cowell and Encke are to be preferred, the total computing times taken for

the complete revolution being about the same in either case. The other rigorous methods are more laborious; in Hansen's polar co-ordinate method, in Herrick's method of variation of parameters, or in the standard variation-of-elements method, the formulae lack the simplicity and symmetry which are the outstanding features of the rectangular co-ordinate methods. A rigorous application of the variation-of-elements method was continued past the close approach to Jupiter; as expected, there was no significant difference in accuracy from the rectangular co-ordinate methods, but the time taken was very much greater. It was found that the first-order methods were quite unsuitable for such an orbit, and errors affecting the fourth significant figure had already accumulated before the closest approach was reached; they would have built up rapidly if the calculations had been continued round the orbit. Such methods are, however, comparatively quick and simple, and would be adequate as approximate methods when perturbations are known to be light. Formulae for these methods, with numerical examples, are given on pp. 142–160.

Use of barycentric co-ordinates. In the numerical integration of the equations of motion in rectangular co-ordinates, three double integrations are necessary, with time as the independent variable. If the co-ordinates are referred to the Sun as origin, the heliocentric forms of the equations of motion (p. 144) must be used, and these contain both direct and indirect terms. The direct terms are calculated for each planet at a suitable interval, while the indirect terms are tabulated as X, Y, Z on pp. 10–57 and 64–103. The double integrals of the indirect terms give the heliocentric position of the centre of mass of the system; the omission of these terms for any planets leads to a change in the system of reference, the origin being then the centre of mass of the Sun and the neglected planets. Any such origin may be used, provided that its heliocentric co-ordinates are known, but the most convenient point of reference is the barycentre S_4, which is the centre of mass of the Sun and the four inner planets. The co-ordinates of this point are always less than 0·00001 and are readily computed and tabulated; moreover the omission of the rapidly changing indirect terms for the four inner planets allows the use of a wider interval and is of particular value when the comet is at a large distance from the Sun. Detailed formulae and examples of the use of this procedure are given below.

Cowell's method. This is the only method which is not based upon the known unperturbed motion of the comet. The true rectangular co-ordinates of the comet are obtained at each step, but no direct indication is given of the changes in the orbital elements. The great merits of the method are that the formulae are extremely simple, and that a geocentric ephemeris is readily calculated from the co-ordinates. Its disadvantages are that the calculations of the solar term, and of the first and second sums of the integrands, involve the use of many significant figures; also the interval of integration is usually smaller than in other methods, since (except at a close approach to a planet) it is determined by the solar term. The effect is greatest at small perihelion distances, when the interval in Cowell's method becomes inconveniently small; it is therefore an advantage, as explained in the *Illustration*, to use Encke's method near the Sun, changing to Cowell's method for the rest of the orbit.

Encke's method. This is a differential method, giving the perturbations of the rectangular co-ordinates. Since the method does not involve the direct solar term, fewer significant figures are used, especially at the beginning of the scheme, and it is thus particularly suitable in the neighbourhood of perihelion. It is generally possible to work an Encke scheme at twice the interval of a Cowell scheme, but each step takes longer. The unperturbed co-ordinates of the comet may, however, be calculated systematically in advance to the necessary accuracy. When the difference between the true and unperturbed positions becomes large, the correcting terms increase in magnitude, and rectification of the orbit becomes necessary. Although this must be regarded as a disadvantage of the method, it usually results in a compensating saving of time in the steps immediately following.

Variation-of-elements methods. The standard variation-of-elements method, originally due to Lagrange, formulates equations for the rates of change of six orbital elements with time. There are five single integrations together with a double integration of the variation of the mean motion n. The reason for this may be seen by differentiating the equation for the mean anomaly $M = M_0 + n(t-t_0)$, in which all the quantities are regarded as variable. This leads to

$$\frac{dM}{dt} = \frac{dM_0}{dt} + (t-t_0)\frac{dn}{dt} + n$$

where n must be obtained by integrating dn/dt. This expression may be simplified by introducing an auxiliary quantity M^*, defined by

$$\frac{dM^*}{dt} = \frac{dM_0}{dt} + (t-t_0)\frac{dn}{dt} \qquad \text{so that} \qquad \frac{dM}{dt} = \frac{dM^*}{dt} + n$$

The perturbation of M is thus obtained as the sum of two integrals; the first is a single integration of the variation of M^*, and the second a double integration of the variation of n.

Although the number of significant figures in the integration schemes is usually small, the labour of differencing and summing the six schemes is comparable with that of the three Encke schemes; the amount of calculation required to form the integrands themselves is certainly greater, since the formulae are more complicated. The accumulated errors due to rounding-off tend to be less in single than in double summations; the root-mean-square error of a single summation is proportional to $N^{\frac{1}{2}}$, where N is the number of steps, while in a double summation it is proportional to $N^{\frac{3}{2}}$. The single integration methods would thus appear to show a marked superiority, but this is not true, since the determination of the position of the comet in its orbit always requires the double integration of the derivative of the mean motion.

The planetary attractions are required with reference to a moving system of rectangular axes; the components are S directed to the comet, T to a point in the plane of the orbit at $v + 90°$, and W normal to the orbit-plane. It is more convenient, however, to calculate both co-ordinates and attractions with reference to other axes, and to transform the attractions to this system. Although the transformation formulae are well suited to calculation by desk machines, they form a large part of the work at each step, and if more than two planets are to be included, the labour involved in the step-by-step process is so great that this method cannot be regarded as suitable for rigorous working.

When perturbations are light and the perihelion distance is not too small, the method may be used in an approximate form; convenient, but fairly accurate procedures are:

(*a*) A first approximation is made, using a first-order procedure in which the variations are calculated from the elements of a fixed orbit, with perturbations by Jupiter only. A more complete calculation then follows, using at each step estimates of the elements based on the first-order work.

(*b*) The step-by-step method is avoided by working several steps at a time, using constant values for the elements of the orbit for the whole group. Alternatively, it is possible to use more reliable estimates of the values of the elements by extrapolating the integration schemes for three or four steps in advance. If perturbations are light, no great accuracy is required, and it is always possible to assess numerically the errors caused in the attractions by any errors in the elements. This is readily done in the standard method with time as independent variable, since the positions of the planets then remain unchanged.

The same principles apply to the various modifications of the method, but in those cases which employ mean anomaly (Merton's method) or eccentric anomaly (Oppolzer's method) as independent variable, the time intervals are not constant. The planetary co-ordinates are therefore interpolated at each step to the calculated times, and must be re-interpolated if a second approximation is to be made.

Strömgren's method. This version of the standard variation-of-elements method (*Pub. Copenhagen Obs.*, No. 65, 1929) takes advantage of the ready transformation of the equatorial co-ordinates of the planets to the required system by using the equatorial constants of the comet's orbit. The changes in these constants are calculated instead of those in ω, Ω and i; this simplifies the subsequent calculation of an ephemeris. The method is a first-order one and is not intended for rigorous work; for general purposes when there is no close approach to a major planet, it is one of the simplest and most useful methods.

Oppolzer's method. This is a useful modification of the variation-of-elements method in which the eccentric anomaly is used as the independent variable. This has the advantages that no solution of Kepler's equation is necessary, and that the time-intervals are least at perihelion; the higher differences are therefore well behaved even at the commencement of the schemes. Provided there is no close approach to a major planet, the wide time-interval at aphelion is no disadvantage, and in most cases a constant interval can be used throughout the revolution. The method may be adapted to rigorous working, as Herrick has suggested, by using the plane of the initial orbit as a fundamental plane, but the additional complications detract from the value of the method, which is best used for approximate working only.

Merton's method. This is a rigorous formulation of Crommelin's method, in which the mean anomaly is used as the independent variable in calculating the variations of the elements. These calculations are simplified by the use of special tables, thus avoiding the solution of Kepler's equation; the tables of Crommelin (*Mem. R.A.S.*, **64**, 149, 1929) or of Stracke (*Veroff. Astr. R.-I.*, No. 48, 1930) are available, but the interval is large and the former are in logarithmic form. Merton proposes to form new tables in natural numbers; the example on p. 155 makes use of preliminary values from these tables. The dates for each step are obtained from the integration of $w\,dt/dM$, and the ecliptic planetary co-ordinates are interpolated to these times. The method is best applied as indicated by Merton, estimating the corrections to the elements for three or four steps in advance, and working in units of $0^{\circ}{\cdot}0001$.

Variation of parameters. Herrick's method (*P.A.S.P.*, **60**, 321, 1948) differs from all the variation-of-elements methods in that the variations of a specially chosen set of parameters are expressed directly in terms of the perturbing forces referred to equatorial axes, and not to axes defined by the comet's orbit. It is intended for rigorous working, taking into account the effect of all the planets; the method uses one double and seven single integrations with time as independent variable. At a close approach to a planet the interval of integration is determined by the rate of convergence of the planetary perturbations, and is the same for all methods if the same number of significant figures is used; but Herrick's technique in calculating the integrands omits a factor depending on the interval used, and more figures are required than in Encke's or Cowell's method, when the interval is small. In the case of a close approach to the Sun it is claimed that the permissible interval is greater than in Encke's method, but this was not confirmed in the calculations with the fictitious comet. Checks are included in the calculation of the variations to detect accidental mistakes immediately; in other methods small mistakes are usually only found by differencing.

Polar co-ordinate method. Hansen's method makes use of cylindrical polar co-ordinates referred to an initial osculating orbit, with time as the independent variable. Although the integrands are small and change slowly, the formulae are complicated and the polar co-ordinates are not explicitly used; there are two double and three single integrations. The difficulty of rectifying the orbit, or of computing a new set of osculating elements, is much greater than in Encke's method, and some doubt is felt as to the accuracy of the method, particularly in regard to the building up of errors. Approximations may be made, but experience suggests that the method is not satisfactory for general use.

2. ILLUSTRATION

The elements of the cometary orbit and the derived constants are assumed to be

Epoch 1960 January 27·0 E.T. = J.D. 243 6960·5

T 1960 January 10·0 E.T. = J.D. 243 6943·5

$\omega = 25°$, $\Omega = 135$, $i = 5$ } 1950·0 $\quad a = 4·0$, $e = 0·75$ $\quad b = 2·645\ 7513$, $e^\circ = 42·971\ 835$, $n^\circ = 0·123\ 20096$

$$x_0 = -3·754\ 2218(\cos E - e) - 0·898\ 4482 \sin E$$
$$y_0 = +1·200\ 6792(\cos E - e) - 2·358\ 1582 \sin E$$
$$z_0 = +0·681\ 3134(\cos E - e) - 0·794\ 9092 \sin E$$

Since the orbit has a small perihelion distance ($q = 1·0$) the work is commenced with an Encke scheme at a 10-day interval; this is quite large enough if roughnesses in the higher differences are to be avoided, and it may easily be doubled at an early stage; a Cowell scheme would require an even smaller interval.

Commencing an Encke scheme. In commencing Encke's method, a first approximation is made by calculating attractions with the assumption that the perturbations are zero, i.e., the unperturbed co-ordinates of the comet are used, and the Encke terms $h(fqx - \xi)$ etc. are assumed to be zero. The co-ordinates x_0, y_0, z_0 are formed for two or three dates on either side of the osculation date:

J.D.	M	E	x_0	y_0	z_0
	°	°			
243 6940·5	−0·36960	− 1·4779	−0·91413	+0·36059	+0·19060
6950·5	+0·86241	+ 3·4434	0·98574	+0·15636	0·12135
6960·5	2·09442	8·2910	1·02887	−0·05243	+0·04858
6970·5	3·32643	12·9739	1·04443	0·25991	−0·02553
6980·5	+4·55844	+17·4308	−1·03529	−0·46136	−0·09908

The planetary attractions are then calculated for each of these dates; in the following example the sum of the attractions includes the direct terms for the five planets Venus to Saturn, and the indirect terms for Jupiter + Saturn only, since the barycentric method is to be used. All the attractions are in units of the seventh decimal, extra figures being carried to guard against the accumulation of rounding-off errors in the process of summation.

J.D. 243 6960·5	x	y	z	K
Comet	−1·0289	−0·0524	+0·0486	
Venus (p. 10)	−0·586	−0·399	−0·143	22·9
Earth (p. 11)	−0·578	+0·732	+0·317	28·4
Mars (p. 42)	−0·206	−1·326	−0·603	0·10
Jupiter (p. 64)	−1·2020	−4·7595	−2·0124	8·934
Saturn (p. 65)	+1·764	−9·127	−3·850	2·672
				ρ^2
Comet − Venus	−0·443	+0·347	+0·192	0·3535
Comet − Earth	−0·451	−0·784	−0·268	0·8899
Comet − Mars	−0·823	+1·274	+0·652	2·726
Comet − Jupiter	+0·1731	+4·7071	+2·0610	26·4345
Comet − Saturn	−2·793	+9·075	+3·899	105·4
Attractions	X	Y	Z	K/ρ^3
(Jupiter + Saturn)/Sun (p. 65)	+2·13	+9·76	+4·13	
Comet/Venus	+1·53	−1·20	−0·66	3·445
Comet/Earth	+0·48	+0·84	+0·29	1·070
Comet/Mars	+0·02	−0·03	−0·01	0·022
Comet/Jupiter	−0·36	−9·78	−4·28	2·0787
Comet/Saturn	+0·22	−0·71	−0·30	0·0781
Sum	+4·02	−1·12	−0·83	

These attractions are differenced, and the values of their first and second sums determined

by the condition that on the date of osculation ξ, η, ζ and ξ', η' ζ' are all zero, so that, using (1.5) and (1.6), p. 142,

$$\delta^{-1}X_{\frac{1}{2}} = 0 - wx_0' + \tfrac{1}{2}X_0 + \tfrac{1}{12}\mu\delta X_0 - \tfrac{11}{720}\mu\delta^3 X_0 + \ldots$$
$$\delta^{-2}X_0 = 0 - x_b - \tfrac{1}{12}X_0 + \tfrac{1}{240}\delta^2 X_0 - \ldots$$

The values of x_b, y_b, z_b are taken from p. 58, and the components of the velocity of the barycentre x_b', y_b', z_b' are found from these co-ordinates by means of the Lagrange formula

$$wf_0' = \frac{w}{120}(f_{-2} - 8f_{-1} + 8f_1 - f_2)$$

This leads to the following values for J.D. 243 6960·5

x_b	−32·6	y_b	+8·1	z_b	+4·2
$10x_b'$	− 1·0	$10y_b'$	−6·5	$10z_b'$	−3·1

and to a preliminary scheme of the perturbations with their sums and differences:

243	$\delta^{-2}X$	$\delta^{-1}X$	X		$\delta^{-2}Y$	$\delta^{-1}Y$	Y		$\delta^{-2}Z$	$\delta^{-1}Z$	Z	
6940·5	+38·4		+4·0		−23·3		−1·1		−11·8		−0·6	
		− 5·1		+1		+8·2		0		+4·2		−1
6950·5	33·3		4·1	−2	15·1		1·1	0	7·6		0·7	0
		− 1·0		−1		7·1		0		3·5		−1
6960·5	32·3		4·0	−2	8·0		1·1	−3	4·1		0·8	−1
		+ 3·0		−3		6·0		−3		2·7		−2
6970·5	35·3		3·7	0	− 2·0		1·4	−3	− 1·4		1·0	−1
		6·7		−3		4·6		−6		1·7		−3
6980·5	+42·0		+3·4		+ 2·6		−2·0		+ 0·3		−1·3	
		+10·1				+2·6				+0·4		

A second approximation is now made, introducing the Encke terms $h(fqx - \xi)$. At this stage it is sufficient to write x_0 for x in calculating the perturbations, so that

$$\xi = x_b + \delta^{-2}X + \tfrac{1}{12}X - \ldots$$
$$r_0^3\, q = x_0\xi + y_0\eta + z_0\zeta \qquad \text{and} \qquad f = 3$$

This leads to the following table of values, and to a second and final approximation.

243	ξ	η	ζ	r_0^3	h	$3q$	$h(3qx-\xi)$ etc.		
6940·5	+11·5	−2·6	−1·9	1·0020	0·0295	−35·37	+0·61	−0·30	−0·14
6950·5	+ 2·9	−0·6	−0·5	1·0109	0·0291	− 8·94	+0·17	−0·02	−0·02
6960·5	0·0	0·0	0·0	1·0637	0·0270	0·00	0·00	0·00	0·00
6970·5	+ 2·9	−0·3	−0·3	1·1590	0·0237	− 7·62	+0·14	+0·05	+0·01
6980·5	+10·9	−1·7	−1·5	1·2945	0·0201	−23·99	+0·28	+0·26	+0·08

The values of X, Y, Z in the new scheme are the sums of the planetary attractions and the Encke terms, and the preliminary values of $\delta^{-2}X$, ... are adjusted accordingly. The schemes are extended by extrapolating values of ξ, η, ζ for the next date, and calculating perturbations as before. In this initial work no great accuracy is necessary in making such estimates, but at later stages the differences may become large, and are taken, if necessary, to the sixth difference. It is essential that these higher differences should flow smoothly, since this is the sole check on the accuracy of the work, and greatly simplifies the extrapolation of the attractions. It is usually convenient in double integrations to choose an interval such that the sixth differences do not exceed two figures; it is then possible to extrapolate with sufficient accuracy to avoid any necessity for recalculation of the perturbations.

The normal method of working is shown below. The values of the unperturbed co-ordinates may be calculated in a systematic manner for some dates in advance, but unnecessary work of this kind is to be avoided. As the comet moves outwards from the Sun, the interval of 10 days

becomes too small, and it is possible to reduce the amount of work either by doubling the interval, or by changing to Cowell's method, still using the 10-day interval.

Doubling the interval. In order to double the interval, alternate attractions are multiplied by 4, the extra decimals in the working being included. The new attractions are differenced, and the table is completed by calculating values of $\delta^{-2}X$ for the four central dates, using (1.12) on p. 142. The differences of these four values, which may include an extra (fictitious) decimal if desired, should be consistent with the attractions. Some small adjustments may be necessary; these should always be made to the values of $\delta^{-2}X$. In most cases it is necessary merely to round up or down to give complete agreement, and any such adjustment is always less than the errors that accumulate in the summations through the rounding of the attractions. The fictitious decimal allows the quantities to be rounded in a consistent manner, and its use is not continued beyond this stage.

Normal Encke step. The normal procedure in the Encke method is described for J.D. 243 7420·5. At this stage the integration schemes are as follows:

243	$\delta^{-2}X$	$\delta^{-1}X$	X	$\delta^{-2}Y$	$\delta^{-1}Y$	Y	$\delta^{-2}Z$	$\delta^{-1}Z$	Z
7300·5	− 122·5		− 84·3	−10266·7		−360·5	− 5164·5		−185·4
		− 290·9			−2405·7			−1210·3	
7320·5	413·4		109·1	12672·4		408·0	6374·8		211·8
		400·0			2813·7			1422·1	
7340·5	813·4		141·3	15486·1		462·2	7796·9		242·5
		541·3			3275·9			1664·6	
7360·5	1354·7		183·5	18762·0		524·7	9461·5		278·4
		724·8			3800·6			1943·0	
7380·5	2079·5		239·3	22562·6		596·9	11404·5		320·7
		964·1			4397·5			2263·7	
7400·5	3043·6		−313·9	26960·1		−680·3	13668·2		−370·8
		−1278·0			−5077·8			−2634·5	
7420·5	−4321·6			−32037·9			−16302·7		

The differences of the attractions, which maintain a check on the work, are at this stage quite smooth, and estimates are readily made of the next value of δ^4X and hence of X. The planetary attractions are calculated as before, and the perturbations are found from

$$\xi = x_b + \delta^{-2}X + \tfrac{1}{12}X - \tfrac{1}{240}\delta^2X + \ldots$$

Estimating the values of X, Y, Z on J.D. 243 7420·5 as −414, −776, and −430 respectively, the true values are found by applying (5.2), p. 146:

J.D. 243 7420·5	x	y	z		
ξ	−4395	−32132	−16351	K	37430·3
x_0	+2·64707	−3·44388	−1·42089	r_0^2	20·886
$x_0+\frac{1}{2}\xi$	+2·64685	−3·44549	−1·42171	q	+5856·7
x	+2·64663	−3·44709	−1·42253	f	2·9956
$fqx-\xi$	+50827	−28344	−8606	fq	+17544
Attractions	X	Y	Z		
(Jupiter+Saturn)/Sun	− 19·28	+ 38·34	+ 16·90		
Comet/Planets	−458·33	−779·43	−436·48		
$h(fqx-\xi)$	+ 63·03	− 35·15	− 10·67	h	0·0012400
Sum	−414·58	−776·24	−430·25		

The correct values for the attractions and their differences are now entered in the table. The direct attractions of each planet on the comet are differenced as a check against accidental error. It is generally possible to calculate the attractions by Saturn at double the interval, using the tabulated differences to extrapolate the extra values; the same procedure may be applied to other planets also. The extra decimal used in the early part of the work may be dropped at any suitable stage. The direct term for any planet may be omitted when its effect is considered negligible. Thus for the short-period comets the terms due to Uranus and Neptune

are generally (though not always justifiably) omitted. Similarly, as the comet moves outwards from the Sun, the direct terms due to Mars may be dropped when ρ reaches about 2 units. The effect of Venus and Earth persists over greater distances, but when the comet is sufficiently far from the Sun (generally when r is 4 or 5 units) it is possible to approximate to the true value of the direct terms by 'throwing the planets into the barycentre'. The resulting formulae (p. 144) lead to a considerable saving of labour while still including the effect of the inner planets. When adopting this procedure in Encke's method formula (5.3) is used; perturbations by the outer planets are calculated as before, but those for the inner planets are allowed for by subtracting the sum of the masses of these planets ($m = 59{\cdot}8 \times 10^{-7}$) from fq and using barycentric co-ordinates throughout. The value of K appropriate to G_1 is still used in forming h. The following results may be compared with those given above:

J.D. 243 7420·5	x	y	z		
ξ	−4356	−32103	−16339	K	37430·3
$\bar{x}$	+2·64663	−3·44709	−1·42252	q	+5856·1
$(fq-m)\bar{x}-\xi$	+50627	−28162	−8531	$fq-m$	+17483

Attractions	X	Y	Z		
(Jupiter + Saturn)/Sun	− 19·28	+ 38·34	+ 16·90		
Comet/(Jupiter + Saturn)	−458·09	−779·65	−436·56		
$h\{(fq-m)\bar{x}-\xi\}$	+ 62·78	− 34·92	− 10·58	h	0·0012400
Sum	−414·59	−776·23	−430·24		

Conversion from Encke's method to Cowell's method. It is normally convenient to change from Encke's method to Cowell's method when r^2 reaches 2 or 3. The unperturbed co-ordinates of the comet are calculated for 6 or 8 dates and, as an additional check, the velocities are also formed for the two central dates. Using the data of p. xi, the values for J.D. 243 7040·5 are:

M 11°·950 493	E 38°·984 523	$\sin E$ +0·629 11044	$\cos E$ +0·777 31593
x_0, y_0, z_0	−0·667 77320	−1·450 74427	−0·481 47497
x_0', y_0', z_0'	+0·498 61810	−0·775 87312	−0·313 69431

Checks: $r_0^2 = 2{\cdot}782\ 3982$ $\qquad ea^{\frac{1}{2}} \sin E = +0{\cdot}943\ 66566$

$x_0^2 + y_0^2 + z_0^2 = 2{\cdot}782\ 3981$ $\qquad x_0x_0' + y_0y_0' + z_0z_0' = +0{\cdot}943\ 66564$

The attractions Comet/Sun are formed from these co-ordinates, using $X = -Kx_0/r_0^3$ etc. These values are differenced and used to form an integration scheme which represents the unperturbed motion of the comet about the Sun. The values of $\delta^{-2}X_0$ and of $\delta^{-1}X_{\frac{1}{2}}$ for the central date are given by (1.6) and (1.5):

$$\delta^{-2}X_0 = x_0 - \tfrac{1}{12}X_0 + \tfrac{1}{240}\delta^2X_0 - \ldots$$

$$\delta^{-1}X_{\frac{1}{2}} = wkM_1x_0' + \tfrac{1}{2}X_0 + \tfrac{1}{12}\mu\delta X_0 - \tfrac{11}{720}\mu\delta^3X_0 + \ldots$$

This unperturbed scheme and the original Encke scheme are then added together, column for column, to give the Cowell scheme which represents the perturbed motion of the comet about the barycentre. Alternatively, the true co-ordinates may be calculated for each date from $x = x_0 + \xi$ etc., and the Cowell scheme commenced directly from these values.

Although it is not necessary to calculate $\delta^{-1}X_{\frac{1}{2}}$, which is the difference between two values of $\delta^{-2}X$, any errors in the first sum will accumulate, while those in the second sum will not. It is therefore essential that $\delta^{-1}X_{\frac{1}{2}}$ should be accurate, and the velocities calculated for the two central dates are used as a check. It is always possible to include an extra decimal in these quantities, which contain the small factor $wk/ra^{\frac{1}{2}}$, amounting in the present case to only 0·1; the extra decimal is also present in the Encke scheme. When this extra decimal is taken into account, it should be found that the values of $\delta^{-1}X$ are the differences of $\delta^{-2}X$ and have the values of X for their own differences. Any necessary adjustment is made to $\delta^{-2}X$ and not to $\delta^{-1}X$.

Commencing a Cowell scheme. In the case of a comet whose perihelion distance is sufficiently large (normally when r^2 is greater than 2), perturbations may be calculated from a Cowell scheme starting with a 10-day interval; an even larger interval may be used in favourable circumstances. At smaller distances a 5-day interval is necessary, but the labour involved may be reduced by calculating the planetary attractions at a larger interval and interpolating. The schemes are commenced by calculating the unperturbed co-ordinates, as in the previous section, for several dates on either side of the osculation date. From these unperturbed values the attractions are calculated and differenced. The velocities are calculated for the date of osculation, and the table completed by calculating values of $\delta^{-1}X_{\frac{1}{2}}$ and $\delta^{-2}X_0$ from (1.5) and (1.6), with the condition that on the date of osculation $x = x_0$ and $x' = x'_0$, so that

$$\delta^{-1}X_{\frac{1}{2}} = wkM_1x'_0 - wx'_b + \tfrac{1}{2}X_0 + \tfrac{1}{12}\mu\delta X_0 - \tfrac{11}{720}\mu\delta^3X_0 + \ldots$$
$$\delta^{-2}X_0 = x_0 - x_b - \tfrac{1}{12}X_0 + \tfrac{1}{240}\delta^2X_0 - \ldots$$

A second approximation is then made, using at each step

$$x = x_b + \delta^{-2}X + \tfrac{1}{12}X - \tfrac{1}{240}\delta^2X + \ldots$$

but in most cases this will cause little alteration to the first scheme; the planetary perturbations need not be recalculated.

Normal Cowell step. The normal procedure for a Cowell step, using (4.2), is illustrated for J.D. 243 7600·5. Part of the X-scheme as it appears at this stage is shown:

243	$\delta^{-2}X$	$\delta^{-1}X$	X				
7480·5	+3·067 1803		−32108	−112	0	+25	
		+133 6250		+186	−24	+28	
7500·5	3·200 8053		31922	136	+28	+10	
		130 4328		+50	+4	38	
7520·5	3·331 2381		31872	132	66	−15	
		127 2456		−82	70	+23	
7540·5	3·458 4837		31954	−62	89	*−50*	
		124 0502		144	159	−27	
7560·5	3·582 5339		32098	+97	*+62*		
		120 8404		−47	*+221*		
7580·5	3·703 3743		32145	*+318*			
		+117 6259		*+271*			
7600·5	+3·821 0002		*−31874*				

An estimate of the sixth difference opposite 7540·5 is made, and the figures in italics are entered in pencil. No great accuracy is necessary in making this estimate; the co-ordinates contain eight significant figures, and only the last of these is likely to be affected by errors in $\frac{1}{12}X$. The planetary attractions are calculated as before (but with the omission of Mars, whose effect is negligible at this stage), and the solar attractions $X = -Kx/r^3$ are added.

J.D. 243 7600·5

x, y, z +3·820 7349 −3·557 9152 −1·542 0778 r^2 29·634 780

Attractions	X	Y	Z		
J+S/Sun (p. 67)	− 29·97	+ 33·16	+ 14·95	K	37430·269
Comet/V+E	− 0·13	+ 0·14	+ 0·06		
Comet/J+S	− 3821·79	+ 169·30	− 385·61		
Comet/Sun	−28032·85	+26104·54	+11314·27	K/r^3	7337·032
Sum	−31884·74	+26307·14	+10943·67		

The correct value of −31885 for X, and the corresponding differences, are now entered in the table in ink. It will be noticed that the error of 11 in the estimated sixth difference causes no appreciable error in the value of X. At later stages an increasing lack of smoothness in

the higher differences makes it difficult to check the work ; in such cases (due here to the rapid approach to Jupiter) the interval should be halved until the disturbance has diminished again.

The alternative method for calculating the attractions, when the comet is 4 or 5 units from the Sun, greatly simplifies the work. The barycentric co-ordinates are found directly from

$$\bar{x} = \delta^{-2}X + \tfrac{1}{12}X - \tfrac{1}{240}\delta^2 X + \ldots$$

and the attractions calculated from (4.3); the value of K appropriate to G_4 is now used:

J.D. 243 7600·5					
$\bar{x}, \bar{y}, \bar{z}$	+3·820 7343	−3·557 9169	−1·542 0786	$\bar{r}^2$	29·634 790
Attractions	X	Y	Z		
J+S/Sun	− 29·97	+ 33·16	+ 14·95	K	37430·486
Comet/J+S	− 3821·79	+ 169·30	− 385·61		
Comet/Sun	−28033·00	+26104·69	+11314·34	$K/\bar{r}^3$	7337·071
Sum	−31884·76	+26307·15	+10943·68		

This method may be continued until the value of r is again less than about 4 units. For less accurate work, the method may be used over a longer period.

Rectification of an Encke scheme. Although the perturbations in the Encke method are small at the commencement of the schemes, they, and their differences, may become so large that extrapolation of the schemes becomes difficult, and constant checking and recalculation become necessary. The difficulty is overcome by rectifying the orbit, i.e., forming new osculating elements with which a new scheme is commenced. Two or three such rectifications are advisable in the course of the revolution, and one of these should be made just before the comet reaches perihelion. The difficulties are greatest at this point, since the difference between the solar attractions calculated from the perturbed and unperturbed orbits will be greatest when r is least.

The rectification is carried out by calculating the unperturbed co-ordinates x_0, y_0, z_0 and the corresponding velocities for a selected date of osculation, and adding to these the perturbations and velocities from the Encke schemes, using (1.7) and (1.8) to obtain $\bar{\xi}'$ and $\bar{\xi}$, from which

$$x = x_0 + \xi = x_0 + \bar{\xi} + x_b \quad \text{and} \quad x' = x_0' + \xi' = x_0' + \bar{\xi}' + x_b'$$

The true co-ordinates and velocities so obtained must be carefully checked; they are then used to calculate elements, working as far as aP_x, bQ_x, etc. (see Example 1 on p. 147) and a new Encke scheme is commenced.

Halving the interval. As the comet approaches a major planet (or the Sun on the return to perihelion) the higher differences become larger and there is increasing difficulty in estimating values of the attractions at the next step. The interval should then be halved by dividing the attractions (with an extra decimal) by 4, and interpolating to halves. The 6-point Lagrange formula on p. 111 is convenient for this purpose. Formulae (1.10) and (1.12) (p. 142) are then used to calculate three values of $\delta^{-2}X$ and two values of $\delta^{-1}X$. The latter should then be the differences of $\delta^{-2}X$ and should have the attractions X as their own differences; an extra (fictitious) decimal may be retained to reduce as much as possible the errors due to rounding. It may be necessary to adjust the rounding of one of the values of $\delta^{-2}X$; in most cases, however, no difficulties will arise in halving the interval in either Encke's or Cowell's method, and the process continues as before, using the values of K appropriate to the new interval.

Conversion from Cowell's method to Encke's method. When Cowell's method is used, the interval becomes inconveniently small if the comet approaches the Sun within the limit set by $r^2 = 2$, and it is then advisable to revert to Encke's method. The true co-ordinates and velocities of the comet are derived from the Cowell schemes for a suitable date, using (1.7) and (1.8) to give $\bar{x}$ and $\bar{x}'$, from which

$$x = \bar{x} + x_b \quad \text{and} \quad x' = \bar{x}' + x_b'$$

and the elements of the orbit are calculated from the formulae of p. 147. It is only necessary

to work as far as aP_x, bQ_x, etc; using these constants the co-ordinates of the comet are calculated for a number of dates, and an Encke scheme is commenced and carried forward past perihelion.

The final elements. The elements of the perturbed orbit of the comet are found for any convenient date by similar methods. The date chosen for the final osculating orbit should be a 40-day date (i.e., the integral part of the Julian date should be divisible by 40). The co-ordinates and velocities are obtained directly from a Cowell scheme, as described in the previous section; in Encke's method, they are obtained as described under *Rectification*. The example on p. 147 shows the complete calculation of the final elements.

3. EXPLANATION OF THE TABLES

The quantities tabulated for each planet are given for 0^h E.T. on each date, and (with the exception of Mercury) are all referred to the mean equinox of 1950·0; they are defined as follows:

l = heliocentric longitude
b = heliocentric latitude
r = radius vector
x, y, z = heliocentric equatorial rectangular co-ordinates
X, Y, Z = indirect attractions; they form part of the total attractions on the comet, and are equal to the negative of the attractions of the planet on the Sun.

The heliocentric longitudes, latitudes and radii vectores of Venus, Earth and Mars have been taken from Newcomb's Tables, and Ross's corrections have been added in the case of Mars. For Jupiter, Saturn, Uranus, Neptune and Pluto, the heliocentric equatorial rectangular co-ordinates given in Volume XII of *Astronomical Papers of the American Ephemeris* have been used; the corrections for the action of the inner planets, given in Vol. XIII, part V of the same publication, have not been applied, since their effect is less than half a unit of the fifth decimal. The subsequent conversions from ecliptic to equatorial co-ordinates (and vice versa) have been carried out on the punched-card machines of H.M. Nautical Almanac Office.

The components of the attraction of the planet on the Sun are in units of the seventh decimal, and are computed from

$$X = -10^7 \frac{w^2k^2mx}{r^3}$$

with similar expressions for Y and Z. The value of k, the Gaussian gravitational constant, and the adopted values of m are given on p. 160. The choice of the number of decimals, the intervals of tabulation, and the combination of planets in these indirect terms, is the result of a detailed examination of requirements. Thus the interval of tabulation (10 days for the planets Venus to Saturn, and 40 days for Uranus and Neptune) covers most normal requirements without interpolation. In those methods in which the tabulated dates are not used, it will be necessary to interpolate the values of l, b, r and $1/r^3$; the interval chosen is in all cases small enough to allow this to be done readily, although in some cases second differences will have to be used to provide full accuracy.

The tabulation of the rectangular co-ordinates to five decimals sets the limits of accuracy for which the volume is basically designed. The normal methods, using rectangular co-ordinates, will involve the calculation of the individual attractions in units of the ninth decimal with subsequent rounding to the eighth; the eighth decimal is then used as a guarding figure in the integration schemes. This accuracy is only possible, however, if no close approach to a major planet occurs; thus, in a 10-day scheme, the attractions by Jupiter can be calculated accurately to the eighth decimal from the printed co-ordinates only if the distance is greater than 0·38 (see Table V), and similar conditions apply to other planets.

The number of accurate figures obtainable in the calculations therefore governs the accuracy required in the indirect terms. For the planets Venus, Earth and Mars, where an interval of 20 days is the largest that is suitable, the attractions (in units of the seventh decimal) are given to three extra decimals; for the planets Jupiter to Neptune, four extra decimals are provided.

Attention is drawn to an important difference of tabulation between this volume and its two predecessors:

The attractions X, Y, Z are tabulated for all planets on the basis of $w = 10$ days; they are to be multiplied by 4, 16 or 64 for intervals of 20, 40 or 80 days respectively.

Tables of Co-ordinates

Julian Dates. Throughout this volume, Julian Date is used as the argument and all data are given for 0^h E.T. On page 1 are tabulated the Calendar Dates corresponding to the standard 40-day Julian Dates. These should always be used for the osculating epochs of the elements of comets and minor planets (*Transactions I.A.U.*, Vol. III, pp. 226 and 301, 1928).

Mercury. These three-decimal heliocentric equatorial rectangular co-ordinates (for mean equinox of date) are given to assist in estimating the size (or computing approximate values) of perturbations by this planet.

Venus, Earth, Mars. The attractions X, Y, Z are included in continuation of those in the two previous volumes, but the use of barycentric co-ordinates eliminates the need for these terms, and allows the use, in favourable circumstances, of a larger interval. The method is described in the *Illustration* above. The co-ordinates tabulated for the Earth are for the centre of mass of the Earth and Moon.

Co-ordinates of the Barycentre. This table gives the heliocentric equatorial co-ordinates of the barycentre S_4, i.e., the centre of mass of the Sun and the four inner planets. They have been calculated from formulae of the type

$$(1 + \sum_{n=1}^{4} m_n)x_b = m_2x_2 + m_3x_3 + m_4x_4$$

(the effect of Mercury being ignored) and are given in units of the seventh decimal.

The maximum displacement in any co-ordinate caused by changing the system of reference from heliocentric to barycentric co-ordinates cannot exceed half a unit of the fifth decimal. Hence the heliocentric co-ordinates tabulated in this volume may be considered to refer to either system, or to the centre of mass of the Sun and Mercury S_1. In cases of a very close approach, more accurate values of the co-ordinates of the outer planets may be obtained from Volume XII of *Astronomical Papers of the American Ephemeris*, but these are best regarded as barycentric, i.e., referred to S_4, since the effect of the inner planets has been neglected. Gravitational constants for S_1 and S_4 are given on p. 160.

Jupiter, Saturn. On the Jupiter (left-hand) pages the attractions X, Y, Z are those for Jupiter only; on the right-hand pages, under Saturn, the sums of the attractions Jupiter + Saturn are tabulated for convenience, since it is unlikely that the indirect attractions of Saturn alone will be required.

Uranus and Neptune. The interval in this table is 40 days and the co-ordinates are given to four decimals. The attractions (which are given for $w = 10$ days, as described above) are those of Uranus (left-hand pages) and of Uranus + Neptune (right-hand pages).

Pluto. The rectangular co-ordinates of Pluto are given to four decimals as an aid to planning further work in the case of a close approach.

Auxiliary Tables

Table I. This table gives the mean obliquity and its trigonometrical functions.

Table II. The quantities a, b, c and c', which are used to convert ecliptic co-ordinates from equinox of date to that of 1950·0 or vice versa, are given in decimal and in sexagesimal measure for the equinox of the beginning of each year. The formulae for conversion are provided in a footnote.

Table III. The quantities tabulated are for the accurate reduction of positions from equinox of date to that of 1950·0 or vice versa, and are based on the following expressions:

$$\begin{aligned} \zeta_0 &= -2304\overset{''}{\cdot}997\ T - 1\overset{''}{\cdot}093\ T^2 - 0\overset{''}{\cdot}0192\ T^3 \\ z &= -2304\overset{''}{\cdot}997\ T - 0\overset{''}{\cdot}302\ T^2 - 0\overset{''}{\cdot}0179\ T^3 \\ \theta &= -2004\overset{''}{\cdot}298\ T + 0\overset{''}{\cdot}426\ T^2 + 0\overset{''}{\cdot}0416\ T^3 \end{aligned}$$

$$M = \zeta_0 + z \qquad N = \theta$$

where T is measured in Julian centuries from 1950·0.

Table IV is for the conversion of equatorial rectangular co-ordinates, or of the equatorial constants P_x, Q_x, etc., from the equinox of 1950·0 to other equinoxes, or vice versa. The numerical values for reduction from the equinox of 1950·0 to that of a given date are derived from the following series, in which T is measured in Julian centuries from 1950·0:

$$\begin{aligned} X_x &= 1{\cdot}000\ 00000 - 0{\cdot}000\ 29697\ T^2 - 0{\cdot}000\ 00013\ T^3 \\ Y_x = -X_y &= -0{\cdot}022\ 34988\ T - 0{\cdot}000\ 00676\ T^2 + 0{\cdot}000\ 00221\ T^3 \\ Z_x = -X_z &= -0{\cdot}009\ 71711\ T + 0{\cdot}000\ 00207\ T^2 + 0{\cdot}000\ 00096\ T^3 \\ Y_y &= 1{\cdot}000\ 00000 - 0{\cdot}000\ 24976\ T^2 - 0{\cdot}000\ 00015\ T^3 \\ Y_z = Z_y &= - 0{\cdot}000\ 10859\ T^2 - 0{\cdot}000\ 00003\ T^3 \\ Z_z &= 1{\cdot}000\ 00000 - 0{\cdot}000\ 04721\ T^2 + 0{\cdot}000\ 00002\ T^3 \end{aligned}$$

Table Va is intended to be used in the qualitative consideration of the magnitude of the attractions of the various planets at given distances. *Table Vb* may be used to determine the number of decimals to be retained in the co-ordinates at close approaches to the planets, and *Table Vc* gives the distances at which the direct attractions of the planets may be neglected if the resulting error is not to exceed half a unit.

Table VI. This table gives five-decimal values of the Lagrange four-point interpolation coefficients. In this volume the quantities tabulated are, in general, used without interpolation and hence no differences are given; this table enables interpolation to be done where necessary without forming differences.

Table VII. This is Encke's fq table, in natural numbers instead of logarithms.

Table VIII. This table gives the values of $1/r^3$ with argument r^2; or, if the argument be regarded as x, the respondent is $x^{-\frac{3}{2}}$. The range of r^2 is from 2 to 20. Since, in actual applications, the quantity $1/r^3$ is multiplied by w^2k^2m, the table may be used outside its range by introducing a correcting factor into w^2k^2m. Hence this table may be entered with the significant figures of r^2, and the value thus obtained used in conjunction with the factors K tabulated on p. 160.

The table of constants on p. 160 includes the masses of the planets and the constants K which are derived from them. The masses are those given by Clemence in *Astronomical Papers of the American Ephemeris*, Vol. XI, part II, 1949, and are consistent with those used in calculating the planetary co-ordinates in this volume.

Julian Date	Calendar Date	Julian Date	Calendar Date	Julian Date	Calendar Date	Julian Date	Calendar Date
243 6920·5	1959 Dec. 18	243 8840·5	1965 Mar. 21	244 0760·5	1970 June 23	244 2680·5	1975 Sept. 25
6960·5	1960 Jan. 27	8880·5	Apr. 30	0800·5	Aug. 2	2720·5	Nov. 4
7000·5	Mar. 7	8920·5	June 9	0840·5	Sept. 11	2760·5	Dec. 14
7040·5	Apr. 16	8960·5	July 19	0880·5	Oct. 21	2800·5	1976 Jan. 23
243 7080·5	May 26	243 9000·5	Aug. 28	244 0920·5	Nov. 30	244 2840·5	Mar. 3
7120·5	July 5	9040·5	Oct. 7	0960·5	1971 Jan. 9	2880·5	Apr. 12
7160·5	Aug. 14	9080·5	Nov. 16	1000·5	Feb. 18	2920·5	May 22
7200·5	Sept. 23	9120·5	Dec. 26	1040·5	Mar. 30	2960·5	July 1
243 7240·5	Nov. 2	243 9160·5	1966 Feb. 4	244 1080·5	May 9	244 3000·5	Aug. 10
7280·5	Dec. 12	9200·5	Mar. 16	1120·5	June 18	3040·5	Sept. 19
7320·5	1961 Jan. 21	9240·5	Apr. 25	1160·5	July 28	3080·5	Oct. 29
7360·5	Mar. 2	9280·5	June 4	1200·5	Sept. 6	3120·5	Dec. 8
243 7400·5	Apr. 11	243 9320·5	July 14	244 1240·5	Oct. 16	244 3160·5	1977 Jan. 17
7440·5	May 21	9360·5	Aug. 23	1280·5	Nov. 25	3200·5	Feb. 26
7480·5	June 30	9400·5	Oct. 2	1320·5	1972 Jan. 4	3240·5	Apr. 7
7520·5	Aug. 9	9440·5	Nov. 11	1360·5	Feb. 13	3280·5	May 17
243 7560·5	Sept. 18	243 9480·5	Dec. 21	244 1400·5	Mar. 24	244 3320·5	June 26
7600·5	Oct. 28	9520·5	1967 Jan. 30	1440·5	May 3	3360·5	Aug. 5
7640·5	Dec. 7	9560·5	Mar. 11	1480·5	June 12	3400·5	Sept. 14
7680·5	1962 Jan. 16	9600·5	Apr. 20	1520·5	July 22	3440·5	Oct. 24
243 7720·5	Feb. 25	243 9640·5	May 30	244 1560·5	Aug. 31	244 3480·5	Dec. 3
7760·5	Apr. 6	9680·5	July 9	1600·5	Oct. 10	3520·5	1978 Jan. 12
7800·5	May 16	9720·5	Aug. 18	1640·5	Nov. 19	3560·5	Feb. 21
7840·5	June 25	9760·5	Sept. 27	1680·5	Dec. 29	3600·5	Apr. 2
243 7880·5	Aug. 4	243 9800·5	Nov. 6	244 1720·5	1973 Feb. 7	244 3640·5	May 12
7920·5	Sept. 13	9840·5	Dec. 16	1760·5	Mar. 19	3680·5	June 21
7960·5	Oct. 23	9880·5	1968 Jan. 25	1800·5	Apr. 28	3720·5	July 31
8000·5	Dec. 2	9920·5	Mar. 5	1840·5	June 7	3760·5	Sept. 9
243 8040·5	1963 Jan. 11	243 9960·5	Apr. 14	244 1880·5	July 17	244 3800·5	Oct. 19
8080·5	Feb. 20	244 0000·5	May 24	1920·5	Aug. 26	3840·5	Nov. 28
8120·5	Apr. 1	0040·5	July 3	1960·5	Oct. 5	3880·5	1979 Jan. 7
8160·5	May 11	0080·5	Aug. 12	2000·5	Nov. 14	3920·5	Feb. 16
243 8200·5	June 20	244 0120·5	Sept. 21	244 2040·5	Dec. 24	244 3960·5	Mar. 28
8240·5	July 30	0160·5	Oct. 31	2080·5	1974 Feb. 2	4000·5	May 7
8280·5	Sept. 8	0200·5	Dec. 10	2120·5	Mar. 14	4040·5	June 16
8320·5	Oct. 18	0240·5	1969 Jan. 19	2160·5	Apr. 23	4080·5	July 26
243 8360·5	Nov. 27	244 0280·5	Feb. 28	244 2200·5	June 2	244 4120·5	Sept. 4
8400·5	1964 Jan. 6	0320·5	Apr. 9	2240·5	July 12	4160·5	Oct. 14
8440·5	Feb. 15	0360·5	May 19	2280·5	Aug. 21	4200·5	Nov. 23
8480·5	Mar. 26	0400·5	June 28	2320·5	Sept. 30	4240·5	1980 Jan. 2
243 8520·5	May 5	244 0440·5	Aug. 7	244 2360·5	Nov. 9	244 4280·5	Feb. 11
8560·5	June 14	0480·5	Sept. 16	2400·5	Dec. 19	4320·5	Mar. 22
8600·5	July 24	0520·5	Oct. 26	2440·5	1975 Jan. 28	4360·5	May 1
8640·5	Sept. 2	0560·5	Dec. 5	2480·5	Mar. 9	4400·5	June 10
243 8680·5	Oct. 12	244 0600·5	1970 Jan. 14	244 2520·5	Apr. 18	244 4440·5	July 20
8720·5	Nov. 21	0640·5	Feb. 23	2560·5	May 28	4480·5	Aug. 29
8760·5	Dec. 31	0680·5	Apr. 4	2600·5	July 7	4520·5	Oct. 8
243 8800·5	1965 Feb. 9	244 0720·5	May 14	244 2640·5	Aug. 16	244 4560·5	Nov. 17

MERCURY

HELIOCENTRIC EQUATORIAL CO-ORDINATES IN UNITS OF THE THIRD DECIMAL

J.D.	x	y	z	J.D.	x	y	z	J.D.	x	y	z	J.D.	x	y	z
243				243				243				243			
6920·5	−394	− 56	+ 11	7160·5	+159	+241	+113	7400·5	+257	−288	−181	7640·5	−241	−356	−166
6925·5	−385	−169	− 51	7165·5	− 3	+272	+146	7405·5	+327	−190	−135	7645·5	−142	−398	−198
6930·5	−339	−266	−107	7170·5	−165	+237	+144	7410·5	+359	− 71	− 75	7650·5	− 32	−410	−216
6935·5	−264	−341	−155	7175·5	−293	+151	+111	7415·5	+340	+ 58	− 4	7655·5	+ 80	−393	−219
6940·5	−168	−390	−191	7180·5	−370	+ 38	+ 58	7420·5	+261	+175	+ 67	7660·5	+185	−346	−204
6945·5	− 60	−410	−213	7185·5	−396	− 81	− 3	7425·5	+125	+254	+123	7665·5	+275	−269	−172
6950·5	+ 52	−400	−220	7190·5	−378	−192	− 64	7430·5	− 40	+270	+149	7670·5	+337	−165	−123
6955·5	+160	−360	−209	7195·5	−325	−284	−119	7435·5	−197	+222	+139	7675·5	+359	− 43	− 60
6960·5	+255	−291	−182	7200·5	−244	−354	−164	7440·5	−314	+128	+101	7680·5	+328	+ 85	+ 12
6965·5	+325	−193	−137	7205·5	−145	−397	−197	7445·5	−380	+ 12	+ 45	7685·5	+235	+197	+ 81
6970·5	+358	− 75	− 77	7210·5	− 36	−410	−216	7450·5	−396	−107	− 16	7690·5	+ 90	+263	+131
6975·5	+341	+ 54	− 6	7215·5	+ 76	−394	−219	7455·5	−369	−214	− 76	7695·5	− 77	+265	+150
6980·5	+264	+172	+ 65	7220·5	+182	−348	−205	7460·5	−309	−302	−130	7700·5	−227	+205	+133
6985·5	+130	+252	+121	7225·5	+273	−271	−173	7465·5	−224	−366	−173	7705·5	−333	+103	+ 90
6990·5	− 35	+271	+148	7230·5	+336	−169	−125	7470·5	−122	−402	−203	7710·5	−387	− 15	+ 32
6995·5	−193	+224	+140	7235·5	+359	− 47	− 62	7475·5	− 11	−410	−218	7715·5	−393	−131	− 30
7000·5	−311	+131	+102	7240·5	+330	+ 81	+ 10	7480·5	+100	−387	−217	7720·5	−358	−235	− 89
7005·5	−378	+ 15	+ 47	7245·5	+239	+194	+ 79	7485·5	+204	−333	−199	7725·5	−292	−318	−140
7010·5	−396	−103	− 14	7250·5	+ 95	+262	+130	7490·5	+289	−251	−164	7730·5	−203	−376	−180
7015·5	−370	−211	− 75	7255·5	− 72	+266	+150	7495·5	+345	−144	−112	7735·5	− 98	−406	−207
7020·5	−311	−299	−128	7260·5	−222	+207	+134	7500·5	+358	− 19	− 47	7740·5	+ 13	−407	−219
7025·5	−227	−364	−171	7265·5	−330	+107	+ 91	7505·5	+315	+108	+ 26	7745·5	+124	−378	−215
7030·5	−125	−401	−202	7270·5	−386	− 11	+ 34	7510·5	+211	+213	+ 92	7750·5	+224	−318	−193
7035·5	− 15	−410	−218	7275·5	−394	−128	− 28	7515·5	+ 60	+269	+138	7755·5	+304	−230	−154
7040·5	+ 97	−388	−218	7280·5	−360	−232	− 87	7520·5	−107	+258	+149	7760·5	+352	−117	− 99
7045·5	+201	−336	−200	7285·5	−295	−316	−139	7525·5	−250	+188	+126	7765·5	+354	+ 10	− 31
7050·5	+287	−254	−166	7290·5	−206	−375	−179	7530·5	−347	+ 82	+ 80	7770·5	+298	+134	+ 41
7055·5	+344	−147	−114	7295·5	−102	−406	−207	7535·5	−392	− 37	+ 21	7775·5	+181	+231	+105
7060·5	+358	− 23	− 49	7300·5	+ 10	−408	−219	7540·5	−389	−152	− 41	7780·5	+ 23	+272	+143
7065·5	+317	+105	+ 23	7305·5	+120	−379	−215	7545·5	−348	−252	− 99	7785·5	−142	+247	+147
7070·5	+216	+211	+ 91	7310·5	+221	−320	−194	7550·5	−277	−331	−149	7790·5	−276	+167	+118
7075·5	+ 65	+268	+137	7315·5	+302	−233	−156	7555·5	−184	−384	−187	7795·5	−361	+ 56	+ 67
7080·5	−102	+259	+149	7320·5	+351	−121	−101	7560·5	− 78	−409	−211	7800·5	−395	− 63	+ 7
7085·5	−247	+191	+128	7325·5	+354	+ 6	− 34	7565·5	+ 34	−404	−220	7805·5	−383	−176	− 54
7090·5	−345	+ 86	+ 81	7330·5	+300	+131	+ 39	7570·5	+144	−369	−212	7810·5	−335	−271	−111
7095·5	−391	− 33	+ 22	7335·5	+186	+228	+103	7575·5	+241	−303	−187	7815·5	−258	−345	−158
7100·5	−390	−149	− 39	7340·5	+ 28	+272	+142	7580·5	+316	−210	−145	7820·5	−162	−392	−193
7105·5	−350	−249	− 97	7345·5	−137	+249	+147	7585·5	+356	− 94	− 87	7825·5	− 53	−410	−214
7110·5	−280	−329	−147	7350·5	−272	+170	+119	7590·5	+348	+ 34	− 18	7830·5	+ 59	−399	−219
7115·5	−187	−383	−186	7355·5	−359	+ 60	+ 69	7595·5	+280	+155	+ 54	7835·5	+167	−357	−208
7120·5	− 81	−408	−210	7360·5	−395	− 59	+ 9	7600·5	+154	+243	+114	7840·5	+260	−285	−179
7125·5	+ 31	−405	−220	7365·5	−384	−172	− 53	7605·5	− 9	+272	+147	7845·5	+328	−186	−134
7130·5	+140	−370	−213	7370·5	−337	−269	−109	7610·5	−170	+235	+143	7850·5	+359	− 67	− 73
7135·5	+238	−306	−188	7375·5	−261	−343	−157	7615·5	−296	+148	+110	7855·5	+338	+ 62	− 2
7140·5	+314	−213	−147	7380·5	−165	−391	−192	7620·5	−371	+ 34	+ 57	7860·5	+257	+178	+ 69
7145·5	+356	− 98	− 89	7385·5	− 57	−410	−214	7625·5	−396	− 85	− 5	7865·5	+120	+255	+124
7150·5	+349	+ 30	− 20	7390·5	+ 55	−400	−220	7630·5	−377	−195	− 66	7870·5	− 46	+270	+149
7155·5	+283	+152	+ 52	7395·5	+163	−359	−209	7635·5	−322	−287	−120	7875·5	−201	+220	+138
7160·5	+159	+241	+113	7400·5	+257	−288	−181	7640·5	−241	−356	−166	7880·5	−317	+124	+ 99

MERCURY ie $\times 10^{-3}$

HELIOCENTRIC EQUATORIAL CO-ORDINATES IN UNITS OF THE THIRD DECIMAL

J.D.	x	y	z	J.D.	x	y	z	J.D.	x	y	z	J.D.	x	y	z
243				243				243				243			
7880·5	−317	+124	+ 99	8120·5	+326	+ 89	+ 14	8360·5	+107	−384	−217	8600·5	−355	−241	− 92
7885·5	−381	+ 8	+ 43	8125·5	+231	+200	+ 83	8365·5	+210	−329	−198	8605·5	−287	−323	−143
7890·5	−395	−110	− 18	8130·5	+ 85	+264	+133	8370·5	+294	−245	−161	8610·5	−196	−379	−183
7895·5	−368	−217	− 78	8135·5	− 82	+264	+150	8375·5	+347	−136	−109	8615·5	− 91	−407	−209
7900·5	−307	−304	−131	8140·5	−231	+202	+132	8380·5	+357	− 11	− 42	8620·5	+ 21	−406	−219
7905·5	−221	−367	−174	8145·5	−335	+100	+ 88	8385·5	+310	+116	+ 30	8625·5	+131	−375	−214
7910·5	−119	−403	−203	8150·5	−388	− 18	+ 30	8390·5	+203	+219	+ 96	8630·5	+230	−313	−191
7915·5	− 8	−409	−218	8155·5	−392	−135	− 32	8395·5	+ 49	+270	+139	8635·5	+309	−223	−151
7920·5	+104	−385	−217	8160·5	−357	−238	− 91	8400·5	−117	+255	+148	8640·5	+354	−110	− 95
7925·5	+207	−331	−199	8165·5	−290	−320	−142	8405·5	−258	+182	+124	8645·5	+352	+ 18	− 27
7930·5	+292	−248	−163	8170·5	−200	−378	−181	8410·5	−351	+ 75	+ 76	8650·5	+292	+141	+ 46
7935·5	+346	−140	−110	8175·5	− 95	−407	−208	8415·5	−393	− 45	+ 17	8655·5	+172	+235	+108
7940·5	+357	− 15	− 45	8180·5	+ 17	−407	−219	8420·5	−388	−159	− 45	8660·5	+ 12	+272	+144
7945·5	+313	+112	+ 28	8185·5	+127	−376	−214	8425·5	−344	−258	−103	8665·5	−151	+243	+146
7950·5	+207	+216	+ 94	8190·5	+227	−315	−192	8430·5	−271	−335	−151	8670·5	−283	+161	+115
7955·5	+ 54	+269	+138	8195·5	+307	−226	−153	8435·5	−178	−386	−188	8675·5	−365	+ 49	+ 64
7960·5	−112	+256	+149	8200·5	+353	−113	− 97	8440·5	− 71	−409	−212	8680·5	−395	− 70	+ 3
7965·5	−254	+185	+125	8205·5	+353	+ 14	− 29	8445·5	+ 42	−403	−220	8685·5	−381	−182	− 58
7970·5	−349	+ 78	+ 78	8210·5	+295	+138	+ 43	8450·5	+150	−365	−211	8690·5	−331	−277	−114
7975·5	−392	− 41	+ 19	8215·5	+177	+233	+106	8455·5	+247	−298	−185	8695·5	−252	−349	−161
7980·5	−389	−155	− 43	8220·5	+ 18	+272	+144	8460·5	+320	−203	−142	8700·5	−155	−394	−195
7985·5	−346	−255	−101	8225·5	−146	+245	+146	8465·5	+357	− 86	− 83	8705·5	− 46	−410	−215
7990·5	−274	−333	−150	8230·5	−279	+164	+116	8470·5	+345	+ 42	− 13	8710·5	+ 66	−397	−219
7995·5	−181	−385	−188	8235·5	−363	+ 53	+ 66	8475·5	+274	+162	+ 59	8715·5	+173	−353	−207
8000·5	− 74	−409	−211	8240·5	−395	− 67	+ 5	8480·5	+145	+247	+117	8720·5	+265	−280	−177
8005·5	+ 38	−403	−220	8245·5	−382	−179	− 56	8485·5	− 19	+272	+147	8725·5	+332	−179	−130
8010·5	+147	−367	−212	8250·5	−333	−274	−112	8490·5	−179	+231	+142	8730·5	+359	− 59	− 68
8015·5	+244	−301	−186	8255·5	−255	−347	−159	8495·5	−302	+141	+107	8735·5	+335	+ 70	+ 3
8020·5	+318	−207	−143	8260·5	−158	−393	−194	8500·5	−374	+ 27	+ 53	8740·5	+250	+185	+ 73
8025·5	+357	− 90	− 85	8265·5	− 50	−410	−215	8505·5	−396	− 92	− 9	8745·5	+110	+258	+127
8030·5	+347	+ 38	− 15	8270·5	+ 62	−398	−219	8510·5	−374	−201	− 69	8750·5	− 56	+268	+149
8035·5	+277	+159	+ 56	8275·5	+170	−355	−207	8515·5	−318	−292	−124	8755·5	−210	+215	+137
8040·5	+149	+245	+116	8280·5	+263	−282	−178	8520·5	−235	−359	−168	8760·5	−322	+117	+ 96
8045·5	− 14	+272	+147	8285·5	+330	−183	−132	8525·5	−135	−399	−200	8765·5	−383	0	+ 40
8050·5	−175	+233	+143	8290·5	+359	− 63	− 71	8530·5	− 25	−410	−217	8770·5	−395	−117	− 22
8055·5	−299	+145	+108	8295·5	+337	+ 66	+ 1	8535·5	+ 87	−391	−218	8775·5	−365	−223	− 82
8060·5	−373	+ 30	+ 55	8300·5	+254	+182	+ 71	8540·5	+192	−342	−203	8780·5	−302	−309	−134
8065·5	−396	− 89	− 7	8305·5	+115	+257	+125	8545·5	+280	−263	−169	8785·5	−215	−370	−176
8070·5	−376	−198	− 67	8310·5	− 51	+269	+149	8550·5	+340	−158	−120	8790·5	−112	−404	−205
8075·5	−320	−290	−122	8315·5	−206	+217	+137	8555·5	+359	− 35	− 56	8795·5	0	−409	−219
8080·5	−238	−357	−167	8320·5	−320	+121	+ 98	8560·5	+324	+ 93	+ 16	8800·5	+111	−383	−216
8085·5	−139	−398	−199	8325·5	−382	+ 4	+ 42	8565·5	+228	+202	+ 85	8805·5	+213	−327	−197
8090·5	− 29	−410	−217	8330·5	−395	−114	− 20	8570·5	+ 80	+265	+134	8810·5	+296	−242	−160
8095·5	+ 83	−392	−218	8335·5	−366	−220	− 80	8575·5	− 87	+263	+149	8815·5	+348	−132	−107
8100·5	+189	−344	−203	8340·5	−304	−307	−133	8580·5	−235	+199	+131	8820·5	+356	− 6	− 40
8105·5	+278	−266	−171	8345·5	−218	−369	−175	8585·5	−338	+ 96	+ 86	8825·5	+308	+120	+ 32
8110·5	+339	−162	−121	8350·5	−115	−404	−204	8590·5	−389	− 22	+ 28	8830·5	+199	+221	+ 98
8115·5	+359	− 39	− 58	8355·5	− 4	−409	−218	8595·5	−392	−138	− 34	8835·5	+ 44	+270	+140
8120·5	+326	+ 89	+ 14	8360·5	+107	−384	−217	8600·5	−355	−241	− 92	8840·5	−122	+253	+148

MERCURY

HELIOCENTRIC EQUATORIAL CO-ORDINATES IN UNITS OF THE THIRD DECIMAL

J.D.	x	y	z	J.D.	x	y	z	J.D.	x	y	z	J.D.	x	y	z
243				243				243				243			
8840·5	−122	+253	+148	9080·5	+354	−106	− 93	9320·5	− 63	−410	−213	9560·5	−396	− 78	− 1
8845·5	−262	+179	+123	9085·5	+351	+ 22	− 24	9325·5	+ 49	−401	−220	9565·5	−379	−189	− 62
8850·5	−353	+ 71	+ 74	9090·5	+289	+145	+ 48	9330·5	+157	−362	−210	9570·5	−326	−282	−117
8855·5	−393	− 48	+ 15	9095·5	+168	+237	+110	9335·5	+252	−293	−183	9575·5	−247	−352	−163
8860·5	−387	−162	− 47	9100·5	+ 7	+272	+145	9340·5	+324	−197	−139	9580·5	−148	−396	−197
8865·5	−342	−261	−104	9105·5	−156	+241	+145	9345·5	+358	− 78	− 79	9585·5	− 39	−411	−216
8870·5	−269	−337	−153	9110·5	−286	+157	+114	9350·5	+343	+ 50	− 9	9590·5	+ 73	−395	−219
8875·5	−174	−388	−189	9115·5	−366	+ 45	+ 62	9355·5	+267	+169	+ 63	9595·5	+179	−349	−205
8880·5	− 67	−410	−212	9120·5	−396	− 74	+ 1	9360·5	+135	+250	+120	9600·5	+270	−274	−175
8885·5	+ 45	−402	−220	9125·5	−380	−186	− 60	9365·5	− 30	+271	+148	9605·5	+335	−172	−127
8890·5	+154	−364	−210	9130·5	−328	−280	−116	9370·5	−188	+227	+141	9610·5	+360	− 51	− 64
8895·5	+250	−296	−184	9135·5	−250	−351	−162	9375·5	−308	+134	+104	9615·5	+332	+ 78	+ 7
8900·5	+322	−200	−140	9140·5	−152	−395	−196	9380·5	−377	+ 19	+ 49	9620·5	+243	+191	+ 77
8905·5	+358	− 82	− 81	9145·5	− 43	−411	−215	9385·5	−396	−100	− 12	9625·5	+100	+261	+129
8910·5	+344	+ 46	− 11	9150·5	+ 70	−396	−219	9390·5	−372	−208	− 73	9630·5	− 66	+267	+149
8915·5	+271	+165	+ 61	9155·5	+176	−351	−206	9395·5	−313	−297	−127	9635·5	−218	+210	+135
8920·5	+140	+249	+119	9160·5	+268	−277	−176	9400·5	−229	−363	−170	9640·5	−328	+110	+ 93
8925·5	− 25	+271	+148	9165·5	+333	−176	−128	9405·5	−128	−401	−201	9645·5	−385	− 7	+ 36
8930·5	−184	+229	+141	9170·5	+359	− 55	− 66	9410·5	− 18	−410	−218	9650·5	−394	−125	− 26
8935·5	−305	+138	+105	9175·5	+333	+ 74	+ 5	9415·5	+ 94	−389	−218	9655·5	−361	−229	− 85
8940·5	−376	+ 23	+ 51	9180·5	+246	+188	+ 75	9420·5	+198	−338	−201	9660·5	−297	−314	−137
8945·5	−396	− 96	− 11	9185·5	+105	+259	+128	9425·5	+285	−257	−167	9665·5	−208	−373	−178
8950·5	−373	−205	− 71	9190·5	− 61	+267	+149	9430·5	+343	−151	−116	9670·5	−105	−405	−206
8955·5	−316	−295	−125	9195·5	−214	+212	+136	9435·5	+359	− 27	− 51	9675·5	+ 7	−408	−219
8960·5	−232	−361	−169	9200·5	−325	+114	+ 94	9440·5	+320	+101	+ 21	9680·5	+118	−380	−216
8965·5	−132	−400	−200	9205·5	−384	− 3	+ 38	9445·5	+220	+208	+ 89	9685·5	+219	−322	−195
8970·5	− 22	−410	−217	9210·5	−394	−121	− 24	9450·5	+ 70	+267	+136	9690·5	+300	−236	−157
8975·5	+ 90	−390	−218	9215·5	−363	−226	− 84	9455·5	− 97	+260	+149	9695·5	+350	−125	−103
8980·5	+195	−340	−202	9220·5	−299	−311	−136	9460·5	−243	+194	+129	9700·5	+355	+ 2	− 36
8985·5	+282	−260	−168	9225·5	−212	−372	−177	9465·5	−342	+ 89	+ 83	9705·5	+303	+127	+ 37
8990·5	+342	−154	−118	9230·5	−108	−405	−205	9470·5	−390	− 30	+ 24	9710·5	+190	+226	+101
8995·5	+359	− 31	− 53	9235·5	+ 3	−408	−219	9475·5	−391	−145	− 38	9715·5	+ 33	+271	+142
9000·5	+322	+ 97	+ 19	9240·5	+114	−382	−216	9480·5	−351	−247	− 96	9720·5	−132	+250	+147
9005·5	+224	+205	+ 87	9245·5	+216	−325	−196	9485·5	−282	−327	−146	9725·5	−269	+173	+120
9010·5	+ 75	+266	+135	9250·5	+298	−239	−159	9490·5	−190	−382	−185	9730·5	−357	+ 64	+ 71
9015·5	− 92	+261	+149	9255·5	+349	−129	−105	9495·5	− 84	−408	−210	9735·5	−394	− 56	+ 11
9020·5	−239	+196	+130	9260·5	+356	− 2	− 38	9500·5	+ 28	−405	−220	9740·5	−385	−169	− 51
9025·5	−340	+ 93	+ 85	9265·5	+305	+123	+ 34	9505·5	+138	−372	−213	9745·5	−338	−266	−108
9030·5	−390	− 26	+ 26	9270·5	+195	+224	+100	9510·5	+236	−308	−189	9750·5	−263	−341	−155
9035·5	−391	−142	− 36	9275·5	+ 39	+271	+141	9515·5	+313	−217	−148	9755·5	−168	−390	−191
9040·5	−353	−244	− 94	9280·5	−127	+252	+148	9520·5	+355	−102	− 91	9760·5	− 60	−410	−213
9045·5	−284	−325	−144	9285·5	−265	+176	+122	9525·5	+350	+ 26	− 22	9765·5	+ 52	−400	−220
9050·5	−193	−380	−184	9290·5	−355	+ 67	+ 73	9530·5	+286	+148	+ 50	9770·5	+160	−360	−209
9055·5	− 88	−408	−209	9295·5	−394	− 52	+ 13	9535·5	+163	+239	+111	9775·5	+255	−290	−182
9060·5	+ 24	−406	−220	9300·5	−386	−166	− 49	9540·5	+ 2	+272	+146	9780·5	+325	−193	−137
9065·5	+134	−373	−214	9305·5	−340	−264	−106	9545·5	−161	+239	+145	9785·5	+359	− 74	− 77
9070·5	+233	−311	−190	9310·5	−266	−339	−154	9550·5	−289	+154	+112	9790·5	+341	+ 54	− 6
9075·5	+311	−220	−150	9315·5	−171	−389	−190	9555·5	−368	+ 41	+ 60	9795·5	+264	+172	+ 65
9080·5	+354	−106	− 93	9320·5	− 63	−410	−213	9560·5	−396	− 78	− 1	9800·5	+130	+252	+121

HELIOCENTRIC EQUATORIAL CO-ORDINATES IN UNITS OF THE THIRD DECIMAL

J.D.	x	y	z	J.D.	x	y	z	J.D.	x	y	z	J.D.	x	y	z
243⁄4				244				244				244			
9800·5	+130	+252	+121	0040·5	+273	−271	−173	0280·5	−223	−366	−173	0520·5	−333	+103	+ 90
9805·5	− 35	+271	+148	0045·5	+336	−169	−125	0285·5	−121	−402	−203	0525·5	−387	− 15	+ 32
9810·5	−193	+224	+140	0050·5	+360	− 47	− 62	0290·5	− 11	−410	−218	0530·5	−393	−132	− 30
9815·5	−311	+131	+102	0055·5	+330	+ 82	+ 10	0295·5	+101	−387	−217	0535·5	−358	−235	− 89
9820·5	−378	+ 15	+ 47	0060·5	+239	+194	+ 79	0300·5	+204	−333	−199	0540·5	−292	−318	−140
9825·5	−396	−103	− 14	0065·5	+ 95	+262	+130	0305·5	+290	−251	−164	0545·5	−202	−376	−180
9830·5	−370	−211	− 75	0070·5	− 72	+266	+150	0310·5	+345	−143	−112	0550·5	− 98	−406	−207
9835·5	−311	−300	−128	0075·5	−223	+207	+134	0315·5	+358	− 18	− 47	0555·5	+ 14	−407	−219
9840·5	−226	−364	−172	0080·5	−330	+107	+ 91	0320·5	+315	+108	+ 26	0560·5	+124	−377	−215
9845·5	−125	−402	−202	0085·5	−386	− 11	+ 34	0325·5	+211	+213	+ 92	0565·5	+225	−318	−193
9850·5	− 14	−410	−218	0090·5	−393	−128	− 28	0330·5	+ 59	+269	+138	0570·5	+305	−229	−154
9855·5	+ 97	−388	−217	0095·5	−360	−232	− 87	0335·5	−107	+258	+149	0575·5	+352	−117	− 99
9860·5	+201	−335	−200	0100·5	−294	−316	−139	0340·5	−250	+188	+126	0580·5	+354	+ 10	− 31
9865·5	+287	−254	−165	0105·5	−205	−375	−179	0345·5	−347	+ 82	+ 80	0585·5	+298	+134	+ 41
9870·5	+344	−147	−114	0110·5	−101	−406	−207	0350·5	−392	− 37	+ 20	0590·5	+181	+231	+105
9875·5	+358	− 23	− 49	0115·5	+ 10	−408	−219	0355·5	−389	−152	− 41	0595·5	+ 23	+272	+143
9880·5	+317	+105	+ 23	0120·5	+121	−379	−215	0360·5	−348	−253	− 99	0600·5	−142	+247	+147
9885·5	+216	+211	+ 91	0125·5	+222	−320	−194	0365·5	−276	−331	−149	0605·5	−276	+167	+118
9890·5	+ 65	+268	+137	0130·5	+303	−233	−156	0370·5	−184	−384	−187	0610·5	−361	+ 56	+ 67
9895·5	−102	+259	+149	0135·5	+351	−121	−101	0375·5	− 77	−409	−211	0615·5	−395	− 63	+ 7
9900·5	−246	+191	+127	0140·5	+354	+ 6	− 33	0380·5	+ 35	−404	−220	0620·5	−383	−176	− 55
9905·5	−345	+ 85	+ 81	0145·5	+300	+131	+ 39	0385·5	+144	−369	−212	0625·5	−334	−272	−111
9910·5	−391	− 34	+ 22	0150·5	+186	+228	+103	0390·5	+242	−303	−187	0630·5	−258	−345	−158
9915·5	−390	−149	− 39	0155·5	+ 28	+272	+142	0395·5	+317	−210	−145	0635·5	−161	−392	−193
9920·5	−350	−250	− 98	0160·5	−137	+248	+147	0400·5	+356	− 94	− 87	0640·5	− 53	−410	−214
9925·5	−279	−329	−147	0165·5	−272	+170	+119	0405·5	+348	+ 34	− 18	0645·5	+ 59	−399	−219
9930·5	−187	−383	−186	0170·5	−359	+ 60	+ 69	0410·5	+280	+155	+ 54	0650·5	+167	−357	−208
9935·5	− 81	−409	−210	0175·5	−394	− 60	+ 9	0415·5	+154	+243	+114	0655·5	+260	−285	−179
9940·5	+ 31	−405	−220	0180·5	−384	−172	− 53	0420·5	− 9	+272	+147	0660·5	+329	−186	−134
9945·5	+141	−370	−213	0185·5	−336	−269	−109	0425·5	−170	+235	+143	0665·5	+359	− 66	− 73
9950·5	+239	−306	−188	0190·5	−260	−343	−157	0430·5	−296	+148	+110	0670·5	+338	+ 62	− 2
9955·5	+315	−213	−147	0195·5	−164	−391	−192	0435·5	−371	+ 34	+ 56	0675·5	+257	+178	+ 69
9960·5	+356	− 98	− 89	0200·5	− 56	−410	−214	0440·5	−396	− 85	− 5	0680·5	+120	+255	+124
9965·5	+349	+ 30	− 20	0205·5	+ 56	−400	−220	0445·5	−377	−195	− 66	0685·5	− 46	+270	+149
9970·5	+283	+152	+ 52	0210·5	+164	−359	−209	0450·5	−322	−287	−121	0690·5	−201	+220	+138
9975·5	+159	+241	+113	0215·5	+258	−288	−181	0455·5	−241	−356	−166	0695·5	−317	+124	+ 99
9980·5	− 3	+272	+146	0220·5	+327	−190	−135	0460·5	−141	−398	−198	0700·5	−381	+ 8	+ 43
9985·5	−165	+237	+144	0225·5	+359	− 70	− 75	0465·5	− 32	−411	−216	0705·5	−395	−111	− 18
9990·5	−293	+151	+111	0230·5	+340	+ 58	− 4	0470·5	+ 80	−393	−219	0710·5	−367	−217	− 78
9995·5	−370	+ 38	+ 58	0235·5	+261	+175	+ 67	0475·5	+186	−346	−204	0715·5	−306	−305	−131
0000·5	−396	− 82	− 3	0240·5	+125	+254	+123	0480·5	+275	−268	−172	0720·5	−220	−368	−174
0005·5	−378	−192	− 64	0245·5	− 40	+270	+149	0485·5	+338	−165	−123	0725·5	−118	−403	−203
0010·5	−324	−285	−119	0250·5	−197	+222	+139	0490·5	+359	− 43	− 60	0730·5	− 7	−409	−218
0015·5	−244	−354	−164	0255·5	−314	+128	+101	0495·5	+328	+ 86	+ 12	0735·5	+104	−385	−217
0020·5	−145	−397	−197	0260·5	−380	+ 11	+ 45	0500·5	+235	+197	+ 81	0740·5	+207	−331	−198
0025·5	− 35	−411	−216	0265·5	−395	−107	− 16	0505·5	+ 90	+263	+131	0745·5	+292	−248	−163
0030·5	+ 77	−394	−219	0270·5	−369	−214	− 77	0510·5	− 77	+265	+150	0750·5	+346	−140	−110
0035·5	+183	−347	−205	0275·5	−309	−302	−130	0515·5	−227	+204	+133	0755·5	+358	− 14	− 45
0040·5	+273	−271	−173	0280·5	−223	−366	−173	0520·5	−333	+103	+ 90	0760·5	+313	+112	+ 28

MERCURY

HELIOCENTRIC EQUATORIAL CO-ORDINATES IN UNITS OF THE THIRD DECIMAL

J.D.	x	y	z	J.D.	x	y	z	J.D.	x	y	z	J.D.	x	y	z
244				244				244				244			
0760·5	+313	+112	+ 28	1000·5	+128	−376	−214	1240·5	−344	−258	−103	1480·5	−151	+243	+146
0765·5	+207	+216	+ 94	1005·5	+228	−315	−192	1245·5	−271	−335	−151	1485·5	−283	+161	+115
0770·5	+ 54	+269	+138	1010·5	+307	−226	−153	1250·5	−177	−387	−189	1490·5	−365	+ 49	+ 64
0775·5	−112	+256	+149	1015·5	+353	−113	− 97	1255·5	− 70	−409	−212	1495·5	−395	− 71	+ 3
0780·5	−254	+185	+125	1020·5	+353	+ 14	− 29	1260·5	+ 42	−403	−220	1500·5	−381	−183	− 58
0785·5	−349	+ 78	+ 78	1025·5	+295	+138	+ 43	1265·5	+151	−365	−211	1505·5	−330	−277	−114
0790·5	−392	− 41	+ 18	1030·5	+177	+233	+106	1270·5	+247	−298	−185	1510·5	−252	−349	−161
0795·5	−388	−156	− 43	1035·5	+ 18	+272	+144	1275·5	+320	−203	−142	1515·5	−154	−394	−195
0800·5	−346	−255	−101	1040·5	−146	+245	+146	1280·5	+357	− 86	− 83	1520·5	− 46	−411	−215
0805·5	−274	−333	−150	1045·5	−279	+164	+116	1285·5	+345	+ 42	− 13	1525·5	+ 67	−397	−219
0810·5	−180	−385	−188	1050·5	−363	+ 52	+ 65	1290·5	+274	+162	+ 58	1530·5	+173	−353	−207
0815·5	− 74	−409	−211	1055·5	−395	− 67	+ 5	1295·5	+145	+247	+117	1535·5	+266	−280	−177
0820·5	+ 39	−403	−220	1060·5	−382	−179	− 56	1300·5	− 19	+272	+147	1540·5	+332	−179	−130
0825·5	+148	−367	−212	1065·5	−332	−274	−113	1305·5	−179	+231	+142	1545·5	+359	− 59	− 68
0830·5	+244	−301	−186	1070·5	−255	−347	−159	1310·5	−302	+141	+107	1550·5	+335	+ 70	+ 3
0835·5	+318	−207	−143	1075·5	−158	−393	−194	1315·5	−374	+ 26	+ 53	1555·5	+250	+185	+ 73
0840·5	+357	− 90	− 85	1080·5	− 49	−410	−215	1320·5	−396	− 93	− 9	1560·5	+110	+258	+127
0845·5	+347	+ 38	− 15	1085·5	+ 63	−398	−219	1325·5	−374	−202	− 69	1565·5	− 56	+268	+149
0850·5	+277	+159	+ 56	1090·5	+170	−355	−207	1330·5	−317	−292	−124	1570·5	−210	+215	+136
0855·5	+149	+245	+116	1095·5	+263	−282	−178	1335·5	−235	−359	−168	1575·5	−322	+117	+ 96
0860·5	− 14	+272	+147	1100·5	+330	−183	−132	1340·5	−135	−399	−200	1580·5	−383	0	+ 40
0865·5	−175	+233	+143	1105·5	+359	− 63	− 71	1345·5	− 25	−410	−217	1585·5	−394	−118	− 22
0870·5	−299	+144	+108	1110·5	+337	+ 66	+ 1	1350·5	+ 87	−391	−218	1590·5	−364	−223	− 82
0875·5	−373	+ 30	+ 55	1115·5	+254	+182	+ 71	1355·5	+192	−342	−203	1595·5	−301	−309	−134
0880·5	−396	− 89	− 7	1120·5	+115	+257	+125	1360·5	+280	−263	−169	1600·5	−214	−371	−176
0885·5	−375	−199	− 67	1125·5	− 51	+269	+149	1365·5	+340	−158	−120	1605·5	−111	−404	−205
0890·5	−320	−290	−122	1130·5	−206	+217	+137	1370·5	+359	− 35	− 56	1610·5	0	−409	−219
0895·5	−238	−358	−167	1135·5	−320	+121	+ 98	1375·5	+324	+ 93	+ 16	1615·5	+111	−383	−216
0900·5	−138	−399	−199	1140·5	−382	+ 4	+ 41	1380·5	+228	+203	+ 85	1620·5	+213	−327	−197
0905·5	− 28	−410	−217	1145·5	−395	−114	− 20	1385·5	+ 80	+265	+134	1625·5	+296	−242	−160
0910·5	+ 84	−392	−218	1150·5	−366	−220	− 80	1390·5	− 87	+263	+149	1630·5	+349	−132	−107
0915·5	+189	−344	−203	1155·5	−304	−307	−133	1395·5	−235	+199	+131	1635·5	+357	− 6	− 40
0920·5	+278	−266	−171	1160·5	−217	−369	−175	1400·5	−338	+ 96	+ 86	1640·5	+308	+120	+ 32
0925·5	+339	−161	−121	1165·5	−115	−404	−204	1405·5	−389	− 22	+ 28	1645·5	+199	+221	+ 98
0930·5	+359	− 39	− 58	1170·5	− 4	−409	−218	1410·5	−392	−139	− 34	1650·5	+ 44	+270	+140
0935·5	+326	+ 89	+ 14	1175·5	+108	−384	−217	1415·5	−355	−241	− 92	1655·5	−122	+253	+148
0940·5	+231	+200	+ 83	1180·5	+210	−329	−198	1420·5	−287	−323	−143	1660·5	−262	+179	+123
0945·5	+ 85	+264	+133	1185·5	+294	−245	−161	1425·5	−196	−379	−183	1665·5	−353	+ 71	+ 74
0950·5	− 82	+264	+149	1190·5	+348	−136	−109	1430·5	− 91	−407	−209	1670·5	−393	− 49	+ 15
0955·5	−231	+202	+132	1195·5	+357	− 10	− 42	1435·5	+ 21	−406	−219	1675·5	−387	−163	− 47
0960·5	−335	+100	+ 88	1200·5	+310	+116	+ 30	1440·5	+131	−375	−214	1680·5	−342	−261	−104
0965·5	−388	− 19	+ 30	1205·5	+203	+219	+ 96	1445·5	+231	−313	−191	1685·5	−268	−337	−153
0970·5	−392	−135	− 32	1210·5	+ 49	+270	+139	1450·5	+309	−223	−151	1690·5	−174	−388	−189
0975·5	−356	−238	− 91	1215·5	−117	+255	+148	1455·5	+354	−109	− 95	1695·5	− 66	−410	−212
0980·5	−289	−321	−142	1220·5	−258	+182	+124	1460·5	+352	+ 18	− 27	1700·5	+ 46	−402	−220
0985·5	−199	−378	−182	1225·5	−351	+ 74	+ 76	1465·5	+292	+141	+ 46	1705·5	+154	−364	−210
0990·5	− 94	−407	−208	1230·5	−393	− 45	+ 17	1470·5	+173	+235	+108	1710·5	+250	−295	−184
0995·5	+ 18	−407	−219	1235·5	−388	−159	− 45	1475·5	+ 12	+272	+144	1715·5	+322	−200	−140
1000·5	+128	−376	−214	1240·5	−344	−258	−103	1480·5	−151	+243	+146	1720·5	+358	− 82	− 81

HELIOCENTRIC EQUATORIAL CO-ORDINATES IN UNITS OF THE THIRD DECIMAL

J.D.	x	y	z	J.D.	x	y	z	J.D.	x	y	z	J.D.	x	y	z
244				244				244				244			
17205	+358	− 82	− 81	19605	− 42	−411	−215	22005	−396	−100	− 13	24405	+100	+261	+129
17255	+344	+ 46	− 11	19655	+ 70	−396	−219	22055	−371	−208	− 73	24455	− 66	+267	+149
17305	+271	+166	+ 61	19705	+177	−351	−206	22105	−313	−297	−127	24505	−218	+210	+135
17355	+140	+249	+119	19755	+268	−277	−176	22155	−229	−363	−170	24555	−328	+110	+ 93
17405	− 25	+271	+148	19805	+333	−176	−128	22205	−128	−401	−201	24605	−385	− 8	+ 36
17455	−184	+229	+141	19855	+360	− 54	− 66	22255	− 17	−410	−218	24655	−394	−125	− 26
17505	−305	+138	+105	19905	+333	+ 74	+ 5	22305	+ 94	−389	−218	24705	−361	−230	− 85
17555	−376	+ 23	+ 51	19955	+247	+188	+ 75	22355	+198	−337	−201	24755	−296	−314	−137
17605	−396	− 96	− 11	20005	+106	+259	+128	22405	+285	−257	−167	24805	−208	−374	−178
17655	−373	−205	− 71	20055	− 61	+267	+149	22455	+343	−151	−116	24855	−104	−406	−206
17705	−315	−295	−125	20105	−214	+212	+136	22505	+359	− 26	− 51	24905	+ 7	−408	−219
17755	−232	−361	−169	20155	−325	+114	+ 94	22555	+320	+101	+ 21	24955	+118	−380	−216
17805	−131	−400	−201	20205	−384	− 4	+ 38	22605	+220	+208	+ 89	25005	+219	−322	−195
17855	− 21	−410	−217	20255	−394	−121	− 24	22655	+ 70	+267	+136	25055	+301	−235	−157
17905	+ 91	−390	−218	20305	−363	−226	− 84	22705	− 97	+260	+149	25105	+351	−124	−103
17955	+195	−339	−202	20355	−299	−312	−136	22755	−243	+193	+128	25155	+355	+ 2	− 36
18005	+283	−260	−168	20405	−211	−372	−177	22805	−342	+ 89	+ 83	25205	+303	+127	+ 37
18055	+342	−154	−118	20455	−108	−405	−205	22855	−390	− 30	+ 24	25255	+190	+226	+101
18105	+359	− 30	− 53	20505	+ 4	−408	−219	22905	−390	−146	− 38	25305	+ 33	+271	+142
18155	+322	+ 97	+ 19	20555	+115	−382	−216	22955	−351	−247	− 96	25355	−132	+250	+147
18205	+224	+205	+ 87	20605	+216	−324	−196	23005	−281	−327	−146	25405	−269	+173	+120
18255	+ 75	+266	+135	20655	+299	−239	−158	23055	−189	−382	−185	25455	−357	+ 63	+ 71
18305	− 92	+261	+149	20705	+350	−128	−105	23105	− 84	−408	−210	25505	−394	− 56	+ 11
18355	−239	+196	+130	20755	+356	− 2	− 38	23155	+ 28	−405	−220	25555	−385	−169	− 51
18405	−340	+ 92	+ 85	20805	+306	+123	+ 34	23205	+138	−372	−213	25605	−338	−267	−108
18455	−389	− 26	+ 26	20855	+195	+224	+ 99	23255	+236	−308	−189	25655	−263	−341	−155
18505	−391	−142	− 36	20905	+ 39	+271	+141	23305	+313	−216	−148	25705	−167	−390	−191
18555	−353	−244	− 94	20955	−127	+252	+148	23355	+355	−102	− 91	25755	− 59	−410	−213
18605	−284	−325	−145	21005	−265	+176	+121	23405	+350	+ 26	− 22	25805	+ 53	−400	−220
18655	−193	−380	−184	21055	−355	+ 67	+ 73	23455	+286	+149	+ 50	25855	+161	−360	−209
18705	− 87	−408	−209	21105	−394	− 52	+ 13	23505	+163	+239	+111	25905	+255	−290	−182
18755	+ 25	−406	−220	21155	−386	−166	− 49	23555	+ 2	+272	+145	25955	+326	−193	−137
18805	+135	−373	−213	21205	−340	−264	−106	23605	−161	+239	+145	26005	+359	− 74	− 77
18855	+234	−310	−190	21255	−266	−339	−154	23655	−289	+154	+112	26055	+341	+ 54	− 6
18905	+311	−220	−150	21305	−170	−389	−190	23705	−368	+ 41	+ 60	26105	+264	+172	+ 65
18955	+355	−106	− 93	21355	− 63	−410	−213	23755	−396	− 78	− 1	26155	+130	+252	+121
19005	+351	+ 22	− 24	21405	+ 49	−401	−220	23805	−379	−189	− 62	26205	− 35	+271	+148
19055	+289	+145	+ 48	21455	+158	−362	−210	23855	−326	−282	−117	26255	−193	+224	+140
19105	+168	+237	+110	21505	+253	−293	−183	23905	−246	−353	−163	26305	−311	+131	+102
19155	+ 7	+272	+145	21555	+324	−196	−138	23955	−148	−396	−197	26355	−378	+ 15	+ 47
19205	−156	+241	+145	21605	+358	− 78	− 79	24005	− 38	−411	−216	26405	−395	−104	− 15
19255	−286	+157	+114	21655	+343	+ 50	− 9	24055	+ 74	−395	−219	26455	−370	−211	− 75
19305	−366	+ 45	+ 62	21705	+267	+169	+ 63	24105	+180	−349	−205	26505	−310	−300	−128
19355	−395	− 74	+ 1	21755	+135	+250	+120	24155	+271	−274	−174	26555	−226	−365	−172
19405	−380	−186	− 60	21805	− 30	+271	+148	24205	+335	−172	−127	26605	−124	−402	−202
19455	−328	−280	−116	21855	−188	+227	+141	24255	+360	− 50	− 64	26655	− 14	−410	−218
19505	−249	−351	−162	21905	−308	+134	+104	24305	+332	+ 78	+ 7	26705	+ 98	−388	−217
19555	−151	−395	−196	21955	−377	+ 19	+ 49	24355	+243	+191	+ 77	26755	+202	−335	−200
19605	− 42	−411	−215	22005	−396	−100	− 13	24405	+100	+261	+129	26805	+288	−254	−165

MERCURY

HELIOCENTRIC EQUATORIAL CO-ORDINATES IN UNITS OF THE THIRD DECIMAL

J.D.	x	y	z	J.D.	x	y	z	J.D.	x	y	z	J.D.	x	y	z
244				244				244				244			
2680·5	+288	−254	−165	2920·5	−205	−375	−179	3160·5	−347	+ 82	+ 79	3400·5	+298	+134	+ 41
2685·5	+344	−147	−114	2925·5	−101	−406	−207	3165·5	−391	− 38	+ 20	3405·5	+182	+231	+105
2690·5	+358	− 22	− 49	2930·5	+ 11	−408	−219	3170·5	−389	−153	− 41	3410·5	+ 23	+272	+143
2695·5	+317	+105	+ 23	2935·5	+121	−379	−215	3175·5	−347	−253	− 99	3415·5	−142	+247	+147
2700·5	+216	+211	+ 90	2940·5	+222	−320	−194	3180·5	−276	−331	−149	3420·5	−276	+167	+118
2705·5	+ 65	+268	+137	2945·5	+303	−232	−156	3185·5	−183	−384	−187	3425·5	−361	+ 56	+ 67
2710·5	−102	+259	+149	2950·5	+352	−121	−101	3190·5	− 77	−409	−211	3430·5	−395	− 64	+ 7
2715·5	−247	+191	+127	2955·5	+355	+ 6	− 33	3195·5	+ 35	−404	−220	3435·5	−383	−176	− 55
2720·5	−345	+ 85	+ 81	2960·5	+300	+131	+ 39	3200·5	+145	−368	−212	3440·5	−334	−272	−111
2725·5	−391	− 34	+ 22	2965·5	+186	+228	+103	3205·5	+242	−303	−187	3445·5	−257	−345	−158
2730·5	−390	−149	− 40	2970·5	+ 28	+272	+142	3210·5	+317	−210	−145	3450·5	−161	−392	−193
2735·5	−349	−250	− 98	2975·5	−137	+248	+147	3215·5	+357	− 94	− 87	3455·5	− 52	−410	−214
2740·5	−279	−329	−147	2980·5	−272	+170	+119	3220·5	+348	+ 34	− 18	3460·5	+ 60	−399	−219
2745·5	−186	−383	−186	2985·5	−359	+ 60	+ 69	3225·5	+280	+155	+ 54	3465·5	+167	−357	−208
2750·5	− 80	−409	−210	2990·5	−394	− 60	+ 9	3230·5	+154	+243	+114	3470·5	+261	−285	−179
2755·5	+ 32	−405	−220	2995·5	−384	−173	− 53	3235·5	− 9	+272	+146	3475·5	+329	−186	−133
2760·5	+141	−370	−212	3000·5	−336	−269	−109	3240·5	+170	+235	+143	3480·5	+359	− 66	− 73
2765·5	+239	−305	−188	3005·5	−260	−343	−157	3245·5	−296	+148	+109	3485·5	+338	+ 62	− 2
2770·5	+315	−213	−146	3010·5	−164	−391	−192	3250·5	−371	+ 34	+ 56	3490·5	+257	+179	+ 69
2775·5	+356	− 98	− 89	3015·5	− 56	−410	−214	3255·5	−396	− 86	− 5	3495·5	+120	+255	+124
2780·5	+349	+ 30	− 20	3020·5	+ 56	−400	−220	3260·5	−376	−196	− 66	3500·5	− 46	+269	+149
2785·5	+283	+152	+ 52	3025·5	+164	−358	−209	3265·5	−322	−288	−121	3505·5	−201	+220	+138
2790·5	+159	+241	+113	3030·5	+258	−288	−180	3270·5	−240	−356	−166	3510·5	−317	+124	+ 99
2795·5	− 4	+272	+146	3035·5	+327	−189	−135	3275·5	−141	−398	−198	3515·5	−381	+ 7	+ 43
2800·5	−165	+237	+144	3040·5	+359	− 70	− 75	3280·5	− 31	−411	−216	3520·5	−395	−111	− 18
2805·5	−293	+151	+111	3045·5	+340	+ 58	− 4	3285·5	+ 81	−393	−219	3525·5	−367	−218	− 78
2810·5	−370	+ 37	+ 58	3050·5	+261	+175	+ 67	3290·5	+186	−345	−204	3530·5	−306	−305	−131
2815·5	−396	− 82	− 3	3055·5	+125	+254	+123	3295·5	+276	−268	−172	3535·5	−220	−368	−174
2820·5	−377	−192	− 64	3060·5	− 40	+270	+149	3300·5	+338	−165	−123	3540·5	−117	−403	−203
2825·5	−324	−285	−119	3065·5	−197	+222	+139	3305·5	+360	− 42	− 60	3545·5	− 7	−409	−218
2830·5	−243	−354	−164	3070·5	−314	+127	+101	3310·5	+328	+ 86	+ 12	3550·5	+105	−385	−217
2835·5	−144	−397	−197	3075·5	−379	+ 11	+ 45	3315·5	+235	+197	+ 81	3555·5	+208	−331	−198
2840·5	− 35	−411	−216	3080·5	−395	−107	− 17	3320·5	+ 90	+263	+131	3560·5	+292	−248	−163
2845·5	+ 77	−394	−219	3085·5	−368	−214	− 77	3325·5	− 77	+265	+149	3565·5	+347	−139	−110
2850·5	+183	−347	−205	3090·5	−308	−302	−130	3330·5	−227	+204	+133	3570·5	+358	− 14	− 45
2855·5	+273	−271	−173	3095·5	−223	−366	−173	3335·5	−333	+103	+ 89	3575·5	+313	+112	+ 28
2860·5	+336	−168	−125	3100·5	−121	−402	−203	3340·5	−387	− 15	+ 32	3580·5	+207	+216	+ 94
2865·5	+360	− 46	− 62	3105·5	− 10	−410	−218	3345·5	−393	−132	− 30	3585·5	+ 54	+269	+138
2870·5	+330	+ 82	+ 10	3110·5	+101	−387	−217	3350·5	−358	−236	− 89	3590·5	−112	+256	+149
2875·5	+239	+194	+ 79	3115·5	+205	−333	−199	3355·5	−291	−319	−140	3595·5	−254	+185	+125
2880·5	+ 95	+262	+130	3120·5	+290	−251	−164	3360·5	−202	−377	−181	3600·5	−349	+ 78	+ 78
2885·5	− 72	+266	+149	3125·5	+345	−143	−112	3365·5	− 97	−407	−207	3605·5	−392	− 41	+ 18
2890·5	−223	+207	+134	3130·5	+358	− 18	− 47	3370·5	+ 14	−407	−219	3610·5	−388	−156	− 43
2895·5	−330	+107	+ 91	3135·5	+315	+109	+ 26	3375·5	+125	−377	−215	3615·5	−346	−256	−101
2900·5	−386	− 11	+ 34	3140·5	+212	+214	+ 92	3380·5	+225	−317	−193	3620·5	−273	−334	−150
2905·5	−393	−128	− 28	3145·5	+ 59	+269	+137	3385·5	+305	−229	−154	3625·5	−180	−386	−188
2910·5	−359	−233	− 87	3150·5	−107	+258	+149	3390·5	+352	−117	− 99	3630·5	− 73	−409	−211
2915·5	−294	−316	−139	3155·5	−250	+188	+126	3395·5	+354	+ 10	− 31	3635·5	+ 39	−403	−220
2920·5	−205	−375	−179	3160·5	−347	+ 82	+ 79	3400·5	+298	+134	+ 41	3640·5	+148	−367	−211

HELIOCENTRIC EQUATORIAL CO-ORDINATES IN UNITS OF THE THIRD DECIMAL

J.D.	x	y	z	J.D.	x	y	z	J.D.	x	y	z	J.D.	x	y	z
244				244				244				244			
3640·5	+148	−367	−211	3880·5	−332	−275	−113	4120·5	−179	+231	+142	4360·5	+360	− 58	− 68
3645·5	+245	−300	−186	3885·5	−254	−347	−159	4125·5	−302	+141	+107	4365·5	+335	+ 70	+ 3
3650·5	+319	−206	−143	3890·5	−157	−393	−194	4130·5	−374	+ 26	+ 53	4370·5	+250	+185	+ 73
3655·5	+357	− 90	− 85	3895·5	− 49	−411	−215	4135·5	−396	− 93	− 9	4375·5	+110	+258	+127
3660·5	+347	+ 38	− 15	3900·5	+ 64	−398	−219	4140·5	−374	−202	− 69	4380·5	− 56	+268	+149
3665·5	+277	+159	+ 56	3905·5	+171	−355	−207	4145·5	−317	−293	−124	4385·5	−210	+215	+136
3670·5	+149	+245	+116	3910·5	+263	−282	−178	4150·5	−234	−360	−168	4390·5	−322	+117	+ 96
3675·5	− 14	+272	+147	3915·5	+331	−183	−132	4155·5	−134	−400	−200	4395·5	−383	0	+ 39
3680·5	−175	+233	+143	3920·5	+359	− 62	− 70	4160·5	− 24	−410	−217	4400·5	−394	−118	− 22
3685·5	−299	+144	+108	3925·5	+337	+ 66	+ 1	4165·5	+ 88	−391	−218	4405·5	−364	−224	− 82
3690·5	−373	+ 30	+ 54	3930·5	+254	+182	+ 71	4170·5	+193	−341	−202	4410·5	−301	−310	−134
3695·5	−396	− 89	− 7	3935·5	+115	+257	+125	4175·5	+281	−262	−169	4415·5	−214	−371	−176
3700·5	−375	−199	− 68	3940·5	− 51	+269	+149	4180·5	+341	−158	−120	4420·5	−111	−404	−205
3705·5	−319	−290	−122	3945·5	−206	+217	+137	4185·5	+359	− 34	− 55	4425·5	+ 1	−409	−219
3710·5	−237	−358	−167	3950·5	−320	+121	+ 97	4190·5	+324	+ 93	+ 16	4430·5	+112	−383	−216
3715·5	−138	−399	−199	3955·5	−382	+ 4	+ 41	4195·5	+228	+203	+ 85	4435·5	+214	−327	−197
3720·5	− 28	−411	−217	3960·5	−395	−114	− 20	4200·5	+ 80	+265	+134	4440·5	+297	−242	−160
3725·5	+ 84	−392	−218	3965·5	−365	−221	− 80	4205·5	− 87	+263	+149	4445·5	+349	−132	−107
3730·5	+189	−343	−203	3970·5	−303	−307	−133	4210·5	−235	+199	+131	4450·5	+357	− 6	− 40
3735·5	+278	−265	−171	3975·5	−217	−369	−175	4215·5	−338	+ 96	+ 86	4455·5	+308	+120	+ 32
3740·5	+339	−161	−121	3980·5	−114	−404	−204	4220·5	−389	− 23	+ 28	4460·5	+199	+221	+ 98
3745·5	+360	− 38	− 58	3985·5	− 3	−409	−218	4225·5	−391	−139	− 34	4465·5	+ 44	+270	+140
3750·5	+326	+ 90	+ 14	3990·5	+108	−384	−217	4230·5	−354	−242	− 93	4470·5	−122	+253	+148
3755·5	+232	+200	+ 83	3995·5	+211	−329	−198	4235·5	−286	−323	−143	4475·5	−262	+179	+123
3760·5	+ 85	+264	+132	4000·5	+294	−245	−161	4240·5	−195	−379	−183	4480·5	−353	+ 71	+ 74
3765·5	− 82	+264	+149	4005·5	+348	−136	−108	4245·5	− 90	−408	−209	4485·5	−393	− 49	+ 14
3770·5	−231	+202	+132	4010·5	+357	− 10	− 42	4250·5	+ 22	−406	−219	4490·5	−386	−163	− 47
3775·5	−335	+100	+ 88	4015·5	+311	+116	+ 30	4255·5	+132	−375	−214	4495·5	−342	−261	−104
3780·5	−388	− 19	+ 30	4020·5	+203	+219	+ 96	4260·5	+231	−313	−191	4500·5	−268	−338	−153
3785·5	−392	−136	− 32	4025·5	+ 49	+270	+139	4265·5	+309	−223	−151	4505·5	−173	−388	−190
3790·5	−356	−239	− 91	4030·5	−117	+255	+148	4270·5	+354	−109	− 95	4510·5	− 66	−410	−212
3795·5	−289	−321	−142	4035·5	−258	+182	+124	4275·5	+352	+ 18	− 27	4515·5	+ 46	−402	−220
3800·5	−199	−378	−182	4040·5	−351	+ 74	+ 76	4280·5	+292	+142	+ 46	4520·5	+155	−364	−210
3805·5	− 94	−407	−208	4045·5	−393	− 45	+ 16	4285·5	+173	+235	+108	4525·5	+250	−295	−184
3810·5	+ 18	−407	−219	4050·5	−387	−160	− 45	4290·5	+ 12	+272	+144	4530·5	+322	−200	−140
3815·5	+128	−376	−214	4055·5	−344	−259	−103	4295·5	−151	+243	+146	4535·5	+358	− 82	− 81
3820·5	+228	−315	−192	4060·5	−271	−336	−151	4300·5	−283	+160	+115	4540·5	+344	+ 46	− 11
3825·5	+307	−226	−153	4065·5	−177	−387	−189	4305·5	−365	+ 48	+ 64	4545·5	+271	+166	+ 61
3830·5	+353	−113	− 97	4070·5	− 69	−410	−212	4310·5	−395	− 71	+ 3	4550·5	+140	+249	+119
3835·5	+353	+ 14	− 29	4075·5	+ 43	−403	−220	4315·5	−381	−183	− 58	4555·5	− 25	+271	+148
3840·5	+295	+138	+ 43	4080·5	+151	−365	−211	4320·5	−330	−277	−114	4560·5	−184	+229	+141
3845·5	+177	+233	+106	4085·5	+248	−298	−185	4325·5	−251	−349	−161	4565·5	−305	+138	+105
3850·5	+ 18	+272	+144	4090·5	+321	−203	−142	4330·5	−154	−394	−195	4570·5	−375	+ 22	+ 51
3855·5	−146	+245	+146	4095·5	+358	− 86	− 83	4335·5	− 45	−411	−215	4575·5	−395	− 97	− 11
3860·5	−279	+164	+116	4100·5	+346	+ 42	− 13	4340·5	+ 67	−397	−219	4580·5	−372	−205	− 71
3865·5	−363	+ 52	+ 65	4105·5	+274	+162	+ 58	4345·5	+174	−353	−207	4585·5	−315	−295	−125
3870·5	−395	− 67	+ 5	4110·5	+145	+247	+117	4350·5	+266	−279	−177	4590·5	−231	−361	−169
3875·5	−382	−180	− 57	4115·5	− 19	+272	+147	4355·5	+332	−179	−130	4595·5	−131	−400	−201
3880·5	−332	−275	−113	4120·5	−179	+231	+142	4360·5	+360	− 58	− 68	4600·5	− 20	−410	−217

Julian Date	Heliocentric Longitude	Heliocentric Latitude	Radius Vector	$\frac{1}{r^3}$	Heliocentric Equatorial Co-ordinates			Attractions on the Sun Venus only		
	l	b	r		x	y	z	X	Y	Z
243	°	°								
6920·5	151·164	+3·278	0·71872	2·69349	−0·62857	+0·30116	+0·17540	+1·228	−0·588	−0·343
6930·5	167·404	3·393	·71937	·68620	·70083	+ ·12673	·10137	1·365	−0·247	0·197
6940·5	183·608	3·239	·72033	·67552	·71775	− ·05772	+ ·01933	1·393	+0·112	−0·038
6950·5	199·755	2·829	·72152	·66229	·67823	·23763	− ·06424	1·310	0·459	+0·124
6960·5	215·830	+2·200	0·72285	2·64763	−0·58562	−0·39896	−0·14278	+1·125	+0·766	+0·274
6970·5	231·830	1·402	·72421	·63271	·44742	·52925	·21022	0·854	1·011	0·401
6980·5	247·760	+0·499	·72551	·61866	·27458	·61858	·26139	0·521	1·175	0·496
6990·5	263·632	−0·439	·72663	·60653	− ·08059	·66029	·29243	+0·152	1·248	0·553
7000·5	279·464	−1·342	0·72750	2·59720	+0·11959	−0·65139	−0·30107	−0·225	+1·227	+0·567
7010·5	295·277	2·141	·72805	·59134	·31065	·59274	·28671	0·584	1·114	0·539
7020·5	311·087	2·777	·72823	·58936	·47804	·48893	·25050	0·898	0·918	0·470
7030·5	326·912	3·204	·72804	·59139	·60902	·34788	·19522	1·145	0·654	0·367
7040·5	342·762	−3·388	0·72749	2·59729	+0·69360	−0·18033	−0·12507	−1·307	+0·340	+0·236
7050·5	358·646	3·314	·72662	·60665	·72520	+ ·00099	− ·04536	1·371	−0·002	+0·086
7060·5	14·567	2·987	·72549	·61882	·70122	·18222	+ ·03782	1·332	0·346	−0·072
7070·5	30·529	2·429	·72419	·63290	·62324	·34941	·11808	1·190	0·667	0·225
7080·5	46·535	−1·681	0·72283	2·64785	+0·49703	+0·48954	+0·18919	−0·955	−0·940	−0·363
7090·5	62·588	−0·800	·72150	·66251	·33214	·59156	·24557	0·641	1·142	0·474
7100·5	78·690	+0·148	·72031	·67570	+ ·14127	·64727	·28273	−0·274	1·256	0·549
7110·5	94·842	1·086	·71936	·68635	− ·06071	·65207	·29766	+0·118	1·270	0·580
7120·5	111·039	+1·940	0·71872	2·69354	−0·25788	+0·60539	+0·28907	+0·504	−1·183	−0·565
7130·5	127·272	2·641	·71844	·69668	·43463	·51078	·25761	0·850	0·999	0·504
7140·5	143·525	3·132	·71855	·69548	·57693	·37569	·20572	1·128	0·734	0·402
7150·5	159·775	3·373	·71903	·69004	·67353	·21083	·13754	1·314	0·411	0·268
7160·5	175·998	+3·345	0·71985	2·68086	−0·71687	+0·02930	+0·05848	+1·394	−0·057	−0·114
7170·5	192·174	3·052	·72094	·66871	·70373	− ·15455	− ·02519	1·362	+0·299	+0·049
7180·5	208·284	2·520	·72222	·65457	·63538	·32629	·10689	1·223	0·628	0·206
7190·5	224·319	1·794	·72358	·63965	·51744	·47258	·18026	0·991	0·905	0·345
7200·5	240·281	+0·932	0·72492	2·62506	−0·35933	−0·58220	−0·23964	+0·684	+1·108	+0·456
7210·5	256·178	+0·001	·72613	·61191	− ·17348	·64689	·28053	+0·329	1·225	0·531
7220·5	272·026	−0·927	·72713	·60119	+ ·02571	·66191	·29988	−0·049	1·249	0·566
7230·5	287·845	1·782	·72783	·59366	·22294	·62630	·29629	0·419	1·178	0·557
7240·5	303·655	−2·502	0·72819	2·58984	+0·40317	−0·54292	−0·27010	−0·757	+1·020	+0·507
7250·5	319·471	3·032	·72817	·58999	·55270	·41819	·22334	1·038	0·786	0·420
7260·5	335·309	3·333	·72779	·59410	·66013	·26161	·15958	1·242	0·492	0·300
7270·5	351·176	3·381	·72706	·60191	·71720	− ·08508	·08364	1·353	+0·161	0·158
7280·5	7·079	−3·172	0·72604	2·61286	+0·71940	+0·09795	−0·00131	−1·363	−0·186	+0·002
7290·5	23·022	2·718	·72481	·62616	·66634	·27344	+ ·08112	1·269	0·521	−0·155
7300·5	39·007	2·053	·72347	·64086	·56182	·42781	·15728	1·076	0·819	0·301
7310·5	55·038	1·227	·72211	·65581	·41370	·54895	·22123	0·797	1·057	0·426
7320·5	71·117	−0·301	0·72084	2·66984	+0·23329	+0·62723	+0·26789	−0·452	−1·215	−0·519
7330·5	87·246	+0·651	·71976	·68182	+ ·03459	·65628	·29353	−0·067	1·277	0·571
7340·5	103·423	1·554	·71897	·69073	− ·16684	·63360	·29604	+0·326	1·236	0·578
7350·5	119·641	2·335	·71851	·69584	·35506	·56081	·27512	0·694	1·097	0·538
7360·5	135·887	+2·931	0·71844	2·69668	−0·51515	+0·44358	+0·23242	+1·008	−0·868	−0·455
7370·5	152·142	3·293	·71875	·69317	·63440	·29120	·17129	1·239	0·569	0·335
7380·5	168·381	3·391	·71942	·68564	·70345	+ ·11576	·09659	1·370	−0·225	0·188
7390·5	184·582	3·221	·72040	·67470	·71697	− ·06882	+ ·01428	1·391	+0·134	−0·028
7400·5	200·724	+2·797	0·72161	2·66130	−0·67411	−0·24800	−0·06917	+1·301	+0·479	+0·134

Julian Date	Heliocentric Longitude l	Heliocentric Latitude b	Radius Vector r	$\frac{1}{r^3}$	Heliocentric Equatorial Co-ordinates x	y	z	Attractions on the Sun Earth only X	Y	Z
243	°	°								
6920·5	85·177	−0·001	0·98394	1·04976	+0·08274	+0·89952	+0·39008	−0·078	−0·848	−0·368
6930·5	95·363	·001	·98336	·05165	− ·09190	·89823	·38952	+ ·087	·849	·368
6940·5	105·555	·001	·98327	·05191	·26369	·86906	·37688	·249	·821	·356
6950·5	115·745	·001	·98371	·05052	·42728	·81291	·35253	·403	·767	·333
6960·5	125·920	−0·001	0·98463	1·04756	−0·57764	+0·73157	+0·31725	+0·544	−0·688	−0·299
6970·5	136·071	·001	·98603	·04312	·71014	·62760	·27217	·665	·588	·255
6980·5	146·189	− ·001	·98784	·03738	·82078	·50431	·21870	·765	·470	·204
6990·5	156·266	·000	·99002	·03055	·90629	·36558	·15854	·839	·338	·147
7000·5	166·296	0·000	0·99249	1·02286	−0·96424	+0·21572	+0·09355	+0·886	−0·198	−0·086
7010·5	176·273	·000	·99519	·01458	·99308	+ ·05934	+ ·02574	·905	− ·054	− ·023
7020·5	186·196	·000	0·99801	1·00599	·99218	− ·09882	− ·04285	·897	+ ·089	+ ·039
7030·5	196·061	·000	1·00089	0·99734	·96182	·25405	·11017	·862	·228	·099
7040·5	205·870	+0·001	1·00373	0·98889	−0·90314	−0·40181	−0·17425	+0·802	+0·357	+0·155
7050·5	215·625	·001	·00646	·98088	·81809	·53785	·23324	·721	·474	·206
7060·5	225·329	·001	·00899	·97352	·70935	·65831	·28548	·620	·576	·250
7070·5	234·987	·001	·01125	·96700	·58022	·75986	·32952	·504	·660	·286
7080·5	244·605	+0·001	1·01318	0·96147	−0·43452	−0·83972	−0·36415	+0·375	+0·725	+0·315
7090·5	254·189	·001	·01474	·95706	·27648	·89575	·38845	·238	·770	·334
7100·5	263·748	·001	·01587	·95387	− ·11062	·92646	·40177	+ ·095	·794	·344
7110·5	273·290	·001	·01654	·95197	+ ·05835	·93109	·40377	− ·050	·796	·345
7120·5	282·824	+0·001	1·01675	0·95140	+0·22568	−0·90954	−0·39443	−0·193	+0·777	+0·337
7130·5	292·359	·001	·01647	·95217	·38667	·86245	·37401	·331	·738	·320
7140·5	301·903	·001	·01573	·95426	·53680	·79111	·34307	·460	·678	·294
7150·5	311·466	·001	·01453	·95763	·67179	·69748	·30247	·578	·600	·260
7160·5	321·055	+0·001	1·01292	0·96222	+0·78779	−0·58414	−0·25332	−0·681	+0·505	+0·219
7170·5	330·678	+ ·001	·01093	·96791	·88141	·45420	·19697	·766	·395	·171
7180·5	340·342	·000	·00862	·97457	·94984	·31130	·13500	·832	·273	·118
7190·5	350·053	·000	·00606	·98205	0·99093	·15943	·06914	·874	·141	·061
7200·5	359·816	0·000	1·00331	0·99015	+1·00330	−0·00295	−0·00128	−0·892	+0·003	+0·001
7210·5	9·634	·000	1·00045	0·99865	0·98634	+ ·15360	+ ·06661	·885	− ·138	− ·060
7220·5	19·508	− ·001	0·99757	1·00732	·94031	·30563	·13254	·851	·277	·120
7230·5	29·439	·001	·99476	·01589	·86632	·44855	·19452	·791	·409	·178
7240·5	39·425	−0·001	0·99209	1·02410	+0·76636	+0·57803	+0·25067	−0·705	−0·532	−0·231
7250·5	49·462	·001	·98966	·03168	·64323	·69003	·29923	·596	·640	·277
7260·5	59·546	·001	·98753	·03836	·50052	·78101	·33869	·467	·729	·316
7270·5	69·670	·001	·98578	·04391	·34249	·84806	·36777	·321	·795	·345
7280·5	79·826	−0·001	0·98445	1·04813	+0·17390	+0·88898	+0·38551	−0·164	−0·837	−0·363
7290·5	90·004	·001	·98360	·05086	− ·00006	·90240	·39133	·000	·852	·369
7300·5	100·194	·001	·98325	·05198	·17402	·88784	·38502	+ ·164	·839	·364
7310·5	110·387	·001	·98341	·05147	·34258	·84571	·36675	·324	·799	·346
7320·5	120·571	−0·001	0·98408	1·04933	−0·50051	+0·77734	+0·33710	+0·472	−0·733	−0·318
7330·5	130·736	·001	·98523	·04565	·64294	·68490	·29702	·604	·643	·279
7340·5	140·873	·001	·98683	·04057	·76553	·57132	·24776	·716	·534	·232
7350·5	150·973	− ·001	·98883	·03428	·86462	·44020	·19090	·803	·409	·177
7360·5	161·028	0·000	0·99116	1·02700	−0·93732	+0·29563	+0·12820	+0·865	−0·273	−0·118
7370·5	171·034	·000	·99375	·01900	·98160	+ ·14209	+ ·06162	·899	− ·130	− ·056
7380·5	180·985	·000	·99652	·01053	·99637	− ·01572	− ·00682	·905	+ ·014	+ ·006
7390·5	190·881	·000	0·99938	1·00187	·98141	·17307	·07505	·883	·156	·068
7400·5	200·719	+0·001	1·00225	0·99328	−0·93743	−0·32531	−0·14107	+0·836	+0·290	+0·126

Julian Date	Heliocentric Longitude	Heliocentric Latitude	Radius Vector	$\frac{1}{r^3}$	Heliocentric Equatorial Co-ordinates			Attractions on the Sun Venus only		
	l	b	r		x	y	z	X	Y	Z
243	°	°								
7400·5	200·724	+2·797	0·72161	2·66130	−0·67411	−0·24800	−0·06917	+1·301	+0·479	+0·134
7410·5	216·794	2·156	·72295	·64651	·57852	·40780	·14721	1·110	0·783	0·283
7420·5	232·789	1·350	·72432	·63153	·43791	·53588	·21381	0·836	1·023	0·408
7430·5	248·714	+0·443	·72561	·61750	·26341	·62250	·26386	0·500	1·182	0·501
7440·5	264·582	−0·496	0·72673	2·60548	−0·06862	−0·66122	−0·29361	+0·130	+1·250	+0·555
7450·5	280·410	1·393	·72758	·59634	+ ·13143	·64929	·30087	−0·247	1·223	0·567
7460·5	296·220	2·184	·72810	·59073	·32146	·58778	·28516	0·604	1·104	0·536
7470·5	312·030	2·809	·72826	·58902	·48700	·48149	·24772	0·914	0·904	0·465
7480·5	327·855	−3·222	0·72805	2·59134	+0·61546	−0·33854	−0·19142	−1·157	+0·636	+0·360
7490·5	343·706	3·391	·72747	·59754	·69702	− ·16981	·12054	1·313	+0·320	0·227
7500·5	359·591	3·302	·72657	·60718	·72534	+ ·01190	− ·04046	1·372	−0·023	+0·077
7510·5	15·514	2·960	·72542	·61960	·69806	·19268	+ ·04273	1·326	0·366	−0·081
7520·5	31·479	−2·389	0·72410	2·63389	+0·61701	+0·35860	+0·12262	−1·179	−0·685	−0·234
7530·5	47·488	1·632	·72273	·64897	·48818	·49675	·19300	0·938	0·954	0·371
7540·5	63·545	−0·744	·72139	·66368	·32136	·59621	·24835	0·621	1·152	0·480
7550·5	79·651	+0·205	·72021	·67684	+ ·12938	·64897	·28426	−0·251	1·260	0·552
7560·5	95·808	+1·140	0·71927	2·68737	−0·07277	+0·65067	+0·29779	+0·142	−1·268	−0·580
7570·5	112·010	1·988	·71864	·69438	·26916	·60098	·28780	0·526	1·174	0·562
7580·5	128·246	2·677	·71839	·69725	·44423	·50369	·25502	0·869	0·985	0·499
7590·5	144·501	3·154	·71852	·69573	·58408	·36648	·20203	1·142	0·717	0·395
7600·5	160·752	+3·379	0·71904	2·68997	−0·67766	+0·20023	+0·13303	+1·322	−0·391	−0·260
7610·5	176·975	3·334	·71989	·68046	·71767	+ ·01814	+ ·05350	1·395	−0·035	−0·104
7620·5	193·147	3·026	·72101	·66800	·70113	− ·16539	− ·03024	1·357	+0·320	+0·059
7630·5	209·253	2·481	·72230	·65364	·62960	·33596	·11162	1·212	0·647	0·215
7640·5	225·283	+1·745	0·72368	2·63854	−0·50895	−0·48033	−0·18429	+0·974	+0·919	+0·353
7650·5	241·240	+0·877	·72502	·62388	·34880	·58746	·24268	0·664	1·118	0·462
7660·5	257·132	−0·056	·72624	·61076	− ·16174	·64926	·28234	+0·306	1·229	0·535
7670·5	272·976	0·981	·72722	·60015	+ ·03775	·66123	·30034	−0·071	1·247	0·566
7680·5	288·792	−1·830	0·72791	2·59280	+0·23437	−0·62264	−0·29537	−0·441	+1·171	+0·555
7690·5	304·599	2·540	·72824	·58922	·41312	·53658	·26788	0·776	1·008	0·503
7700·5	320·415	3·057	·72820	·58966	·56041	·40966	·21999	1·053	0·769	0·413
7710·5	336·252	3·343	·72779	·59407	·66503	·25155	·15535	1·251	0·473	0·292
7720·5	352·120	−3·376	0·72704	2·60216	+0·71892	−0·07425	−0·07887	−1·357	+0·140	+0·149
7730·5	8·025	3·151	·72599	·61337	·71780	+ ·10872	+ ·00365	1·361	−0·206	−0·007
7740·5	23·969	2·684	·72475	·62691	·66152	·28332	·08588	1·260	0·540	0·164
7750·5	39·956	2·008	·72339	·64175	·55416	·43603	·16147	1·062	0·835	0·309
7760·5	55·990	−1·173	0·72202	2·65678	+0·40377	+0·55486	+0·22452	−0·778	−1·069	−0·433
7770·5	72·073	−0·244	·72075	·67083	·22185	·63036	·27003	0·430	1·221	0·523
7780·5	88·206	+0·707	·71968	·68274	+ ·02253	·65636	·29433	−0·044	1·277	0·573
7790·5	104·387	1·605	·71890	·69151	− ·17856	·63060	·29543	+0·349	1·231	0·577
7800·5	120·609	+2·377	0·71846	2·69640	−0·36551	+0·55496	+0·27315	+0·715	−1·085	−0·534
7810·5	136·858	2·960	·71841	·69699	·52350	·43534	·22923	1·024	0·852	0·448
7820·5	153·113	3·306	·71875	·69322	·63999	·28121	·16714	1·250	0·549	0·326
7830·5	169·353	3·389	·71944	·68541	·70582	+ ·10482	·09181	1·375	−0·204	0·179
7840·5	185·552	+3·203	0·72044	2·67425	−0·71594	−0·07986	+0·00924	+1·389	+0·155	−0·018
7850·5	201·691	2·764	·72167	·66066	·66979	·25827	− ·07407	1·293	0·498	+0·143
7860·5	217·757	2·111	·72302	·64577	·57124	·41649	·15159	1·096	0·799	0·291
7870·5	233·748	1·297	·72439	·63075	·42825	·54232	·21732	0·817	1·035	0·415
7880·5	249·669	+0·386	0·72568	2·61678	−0·25213	−0·62622	−0·26625	+0·479	+1·188	+0·505

Julian Date	Heliocentric Longitude	Heliocentric Latitude	Radius Vector	$\frac{1}{r^3}$	Heliocentric Equatorial Co-ordinates			Attractions on the Sun Earth only		
	l	b	r		x	y	z	X	Y	Z
243	°	°								
7400·5	200·719	+0·001	1·00225	0·99328	−0·93743	−0·32531	−0·14107	+0·836	+0·290	+0·126
7410·5	210·502	·001	·00505	·98501	·86596	·46802	·20296	·766	·414	·180
7420·5	220·232	·001	·00769	·97730	·76930	·59712	·25895	·675	·524	·227
7430·5	229·914	·001	·01009	·97032	·65044	·70900	·30746	·567	·618	·268
7440·5	239·552	+0·001	1·01221	0·96426	−0·51295	−0·80057	−0·34717	+0·444	+0·694	+0·301
7450·5	249·153	·001	·01396	·95926	·36084	·86936	·37700	·311	·749	·325
7460·5	258·725	·002	·01531	·95544	·19852	·91352	·39615	·170	·784	·340
7470·5	268·275	·002	·01622	·95287	− ·03059	·93191	·40413	+ ·026	·798	·346
7480·5	277·813	+0·001	1·01667	0·95161	+0·13821	−0·92408	−0·40074	−0·118	+0·790	+0·343
7490·5	287·347	·001	·01664	·95168	·30312	·89029	·38608	·259	·761	·330
7500·5	296·885	·001	·01614	·95309	·45951	·83149	·36058	·393	·712	·309
7510·5	306·438	·001	·01518	·95581	·60297	·74929	·32494	·518	·643	·279
7520·5	316·013	+0·001	1·01378	0·95977	+0·72941	−0·64595	−0·28012	−0·629	+0·557	+0·242
7530·5	325·618	·001	·01199	·96488	·83518	·52430	·22737	·724	·454	·197
7540·5	335·261	+ ·001	·00984	·97104	·91716	·38772	·16814	·800	·338	·147
7550·5	344·947	·000	·00741	·97810	0·97284	·24004	·10410	·855	·211	·091
7560·5	354·683	0·000	1·00476	0·98587	+1·00043	−0·08543	−0·03705	−0·886	+0·076	+0·033
7570·5	4·471	·000	1·00195	0·99416	0·99890	+ ·07166	+ ·03107	·892	− ·064	− ·028
7580·5	14·316	− ·001	0·99909	1·00274	·96806	·22665	·09828	·872	·204	·089
7590·5	24·217	·001	·99624	·01137	·90857	·37491	·16258	·826	·341	·148
7600·5	34·174	−0·001	0·99349	1·01978	+0·82196	+0·51198	+0·22202	−0·753	−0·469	−0·203
7610·5	44·184	·001	·99094	·02770	·71061	·63363	·27478	·656	·585	·254
7620·5	54·243	·001	·98864	·03486	·57771	·73606	·31919	·537	·684	·297
7630·5	64·346	·001	·98669	·04102	·42717	·81600	·35386	·399	·763	·331
7640·5	74·485	−0·002	0·98513	1·04596	+0·26351	+0·87088	+0·37766	−0·248	−0·818	−0·355
7650·5	84·652	·002	·98403	·04948	+ ·09172	·89887	·38980	− ·086	·847	·368
7660·5	94·836	·002	·98341	·05147	− ·08291	·89902	·38986	+ ·078	·849	·368
7670·5	105·028	·001	·98330	·05183	·25497	·87127	·37783	·241	·823	·357
7680·5	115·217	−0·001	0·98370	1·05055	−0·41911	+0·81648	+0·35407	+0·396	−0·771	−0·334
7690·5	125·393	·001	·98459	·04769	·57026	·73638	·31934	·537	·693	·301
7700·5	135·545	·001	·98595	·04336	·70378	·63350	·27472	·660	·594	·258
7710·5	145·665	·001	·98774	·03770	·81563	·51112	·22165	·760	·476	·207
7720·5	155·745	−0·001	0·98989	1·03094	−0·90251	+0·37308	+0·16179	+0·836	−0·346	−0·150
7730·5	165·777	·000	·99235	·02331	·96193	·22368	·09700	·884	·206	·089
7740·5	175·758	·000	·99503	·01508	·99230	+ ·06753	+ ·02929	·905	− ·062	− ·027
7750·5	185·683	·000	0·99784	1·00650	·99294	− ·09066	− ·03931	·898	+ ·082	+ ·036
7760·5	195·552	+0·001	1·00072	0·99785	−0·96408	−0·24616	−0·10675	+0·864	+0·221	+0·096
7770·5	205·365	·001	·00356	·98939	·90682	·39442	·17104	·806	·351	·152
7780·5	215·123	·001	·00629	·98135	·82307	·53116	·23034	·726	·468	·203
7790·5	224·830	·001	·00884	·97396	·71547	·65252	·28297	·626	·571	·248
7800·5	234·490	+0·001	1·01111	0·96739	−0·58730	−0·75512	−0·32746	+0·510	+0·656	+0·285
7810·5	244·110	·002	·01307	·96181	·44235	·83615	·36260	·382	·722	·313
7820·5	253·697	·002	·01464	·95733	·28483	·89345	·38745	·245	·768	·333
7830·5	263·258	·002	·01579	·95408	− ·11926	·92549	·40134	+ ·102	·793	·344
7840·5	272·801	+0·002	1·01649	0·95212	+0·04967	−0·93146	−0·40393	−0·042	+0·797	+0·346
7850·5	282·336	·002	·01672	·95149	·21721	·91125	·39517	·186	·779	·338
7860·5	291·871	·001	·01646	·95219	·37865	·86543	·37530	·324	·740	·321
7870·5	301·415	·001	·01574	·95422	·52944	·79529	·34488	·454	·682	·296
7880·5	310·977	+0·001	1·01457	0·95753	+0·66531	−0·70274	−0·30475	−0·572	+0·605	+0·262

Julian Date	Heliocentric Longitude	Heliocentric Latitude	Radius Vector	$\frac{1}{r^3}$	Heliocentric Equatorial Co-ordinates			Attractions on the Sun Venus only		
	l	b	r		x	y	z	X	Y	Z
243	°	°								
7880·5	249·669	+0·386	0·72568	2·61678	−0·25213	−0·62622	−0·26625	+0·479	+1·188	+0·505
7890·5	265·534	−0·551	·72678	·60487	− ·05659	·66194	·29470	+0·107	1·251	0·557
7900·5	281·361	1·445	·72762	·59590	+ ·14329	·64696	·30057	−0·270	1·218	0·566
7910·5	297·170	2·227	·72812	·59050	·33224	·58259	·28350	0·624	1·095	0·533
7920·5	312·980	−2·840	0·72826	2·58903	+0·49588	−0·47384	−0·24484	−0·931	+0·890	+0·460
7930·5	328·806	3·239	·72802	·59159	·62177	·32902	·18753	1·169	0·618	0·352
7940·5	344·659	3·393	·72742	·59800	·70028	− ·15912	·11593	1·320	+0·300	0·218
7950·5	0·546	3·288	·72651	·60781	·72528	+ ·02292	− ·03548	1·372	−0·043	+0·067
7960·5	16·472	−2·932	0·72535	2·62033	+0·69467	+0·20320	+0·04769	−1·320	−0·386	−0·091
7970·5	32·439	2·349	·72404	·63464	·61055	·36781	·12717	1·167	0·703	0·243
7980·5	48·450	1·581	·72267	·64965	·47914	·50392	·19681	0·921	0·968	0·378
7990·5	64·509	−0·688	·72135	·66421	·31042	·60077	·25110	0·600	1·161	0·485
8000·5	80·618	+0·262	0·72018	2·67716	+0·11741	+0·65056	+0·28573	−0·228	−1·263	−0·555
8010·5	96·775	1·194	·71926	·68744	− ·08484	·64916	·29788	+0·165	1·265	0·581
8020·5	112·978	2·034	·71866	·69417	·28037	·59648	·28649	0·548	1·166	0·560
8030·5	129·214	2·713	·71843	·69678	·45370	·49657	·25242	0·887	0·971	0·494
8040·5	145·467	+3·175	0·71859	2·69504	−0·59107	+0·35731	+0·19834	+1·155	−0·698	−0·388
8050·5	161·716	3·384	·71911	·68912	·68161	·18973	·12855	1·329	0·370	0·251
8060·5	177·935	3·323	·71997	·67952	·71829	+ ·00716	+ ·04860	1·396	−0·014	−0·094
8070·5	194·103	3·000	·72109	·66704	·69840	− ·17599	− ·03519	1·351	+0·340	+0·068
8080·5	210·204	+2·442	0·72238	2·65274	−0·62375	−0·34536	−0·11622	+1·200	+0·664	+0·224
8090·5	226·230	1·697	·72375	·63776	·50045	·48780	·18820	0·957	0·933	0·360
8100·5	242·183	+0·822	·72508	·62329	·33833	·59242	·24558	0·644	1·127	0·467
8110·5	258·073	−0·112	·72627	·61040	− ·15010	·65136	·28403	+0·284	1·233	0·538
8120·5	273·916	−1·034	0·72723	2·60006	+0·04966	−0·66030	−0·30067	−0·094	+1·245	+0·567
8130·5	289·733	1·877	·72789	·59298	·24563	·61876	·29433	0·462	1·164	0·554
8140·5	305·542	2·576	·72820	·58967	·42288	·53003	·26555	0·794	0·996	0·499
8150·5	321·361	3·081	·72814	·59036	·56792	·40095	·21654	1·067	0·753	0·407
8160·5	337·202	−3·352	0·72770	2·59499	+0·66971	−0·24132	−0·15104	−1·260	+0·454	+0·284
8170·5	353·074	3·370	·72694	·60324	·72038	− ·06328	− ·07402	1·360	+0·119	+0·140
8180·5	8·983	3·130	·72589	·61450	·71592	+ ·11959	+ ·00867	1·358	−0·227	−0·016
8190·5	24·931	2·649	·72464	·62801	·65642	·29326	·09068	1·251	0·559	0·173
8200·5	40·922	−1·961	0·72329	2·64275	+0·54621	+0·44426	+0·16569	−1·047	−0·852	−0·318
8210·5	56·958	1·119	·72195	·65758	·39357	·56073	·22781	0·759	1·081	0·439
8220·5	73·043	−0·187	·72070	·67135	·21019	·63338	·27213	0·407	1·227	0·527
8230·5	89·178	+0·764	·71966	·68295	+ ·01032	·65630	·29508	−0·020	1·277	0·574
8240·5	105·360	+1·656	0·71891	2·69139	−0·19035	+0·62747	+0·29477	+0·372	−1·225	−0·575
8250·5	121·582	2·418	·71850	·69597	·37596	·54899	·27113	0·735	1·073	0·530
8260·5	137·829	2·987	·71848	·69627	·53177	·42702	·22601	1·040	0·835	0·442
8270·5	154·082	3·319	·71883	·69228	·64545	·27121	·16298	1·260	0·530	0·318
8280·5	170·317	+3·385	0·71954	2·68433	−0·70805	+0·09393	+0·08705	+1·378	−0·183	−0·169
8290·5	186·511	3·183	·72055	·67310	·71479	− ·09077	+ ·00425	1·386	+0·176	−0·008
8300·5	202·645	2·731	·72177	·65954	·66537	·26835	− ·07889	1·283	0·518	+0·152
8310·5	218·706	2·067	·72311	·64476	·56392	·42496	·15587	1·082	0·815	0·299
8320·5	234·693	+1·245	0·72447	2·62992	−0·41862	−0·54854	−0·22073	+0·798	+1·046	+0·421
8330·5	250·610	+0·330	·72574	·61617	·24093	·62971	·26853	0·457	1·195	0·510
8340·5	266·473	−0·607	·72682	·60452	− ·04471	·66245	·29568	+0·084	1·251	0·559
8350·5	282·300	1·495	·72763	·59583	+ ·15496	·64445	·30018	−0·292	1·213	0·565
8360·5	298·111	−2·269	0·72810	2·59071	+0·34280	−0·57726	−0·28177	−0·644	+1·085	+0·529

Julian Date	Heliocentric Longitude	Heliocentric Latitude	Radius Vector	$\frac{1}{r^3}$	Heliocentric Equatorial Co-ordinates			Attractions on the Sun Earth only		
	l	b	r		x	y	z	X	Y	Z
243	°	°								
7880·5	310·977	+0·001	1·01457	0·95753	+0·66531	−0·70274	−0·30475	−0·572	+0·605	+0·262
7890·5	320·565	·001	·01298	·96205	·78237	·59033	·25600	·676	·510	·221
7900·5	330·187	+ ·001	·01101	·96768	·87721	·46115	·19998	·763	·401	·174
7910·5	339·850	·000	·00872	·97428	·94698	·31880	·13825	·829	·279	·121
7920·5	349·559	0·000	1·00618	0·98170	+0·98952	−0·16729	−0·07255	−0·873	+0·148	+0·064
7930·5	359·320	·000	·00345	·98974	1·00337	− ·01093	− ·00474	·892	+ ·010	+ ·004
7940·5	9·134	·000	1·00061	0·99819	0·98792	+ ·14574	+ ·06320	·886	− ·131	− ·057
7950·5	19·006	− ·001	0·99774	1·00681	·94335	·29810	·12927	·853	·270	·117
7960·5	28·933	−0·001	0·99493	1·01536	+0·87075	+0·44160	+0·19150	−0·794	−0·403	−0·175
7970·5	38·915	·001	·99227	·02355	·77206	·57186	·24799	·710	·526	·228
7980·5	48·949	·001	·98983	·03114	·65005	·68484	·29698	·602	·634	·275
7990·5	59·030	·002	·98769	·03786	·50826	·77697	·33693	·474	·724	·314
8000·5	69·151	−0·002	0·98592	1·04347	+0·35090	+0·84530	+0·36656	−0·329	−0·792	−0·344
8010·5	79·303	·002	·98457	·04777	·18274	·88759	·38491	·172	·835	·362
8020·5	89·479	·002	·98368	·05059	+ ·00894	·90244	·39135	− ·008	·852	·369
8030·5	99·669	·002	·98330	·05183	− ·16514	·88931	·38565	+ ·156	·840	·364
8040·5	109·861	−0·002	0·98342	1·05143	−0·33410	+0·84857	+0·36799	+0·316	−0·802	−0·348
8050·5	120·045	·001	·98405	·04942	·49269	·78151	·33890	·464	·737	·320
8060·5	130·211	·001	·98517	·04586	·63603	·69024	·29933	·598	·649	·281
8070·5	140·349	·001	·98673	·04089	·75973	·57766	·25051	·710	·540	·234
8080·5	150·452	−0·001	0·98869	1·03470	−0·86010	+0·44733	+0·19399	+0·799	−0·416	−0·180
8090·5	160·510	·000	·99100	·02751	·93421	·30334	·13155	·862	·280	·121
8100·5	170·519	·000	·99356	·01957	·97999	+ ·15014	+ ·06511	·898	− ·138	− ·060
8110·5	180·475	·000	·99632	·01114	·99628	− ·00758	− ·00328	·905	+ ·007	+ ·003
8120·5	190·374	0·000	0·99917	1·00249	−0·98284	−0·16508	−0·07158	+0·885	+0·149	+0·064
8130·5	200·217	+ ·001	1·00204	0·99390	·94031	·31770	·13777	·840	·284	·123
8140·5	210·004	·001	·00485	·98559	·87019	·46101	·19991	·770	·408	·177
8150·5	219·738	·001	·00751	·97782	·77475	·59091	·25625	·681	·519	·225
8160·5	229·423	+0·001	1·00994	0·97077	−0·65694	−0·70375	−0·30518	+0·573	+0·614	+0·266
8170·5	239·063	·002	·01208	·96463	·52030	·79643	·34537	·451	·690	·299
8180·5	248·667	·002	·01386	·95954	·36884	·86643	·37573	·318	·747	·324
8190·5	258·240	·002	·01525	·95561	·20692	·91189	·39544	·178	·783	·339
8200·5	267·791	+0·002	1·01620	0·95294	−0·03917	−0·93162	−0·40400	+0·034	+0·798	+0·346
8210·5	277·329	·002	·01668	·95158	+ ·12969	·92513	·40118	− ·111	·791	·343
8220·5	286·862	·002	·01669	·95156	·29491	·89266	·38710	·252	·763	·331
8230·5	296·399	·001	·01622	·95289	·45183	·83510	·36215	·387	·715	·310
8240·5	305·950	+0·001	1·01528	0·95553	+0·59605	−0·75405	−0·32700	−0·512	+0·647	+0·281
8250·5	315·522	·001	·01391	·95942	·72345	·65173	·28262	·624	·562	·244
8260·5	325·125	·001	·01213	·96448	·83035	·53095	·23025	·719	·460	·200
8270·5	334·765	+ ·001	·01000	·97060	·91361	·39505	·17132	·797	·344	·149
8280·5	344·448	0·000	1·00757	0·97763	+0·97068	−0·24784	−0·10748	−0·853	+0·218	+0·094
8290·5	354·181	·000	·00492	·98538	·99974	− ·09348	− ·04054	·885	+ ·083	+ ·036
8300·5	3·966	·000	1·00212	0·99367	·99972	+ ·06359	+ ·02757	·892	− ·057	− ·025
8310·5	13·807	− ·001	0·99925	1·00226	·97037	·21879	·09488	·874	·197	·085
8320·5	23·705	−0·001	0·99639	1·01090	+0·91232	+0·36751	+0·15937	−0·829	−0·334	−0·145
8330·5	33·659	·001	·99364	·01934	·82705	·50527	·21911	·757	·463	·201
8340·5	43·667	·001	·99107	·02729	·71690	·62781	·27225	·662	·579	·251
8350·5	53·724	·002	·98876	·03450	·58502	·73131	·31713	·544	·680	·295
8360·5	63·825	−0·002	0·98679	1·04072	+0·43529	+0·81249	+0·35233	−0·407	−0·760	−0·329

Julian Date	Heliocentric Longitude	Heliocentric Latitude	Radius Vector	$\frac{1}{r^3}$	Heliocentric Equatorial Co-ordinates			Attractions on the Sun Venus only		
	l	b	r		x	y	z	X	Y	Z
243	°	°								
8360·5	298·111	−2·269	0·72810	2·59071	+0·34280	−0·57726	−0·28177	−0·644	+1·085	+0·529
8370·5	313·923	2·871	·72822	·58952	·50452	·46609	·24189	0·948	0·875	0·454
8380·5	329·752	3·256	·72795	·59233	·62783	·31943	·18360	1·180	0·601	0·345
8390·5	345·609	3·394	·72734	·59894	·70328	− ·14842	·11130	1·326	+0·280	0·210
8400·5	1·500	−3·274	0·72641	2·60890	+0·72497	+0·03392	−0·03051	−1·372	−0·064	+0·058
8410·5	17·429	2·903	·72524	·62150	·69106	·21365	+ ·05262	1·314	0·406	−0·100
8420·5	33·400	2·307	·72393	·63580	·60388	·37690	·13169	1·154	0·721	0·252
8430·5	49·415	1·530	·72257	·65076	·46992	·51094	·20055	0·903	0·982	0·386
8440·5	65·477	−0·632	0·72126	2·66518	+0·29935	+0·60515	+0·25378	−0·579	−1·170	−0·491
8450·5	81·589	+0·320	·72011	·67794	+ ·10534	·65194	·28712	−0·205	1·266	0·558
8460·5	97·749	1·248	·71922	·68796	− ·09695	·64742	·29786	+0·189	1·262	0·581
8470·5	113·954	2·080	·71864	·69441	·29158	·59175	·28507	0·570	1·156	0·557
8480·5	130·192	+2·747	0·71843	2·69674	−0·46311	+0·48922	+0·24970	+0·906	−0·957	−0·488
8490·5	146·445	3·195	·71861	·69475	·59793	·34791	·19454	1·169	0·680	0·380
8500·5	162·692	3·388	·71916	·68859	·68540	+ ·17904	·12397	1·337	−0·349	0·242
8510·5	178·908	3·311	·72003	·67880	·71870	− ·00398	+ ·04360	1·396	+0·008	−0·085
8520·5	195·073	+2·973	0·72117	2·66622	−0·69542	−0·18670	−0·04020	+1·345	+0·361	+0·078
8530·5	211·169	2·402	·72247	·65185	·61763	·35480	·12086	1·188	0·682	0·232
8540·5	227·191	1·647	·72383	·63688	·49168	·49525	·19211	0·940	0·947	0·367
8550·5	243·140	+0·767	·72515	·62246	·32761	·59732	·24847	0·623	1·136	0·473
8560·5	259·027	−0·168	0·72634	2·60966	−0·13826	−0·65333	−0·28567	+0·262	+1·237	+0·541
8570·5	274·868	1·088	·72729	·59942	+ ·06171	·65922	·30095	−0·116	1·243	0·567
8580·5	290·683	1·924	·72794	·59249	·25696	·61472	·29323	0·483	1·156	0·551
8590·5	306·492	2·613	·72823	·58934	·43264	·52335	·26316	0·812	0·983	0·494
8600·5	322·310	−3·104	0·72815	2·59019	+0·57537	−0·39214	−0·21304	−1·081	+0·737	+0·400
8610·5	338·152	3·361	·72770	·59500	·67427	·23106	·14671	1·269	0·435	0·276
8620·5	354·024	3·363	·72692	·60343	·72172	− ·05235	− ·06917	1·363	+0·099	+0·131
8630·5	9·933	3·107	·72585	·61489	·71392	+ ·13036	+ ·01365	1·354	−0·247	−0·026
8640·5	25·883	−2·613	0·72459	2·62856	+0·65123	+0·30303	+0·09542	−1·242	−0·578	−0·182
8650·5	41·875	1·915	·72323	·64341	·53822	·45227	·16980	1·032	0·867	0·326
8660·5	57·914	1·065	·72188	·65833	·38339	·56636	·23099	0·739	1·092	0·445
8670·5	74·001	−0·130	·72063	·67212	+ ·19862	·63618	·27412	−0·385	1·233	0·531
8680·5	90·139	+0·819	0·71960	2·68365	−0·00175	+0·65602	+0·29572	+0·003	−1·277	−0·576
8690·5	106·325	1·706	·71886	·69199	·20196	·62412	·29400	0·394	1·219	0·574
8700·5	122·549	2·458	·71846	·69640	·38620	·54284	·26901	0·755	1·062	0·526
8710·5	138·799	3·014	·71845	·69652	·53982	·41854	·22270	1·056	0·819	0·436
8720·5	155·053	+3·330	0·71883	2·69233	−0·65066	+0·26107	+0·15874	+1·271	−0·510	−0·310
8730·5	171·288	3·381	·71955	·68419	·71001	+ ·08293	+ ·08222	1·382	−0·161	−0·160
8740·5	187·481	3·163	·72057	·67279	·71335	− ·10176	− ·00079	1·383	+0·197	+0·002
8750·5	203·612	2·697	·72181	·65911	·66064	·27846	·08375	1·274	0·537	0·162
8760·5	219·670	+2·021	0·72316	2·64423	−0·55629	−0·43341	−0·16016	+1·067	+0·831	+0·307
8770·5	235·654	1·192	·72452	·62934	·40868	·55468	·22413	0·779	1·058	0·427
8780·5	251·569	+0·274	·72579	·61559	·22947	·63308	·27078	0·435	1·201	0·514
8790·5	267·429	−0·662	·72687	·60397	− ·03260	·66279	·29661	+0·062	1·252	0·560
8800·5	283·255	−1·546	0·72767	2·59536	+0·16678	−0·64176	−0·29972	−0·314	+1·208	+0·564
8810·5	299·064	2·311	·72814	·59034	·35344	·57174	·27996	0·664	1·074	0·526
8820·5	314·876	2·901	·72824	·58927	·51317	·45818	·23887	0·964	0·860	0·449
8830·5	330·705	3·271	·72796	·59221	·63383	·30972	·17960	1·192	0·582	0·338
8840·5	346·562	−3·394	0·72733	2·59897	+0·70618	−0·13766	−0·10664	−1·331	+0·259	+0·201

Julian Date	Heliocentric Longitude	Heliocentric Latitude	Radius Vector	$\frac{1}{r^3}$	Heliocentric Equatorial Co-ordinates			Attractions on the Sun Earth only		
	l	b	r		x	y	z	X	Y	Z
243	°	°								
8360·5	63·825	−0·002	0·98679	1·04072	+0·43529	+0·81249	+0·35233	−0·407	−0·760	−0·329
8370·5	73·962	·002	·98521	·04572	·27219	·86870	·37671	·256	·816	·354
8380·5	84·128	·002	·98408	·04932	+ ·10069	·89811	·38946	− ·095	·847	·367
8390·5	94·311	·002	·98344	·05139	− ·07393	·89970	·39016	+ ·070	·850	·369
8400·5	104·503	−0·002	0·98330	1·05183	−0·24625	+0·87338	+0·37874	+0·233	−0·825	−0·358
8410·5	114·692	·002	·98367	·05065	·41092	·81995	·35557	·388	·774	·336
8420·5	124·869	·001	·98453	·04787	·56286	·74109	·32138	·530	·698	·303
8430·5	135·022	·001	·98587	·04362	·69739	·63932	·27724	·654	·599	·260
8440·5	145·144	−0·001	0·98763	1·03804	−0·81045	+0·51785	+0·22457	+0·756	−0·483	−0·209
8450·5	155·226	− ·001	·98977	·03134	·89868	·38051	·16501	·833	·353	·153
8460·5	165·262	·000	·99220	·02376	·95956	·23158	·10043	·883	·213	·092
8470·5	175·245	·000	·99487	·01556	·99144	+ ·07566	+ ·03281	·905	− ·069	− ·030
8480·5	185·174	0·000	0·99768	1·00700	−0·99361	−0·08255	−0·03579	+0·899	+0·075	+0·032
8490·5	195·046	+ ·001	1·00055	0·99835	·96625	·23830	·10334	·867	·214	·093
8500·5	204·863	·001	·00340	·98988	·91040	·38705	·16784	·810	·344	·149
8510·5	214·624	·001	·00614	·98181	·82795	·52448	·22744	·730	·463	·201
8520·5	224·334	+0·001	1·00870	0·97436	−0·72150	−0·64672	−0·28045	+0·632	+0·566	+0·245
8530·5	233·997	·002	·01099	·96773	·59429	·75036	·32539	·517	·652	·283
8540·5	243·619	·002	·01297	·96207	·45010	·83257	·36104	·389	·720	·312
8550·5	253·207	·002	·01457	·95753	·29312	·89112	·38643	·252	·767	·332
8560·5	262·769	+0·002	1·01575	0·95419	−0·12785	−0·92449	−0·40090	+0·110	+0·792	+0·344
8570·5	272·313	·002	·01648	·95215	+ ·04102	·93181	·40408	− ·035	·797	·346
8580·5	281·847	·002	·01674	·95143	·20874	·91293	·39589	·178	·780	·338
8590·5	291·382	·002	·01651	·95205	·37060	·86841	·37659	·317	·743	·322
8600·5	300·925	+0·002	1·01582	0·95401	+0·52204	−0·79948	−0·34669	−0·447	+0·685	+0·297
8610·5	310·485	·001	·01467	·95726	·65877	·70802	·30704	·567	·609	·264
8620·5	320·071	·001	·01309	·96172	·77688	·59656	·25870	·671	·515	·224
8630·5	329·691	+ ·001	·01114	·96731	·87293	·46817	·20302	·759	·407	·176
8640·5	339·351	0·000	1·00886	0·97388	+0·94405	−0·32640	−0·14155	−0·826	+0·286	+0·124
8650·5	349·057	·000	·00632	·98128	0·98802	·17526	·07600	·871	·155	·067
8660·5	358·815	·000	·00358	·98933	1·00337	− ·01904	− ·00826	·892	+ ·017	+ ·007
8670·5	8·627	·000	1·00074	0·99779	0·98941	+ ·13772	+ ·05972	·887	− ·123	− ·054
8680·5	18·496	−0·001	0·99786	1·00645	+0·94632	+0·29042	+0·12594	−0·856	−0·263	−0·114
8690·5	28·421	·001	·99504	·01503	·87511	·43449	·18841	·798	·396	·172
8700·5	38·401	·001	·99236	·02327	·77769	·56554	·24524	·715	·520	·225
8710·5	48·434	·002	·98991	·03090	·65679	·67950	·29466	·608	·629	·273
8720·5	58·513	−0·002	0·98775	1·03767	+0·51591	+0·77278	+0·33511	−0·481	−0·720	−0·312
8730·5	68·633	·002	·98596	·04332	·35923	·84240	·36530	·337	·790	·342
8740·5	78·785	·002	·98460	·04766	·19150	·88607	·38424	·180	·834	·362
8750·5	88·960	·002	·98371	·05052	+ ·01785	·90235	·39130	− ·017	·852	·369
8760·5	99·149	−0·002	0·98331	1·05180	−0·15635	+0·89066	+0·38623	+0·148	−0·842	−0·365
8770·5	109·341	·002	·98342	·05144	·32570	·85132	·36917	·308	·804	·349
8780·5	119·526	·002	·98404	·04947	·48494	·78556	·34066	·457	·741	·321
8790·5	129·692	·001	·98514	·04594	·62917	·69548	·30159	·591	·653	·283
8800·5	139·831	−0·001	0·98669	1·04102	−0·75397	+0·58392	+0·25322	+0·705	−0·546	−0·237
8810·5	149·934	·001	·98864	·03486	·85562	·45442	·19706	·795	·422	·183
8820·5	159·993	− ·001	·99093	·02771	·93113	·31104	·13488	·860	·287	·125
8830·5	170·004	·000	·99349	·01980	·97841	·15822	·06861	·896	·145	− ·063
8840·5	179·961	0·000	0·99623	1·01139	−0·99623	+0·00062	+0·00027	+0·905	−0·001	0·000

Julian Date	Heliocentric Longitude	Heliocentric Latitude	Radius Vector	$\frac{1}{r^3}$	Heliocentric Equatorial Co-ordinates			Attractions on the Sun Venus only		
	l	b	r		x	y	z	X	Y	Z
243	°	°								
8840·5	346·562	−3·394	0·72733	2·59897	+0·70618	−0·13766	−0·10664	−1·331	+0·259	+0·201
8850·5	2·453	3·259	·72639	·60909	·72455	+ ·04491	− ·02553	1·371	−0·085	+0·048
8860·5	18·383	2·873	·72521	·62183	·68734	·22402	+ ·05753	1·307	0·426	−0·109
8870·5	34·354	2·265	·72389	·63626	·59715	·38586	·13616	1·142	0·738	0·260
8880·5	50·371	−1·480	0·72252	2·65129	+0·46068	+0·51778	+0·20422	−0·886	−0·996	−0·393
8890·5	66·435	−0·576	·72121	·66576	·28832	·60933	·25636	0·557	1·178	0·496
8900·5	82·549	+0·376	·72006	·67850	+ ·09338	·65314	·28841	−0·181	1·269	0·560
8910·5	98·712	1·301	·71917	·68846	− ·10890	·64551	·29776	+0·212	1·259	0·581
8920·5	114·919	+2·125	0·71861	2·69478	−0·30257	+0·58689	+0·28357	+0·591	−1·147	−0·554
8930·5	131·159	2·780	·71842	·69694	·47227	·48178	·24693	0·924	0·942	0·483
8940·5	147·414	3·214	·71861	·69475	·60454	·33848	·19071	1·182	0·662	0·373
8950·5	163·661	3·391	·71918	·68840	·68892	+ ·16837	·11938	1·343	−0·328	0·233
8960·5	179·876	+3·298	0·72007	2·67845	−0·71887	−0·01505	+0·03862	+1·396	+0·029	−0·075
8970·5	196·038	2·945	·72121	·66572	·69223	·19730	− ·04518	1·338	0·381	+0·087
8980·5	212·131	2·362	·72252	·65127	·61133	·36410	·12545	1·176	0·700	0·241
8990·5	228·149	1·597	·72389	·63627	·48278	·50253	·19595	0·923	0·961	0·375
9000·5	244·095	+0·712	0·72521	2·62188	−0·31680	−0·60202	−0·25127	+0·602	+1·145	+0·478
9010·5	259·979	−0·225	·72638	·60916	− ·12639	·65511	·28722	+0·239	1·240	0·544
9020·5	275·819	1·141	·72732	·59907	+ ·07373	·65794	·30113	−0·139	1·240	0·568
9030·5	291·634	1·970	·72795	·59232	·26822	·61048	·29203	0·504	1·148	0·549
9040·5	307·443	−2·648	0·72823	2·58938	+0·44227	−0·51649	−0·26067	−0·831	+0·970	+0·490
9050·5	323·263	3·127	·72813	·59045	·58265	·38317	·20946	1·095	0·720	0·394
9060·5	339·106	3·368	·72766	·59545	·67864	·22066	·14230	1·277	0·415	0·268
9070·5	354·981	3·354	·72686	·60406	·72283	− ·04132	− ·06428	1·365	+0·078	+0·121
9080·5	10·892	−3·084	0·72578	2·61566	+0·71167	+0·14118	+0·01866	−1·350	−0·268	−0·035
9090·5	26·844	2·576	·72452	·62941	·64579	·31281	·10016	1·232	0·597	0·191
9100·5	42·839	1·867	·72315	·64429	·52998	·46024	·17392	1·016	0·883	0·334
9110·5	58·881	1·011	·72180	·65916	·37299	·57189	·23414	0·719	1·103	0·452
9120·5	74·971	−0·072	0·72057	2·67284	+0·18685	+0·63883	+0·27606	−0·362	−1·238	−0·535
9130·5	91·112	+0·875	·71955	·68421	− ·01396	·65557	·29629	+0·027	1·276	0·577
9140·5	107·300	1·755	·71883	·69227	·21366	·62059	·29314	0·417	1·212	0·572
9150·5	123·526	2·497	·71847	·69637	·39645	·53651	·26680	0·775	1·049	0·522
9160·5	139·776	+3·040	0·71849	2·69614	−0·54781	+0·40991	+0·21931	+1·071	−0·802	−0·429
9170·5	156·029	3·341	·71889	·69159	·65577	·25083	·15445	1·280	0·490	0·302
9180·5	172·260	3·375	·71965	·68314	·71185	+ ·07190	+ ·07736	1·385	−0·140	−0·151
9190·5	188·448	3·142	·72069	·67152	·71180	− ·11271	− ·00583	1·379	+0·218	+0·011
9200·5	204·573	+2·661	0·72194	2·65770	−0·65584	−0·28847	−0·08857	+1·264	+0·556	+0·171
9210·5	220·625	1·975	·72329	·64281	·54864	·44172	·16439	1·052	0·847	0·315
9220·5	236·602	1·139	·72464	·62803	·39880	·56065	·22745	0·760	1·069	0·434
9230·5	252·511	+0·218	·72589	·61447	·21814	·63627	·27294	0·414	1·207	0·518
9240·5	268·368	−0·717	0·72694	2·60315	−0·02070	−0·66298	−0·29744	+0·039	+1·252	+0·562
9250·5	284·192	1·595	·72772	·59487	+ ·17834	·63895	·29918	−0·336	1·202	0·563
9260·5	300·001	2·351	·72815	·59022	·36378	·56616	·27810	0·683	1·064	0·522
9270·5	315·814	2·929	·72822	·58953	·52151	·45024	·23582	0·979	0·846	0·443
9280·5	331·646	−3·286	0·72791	2·59284	+0·63952	−0·30004	−0·17559	−1·203	+0·564	+0·330
9290·5	347·506	3·393	·72724	·59992	·70878	− ·12697	·10198	1·337	+0·239	0·192
9300·5	3·401	3·242	·72628	·61028	·72384	+ ·05581	− ·02057	1·370	−0·106	+0·039
9310·5	19·335	2·843	·72509	·62319	·68335	·23428	+ ·06241	1·300	0·446	−0·119
9320·5	35·311	−2·222	0·72376	2·63769	+0·59016	+0·39468	+0·14058	−1·129	−0·755	−0·269

Julian Date	Heliocentric Longitude l	Heliocentric Latitude b	Radius Vector r	$\frac{1}{r^3}$	Heliocentric Equatorial Co-ordinates x	y	z	Attractions on the Sun Earth only X	Y	Z
243	°	°								
8840·5	179·961	0·000	0·99623	1·01139	−0·99623	+0·00062	+0·00027	+0·905	−0·001	0·000
8850·5	189·862	·000	0·99908	1·00277	·98431	− ·15699	− ·06808	·887	+ ·141	+ ·061
8860·5	199·707	+ ·001	1·00194	0·99419	·94326	·30997	·13442	·842	·277	·120
8870·5	209·496	·001	·00474	·98590	·87452	·45386	·19681	·775	·402	·174
8880·5	219·231	+0·001	1·00740	0·97812	−0·78033	−0·58454	−0·25348	+0·686	+0·514	+0·223
8890·5	228·918	·002	·00983	·97107	·66360	·69835	·30284	·579	·609	·264
8900·5	238·561	·002	·01198	·96491	·52784	·79214	·34351	·458	·687	·298
8910·5	248·166	·002	·01377	·95979	·37704	·86337	·37439	·325	·744	·323
8920·5	257·741	+0·002	1·01517	0·95583	−0·21556	−0·91013	−0·39467	+0·185	+0·782	+0·339
8930·5	267·293	·002	·01613	·95312	− ·04798	·93121	·40382	+ ·041	·797	·346
8940·5	276·832	·002	·01664	·95171	+ ·12094	·92609	·40160	− ·103	·792	·343
8950·5	286·366	·002	·01666	·95164	·28647	·89494	·38809	·245	·765	·332
8960·5	295·904	+0·002	1·01621	0·95290	+0·44395	−0·83865	−0·36368	−0·380	+0·718	+0·311
8970·5	305·455	·002	·01530	·95547	·58893	·75877	·32904	·506	·651	·282
8980·5	315·027	·001	·01395	·95930	·71730	·65748	·28511	·618	·567	·246
8990·5	324·628	·001	·01219	·96430	·82535	·53757	·23312	·715	·466	·202
9000·5	334·266	+0·001	1·01008	0·97036	+0·90990	−0·40236	−0·17448	−0·793	+0·351	+0·152
9010·5	343·948	·000	·00767	·97733	·96838	·25563	·11085	·850	·224	·097
9020·5	353·678	·000	·00503	·98505	0·99892	− ·10153	− ·04403	·884	+ ·090	+ ·039
9030·5	3·462	·000	1·00224	0·99331	1·00041	+ ·05552	+ ·02407	·893	− ·050	− ·021
9040·5	13·300	−0·001	0·99937	1·00188	+0·97257	+0·21093	+0·09147	−0·875	−0·190	−0·082
9050·5	23·196	·001	·99652	·01052	·91596	·36010	·15616	·832	·327	·142
9060·5	33·147	·001	·99376	·01897	·83204	·49852	·21618	·762	·456	·198
9070·5	43·153	·001	·99118	·02695	·72310	·62195	·26970	·667	·574	·249
9080·5	53·208	−0·002	0·98885	1·03420	+0·59224	+0·72652	+0·31505	−0·550	−0·675	−0·293
9090·5	63·307	·002	·98686	·04047	·44331	·80891	·35078	·414	·756	·328
9100·5	73·443	·002	·98527	·04553	·28077	·86645	·37573	·264	·814	·353
9110·5	83·607	·002	·98412	·04919	+ ·10957	·89727	·38910	− ·103	·846	·367
9120·5	93·791	−0·002	0·98346	1·05132	−0·06502	+0·90030	+0·39041	+0·061	−0·850	−0·369
9130·5	103·982	·002	·98330	·05182	·23758	·87540	·37961	·224	·827	·359
9140·5	114·172	·002	·98365	·05070	·40278	·82333	·35703	·380	·777	·337
9150·5	124·349	·002	·98450	·04798	·55548	·74572	·32338	·523	·702	·304
9160·5	134·503	−0·001	0·98582	1·04378	−0·69101	+0·64505	+0·27973	+0·648	−0·605	−0·262
9170·5	144·627	·001	·98756	·03826	·80526	·52451	·22745	·751	·489	·212
9180·5	154·710	− ·001	·98968	·03161	·89483	·38789	·16821	·829	·359	·156
9190·5	164·747	·000	·99211	·02406	·95716	·23946	·10384	·881	·220	·096
9200·5	174·733	0·000	0·99476	1·01590	−0·99056	+0·08378	+0·03634	+0·904	−0·076	−0·033
9210·5	184·664	·000	0·99756	1·00736	·99425	− ·07442	− ·03227	·900	+ ·067	+ ·029
9220·5	194·538	+ ·001	1·00042	0·99873	·96839	·23041	·09991	·869	·207	·090
9230·5	204·357	·001	·00327	·99027	·91397	·37961	·16461	·813	·338	·146
9240·5	214·121	+0·001	1·00601	0·98220	−0·83283	−0·51773	−0·22451	+0·735	+0·457	+0·198
9250·5	223·833	·002	·00856	·97475	·72754	·64083	·27789	·637	·561	·243
9260·5	233·499	·002	·01087	·96810	·60131	·74550	·32328	·523	·648	·281
9270·5	243·123	·002	·01285	·96241	·45789	·82887	·35943	·396	·717	·311
9280·5	252·714	+0·002	1·01446	0·95783	−0·30145	−0·88868	−0·38537	+0·259	+0·765	+0·332
9290·5	262·277	·002	·01566	·95445	− ·13648	·92337	·40041	+ ·117	·792	·343
9300·5	271·823	·002	·01641	·95235	+ ·03233	·93203	·40417	− ·028	·797	·346
9310·5	281·359	·002	·01669	·95157	·20024	·91449	·39656	·171	·782	·339
9320·5	290·894	+0·002	1·01649	0·95212	+0·36251	−0·87126	−0·37781	−0·310	+0·745	+0·323

Julian Date	Heliocentric Longitude	Heliocentric Latitude	Radius Vector	$\frac{1}{r^3}$	Heliocentric Equatorial Co-ordinates			Attractions on the Sun Venus only		
	l	b	r		x	y	z	X	Y	Z
243	°	°								
9320·5	35·311	−2·222	0·72376	2·63769	+0·59016	+0·39468	+0·14058	−1·129	−0·755	−0·269
9330·5	51·332	1·428	·72239	·65270	·45121	·52446	·20783	0·868	1·009	0·400
9340·5	67·401	−0·519	·72109	·66703	·27709	·61333	·25888	0·536	1·186	0·501
9350·5	83·520	+0·434	·71997	·67954	+ ·08126	·65412	·28962	−0·158	1·271	0·563
9360·5	99·687	+1·355	0·71911	2·68918	−0·12097	+0·64338	+0·29756	+0·236	−1·255	−0·580
9370·5	115·897	2·170	·71858	·69512	·31362	·58179	·28198	0·613	1·137	0·551
9380·5	132·139	2·813	·71842	·69687	·48143	·47412	·24406	0·942	0·927	0·477
9390·5	148·393	3·232	·71865	·69426	·61108	·32887	·18679	1·194	0·643	0·365
9400·5	164·638	+3·393	0·71925	2·68753	−0·69234	+0·15757	+0·11473	+1·350	−0·307	−0·224
9410·5	180·848	3·284	·72017	·67725	·71891	− ·02618	+ ·03361	1·396	+0·051	−0·065
9420·5	197·004	2·916	·72134	·66431	·68891	·20788	− ·05016	1·331	0·402	+0·097
9430·5	213·091	2·320	·72266	·64975	·60495	·37332	·13001	1·163	0·717	0·250
9440·5	229·102	+1·547	0·72402	2·63476	−0·47386	−0·50968	−0·19974	+0·906	+0·974	+0·382
9450·5	245·041	+0·657	·72534	·62049	·30605	·60657	·25400	0·582	1·153	0·483
9460·5	260·920	−0·281	·72649	·60802	− ·11464	·65673	·28870	+0·217	1·242	0·546
9470·5	276·757	1·194	·72740	·59824	+ ·08556	·65654	·30125	−0·161	1·237	0·568
9480·5	292·570	−2·015	0·72800	2·59185	+0·27924	−0·60618	−0·29079	−0·525	+1·139	+0·547
9490·5	308·379	2·683	·72824	·58930	·45163	·50961	·25817	0·848	0·957	0·485
9500·5	324·200	3·148	·72810	·59075	·58965	·37425	·20588	1·108	0·703	0·387
9510·5	340·046	3·375	·72760	·59611	·68273	·21037	·13792	1·286	0·396	0·260
9520·5	355·923	−3·345	0·72677	2·60502	+0·72370	−0·03045	−0·05943	−1·367	+0·058	+0·112
9530·5	11·839	3·060	·72567	·61685	·70922	+ ·15181	+ ·02361	1·346	−0·288	−0·045
9540·5	27·795	2·539	·72439	·63073	·64019	·32236	·10483	1·221	0·615	0·200
9550·5	43·794	1·819	·72303	·64565	·52164	·46798	·17793	1·001	0·898	0·341
9560·5	59·841	−0·956	0·72169	2·66046	+0·36253	+0·57718	+0·23719	−0·700	−1·114	−0·458
9570·5	75·936	−0·015	·72047	·67398	+ ·17508	·64124	·27790	−0·340	1·244	0·539
9580·5	92·081	+0·931	·71947	·68510	− ·02612	·65490	·29676	+0·051	1·275	0·578
9590·5	108·272	1·804	·71878	·69288	·22525	·61687	·29220	0·440	1·205	0·571
9600·5	124·501	+2·536	0·71844	2·69666	−0·40654	+0·53001	+0·26451	+0·795	−1·037	−0·517
9610·5	140·752	3·066	·71849	·69611	·55561	·40116	·21586	1·086	0·784	0·422
9620·5	157·005	3·351	·71892	·69127	·66066	·24051	·15010	1·290	0·469	0·293
9630·5	173·234	3·368	·71970	·68258	·71345	+ ·06083	+ ·07247	1·388	−0·118	−0·141
9640·5	189·419	+3·119	0·72076	2·67076	−0·70999	−0·12366	−0·01088	+1·375	+0·240	+0·021
9650·5	205·540	2·625	·72202	·65682	·65078	·29845	·09338	1·254	0·575	0·180
9660·5	221·587	1·929	·72337	·64188	·54074	·44994	·16860	1·036	0·862	0·323
9670·5	237·559	1·085	·72473	·62712	·38869	·56649	·23072	0·741	1·079	0·440
9680·5	253·465	+0·161	0·72597	2·61366	−0·20661	−0·63930	−0·27503	+0·392	+1·212	+0·521
9690·5	269·319	−0·772	·72700	·60250	− ·00864	·66297	·29820	+0·016	1·251	0·563
9700·5	285·141	1·645	·72776	·59445	+ ·19000	·63592	·29856	−0·358	1·197	0·562
9710·5	300·950	2·391	·72817	·59002	·37416	·56034	·27613	0·703	1·053	0·519
9720·5	316·764	−2·957	0·72821	2·58956	+0·52982	−0·44209	−0·23268	−0·995	+0·830	+0·437
9730·5	332·596	3·299	·72788	·59306	·64514	·29018	·17150	1·213	0·546	0·323
9740·5	348·458	3·391	·72721	·60031	·71126	− ·11614	·09726	1·341	+0·219	0·183
9750·5	4·355	3·225	·72623	·61078	·72299	+ ·06677	− ·01557	1·369	−0·126	+0·029
9760·5	20·291	−2·811	0·72504	2·62373	+0·67923	+0·24454	+0·06730	−1·293	−0·465	−0·128
9770·5	36·268	2·179	·72371	·63824	·58307	·40344	·14497	1·116	0·772	0·277
9780·5	52·291	1·376	·72234	·65319	·44170	·53103	·21140	0·850	1·022	0·407
9790·5	68·361	−0·462	·72106	·66744	·26589	·61720	·26133	0·514	1·194	0·506
9800·5	84·481	+0·491	0·71994	2·67983	+0·06924	+0·65496	+0·29077	−0·135	−1·273	−0·565

Julian Date	Heliocentric Longitude	Heliocentric Latitude	Radius Vector	$\frac{1}{r^3}$	Heliocentric Equatorial Co-ordinates			Attractions on the Sun Earth only		
	l	b	r		x	y	z	X	Y	Z
243	°	°								
9320·5	290·894	+0·002	1·01649	0·95212	+0·36251	−0·87126	−0·37781	−0·310	+0·745	+0·323
9330·5	300·437	·002	·01582	·95400	·51460	·80353	·34845	·441	·689	·299
9340·5	309·997	·002	·01470	·95717	·65219	·71317	·30926	·561	·613	·266
9350·5	319·582	·001	·01315	·96155	·77135	·60266	·26134	·666	·521	·226
9360·5	329·200	+0·001	1·01123	0·96706	+0·86861	−0·47505	−0·20600	−0·755	+0·413	+0·179
9370·5	338·858	+ ·001	·00898	·97355	·94106	·33387	·14479	·823	·292	·127
9380·5	348·562	·000	·00646	·98088	0·98647	·18311	·07941	·869	·161	·070
9390·5	358·317	·000	·00374	·98886	1·00331	− ·02705	− ·01173	·891	+ ·024	+ ·010
9400·5	8·126	−0·001	1·00091	0·99728	+0·99086	+0·12980	+0·05628	−0·888	−0·116	−0·050
9410·5	17·991	·001	0·99804	1·00590	·94924	·28282	·12264	·858	·256	·111
9420·5	27·912	·001	·99522	·01447	·87944	·42743	·18535	·801	·390	·169
9430·5	37·889	·001	·99254	·02272	·78331	·55923	·24251	·720	·514	·223
9440·5	47·918	−0·002	0·99007	1·03039	+0·66354	+0·67416	+0·29234	−0·614	−0·624	−0·271
9450·5	57·994	·002	·98790	·03721	·52360	·76857	·33329	·488	·716	·311
9460·5	68·111	·002	·98608	·04294	·36763	·83946	·36403	·344	·787	·341
9470·5	78·260	·002	·98469	·04738	·20035	·88451	·38356	·189	·832	·361
9480·5	88·434	−0·002	0·98376	1·05035	+0·02688	+0·90221	+0·39124	−0·025	−0·851	−0·369
9490·5	98·623	·002	·98333	·05174	− ·14742	·89196	·38679	+ ·139	·843	·365
9500·5	108·814	·002	·98340	·05150	·31715	·85401	·37034	·300	·807	·350
9510·5	119·000	·002	·98398	·04964	·47704	·78957	·34239	·450	·745	·323
9520·5	129·168	−0·002	0·98505	1·04622	−0·62215	+0·70067	+0·30384	+0·585	−0·659	−0·286
9530·5	139·309	·001	·98658	·04138	·74805	·59013	·25591	·700	·552	·239
9540·5	149·414	·001	·98851	·03529	·85097	·46146	·20011	·791	·429	·186
9550·5	159·477	− ·001	·99078	·02819	·92789	·31868	·13820	·857	·294	·128
9560·5	169·491	0·000	0·99332	1·02030	−0·97666	+0·16622	+0·07209	+0·895	−0·152	−0·066
9570·5	179·451	·000	·99606	·01192	·99601	+ ·00875	+ ·00380	·905	− ·008	− ·003
9580·5	189·356	+ ·001	0·99891	1·00329	·98562	− ·14898	− ·06460	·888	+ ·134	+ ·058
9590·5	199·204	·001	1·00177	0·99470	·94603	·30231	·13109	·845	·270	·117
9600·5	208·996	+0·001	1·00458	0·98637	−0·87866	−0·44677	−0·19374	+0·779	+0·396	+0·172
9610·5	218·735	·001	·00725	·97856	·78571	·57823	·25074	·691	·508	·220
9620·5	228·424	·002	·00970	·97145	·67005	·69298	·30050	·585	·605	·262
9630·5	238·069	·002	·01187	·96523	·53517	·78787	·34165	·464	·683	·296
9640·5	247·676	+0·002	1·01368	0·96005	−0·38504	−0·86030	−0·37306	+0·332	+0·742	+0·322
9650·5	257·253	·002	·01510	·95603	·22399	·90835	·39390	·192	·780	·338
9660·5	266·806	·002	·01609	·95324	− ·05661	·93077	·40362	+ ·048	·797	·346
9670·5	276·346	·002	·01662	·95176	+ ·11236	·92698	·40198	− ·096	·793	·344
9680·5	285·880	+0·002	1·01667	0·95161	+0·27818	−0·89715	−0·38904	−0·238	+0·767	+0·333
9690·5	295·417	·002	·01625	·95281	·43618	·84211	·36518	·373	·721	·313
9700·5	304·967	·002	·01536	·95531	·58191	·76338	·33104	·499	·655	·284
9710·5	314·538	·001	·01403	·95907	·71122	·66312	·28756	·613	·571	·248
9720·5	324·138	+0·001	1·01229	0·96401	+0·82039	−0·54409	−0·23594	−0·710	+0·471	+0·204
9730·5	333·774	+ ·001	·01020	·97001	·90621	·40957	·17761	·790	·357	·155
9740·5	343·453	·000	·00781	·97694	·96607	·26333	·11420	·848	·231	·100
9750·5	353·181	·000	·00518	·98462	0·99807	− ·10950	− ·04749	·883	+ ·097	+ ·042
9760·5	2·961	0·000	1·00239	0·99285	+1·00106	+0·04751	+0·02059	−0·893	−0·042	−0·018
9770·5	12·797	− ·001	0·99953	1·00141	0·97470	·20312	·08807	·877	·183	·079
9780·5	22·689	·001	·99667	·01005	·91954	·35271	·15294	·834	·320	·139
9790·5	32·638	·002	·99390	·01852	·83696	·49179	·21325	·766	·450	·195
9800·5	42·640	−0·002	0·99131	1·02653	+0·72923	+0·61608	+0·26715	−0·672	−0·568	−0·246

Julian Date	Heliocentric Longitude	Heliocentric Latitude	Radius Vector	$\frac{1}{r^3}$	Heliocentric Equatorial Co-ordinates			Attractions on the Sun Venus only		
	l	b	r		x	y	z	X	Y	Z
243/4	°	°								
9800·5	84·481	+0·491	0·71994	2·67983	+0·06924	+0·65496	+0·29077	−0·135	−1·273	−0·565
9810·5	100·650	1·407	·71909	·68934	− ·13285	·64114	·29730	+0·259	1·251	0·580
9820·5	116·861	2·214	·71858	·69514	·32443	·57664	·28034	0·634	1·127	0·548
9830·5	133·103	2·845	·71843	·69676	·49031	·46646	·24116	0·959	0·912	0·472
9840·5	149·357	+3·249	0·71868	2·69403	−0·61733	+0·31931	+0·18288	+1·206	−0·624	−0·357
9850·5	165·601	3·394	·71928	·68720	·69547	+ ·14687	·11011	1·355	−0·286	0·215
9860·5	181·810	3·269	·72021	·67685	·71868	− ·03718	+ ·02864	1·395	+0·072	−0·056
9870·5	197·964	2·886	·72138	·66387	·68534	·21831	− ·05509	1·324	0·422	+0·106
9880·5	214·048	+2·278	0·72270	2·64932	−0·59833	−0·38235	−0·13451	+1·150	+0·735	+0·258
9890·5	230·056	1·496	·72406	·63437	·46472	·51663	·20346	0·888	0·987	0·389
9900·5	245·993	+0·601	·72537	·62017	·29509	·61090	·25665	0·561	1·161	0·488
9910·5	261·871	−0·337	·72651	·60781	− ·10273	·65812	·29008	+0·194	1·245	0·549
9920·5	277·707	−1·247	0·72741	2·59816	+0·09753	−0·65487	−0·30126	−0·184	+1·234	+0·568
9930·5	293·521	2·060	·72799	·59190	·29034	·60159	·28943	0·546	1·131	0·544
9940·5	309·331	2·717	·72822	·58949	·46103	·50245	·25553	0·866	0·944	0·480
9950·5	325·154	3·168	·72807	·59108	·59661	·36506	·20218	1·121	0·686	0·380
9960·5	341·002	−3·380	0·72756	2·59655	+0·68673	−0·19985	−0·13343	−1·293	+0·376	+0·251
9970·5	356·882	3·335	·72672	·60554	·72442	− ·01939	− ·05449	1·369	+0·037	+0·103
9980·5	12·799	3·035	·72562	·61739	·70660	+ ·16255	+ ·02862	1·341	−0·309	−0·054
9990·5	28·756	2·500	·72434	·63127	·63441	·33197	·10953	1·211	0·634	0·209
0000·5	44·757	−1·771	0·72299	2·64614	+0·51315	+0·47569	+0·18195	−0·985	−0·913	−0·349
0010·5	60·804	−0·901	·72165	·66084	·35198	·58240	·24021	0·679	1·124	0·464
0020·5	76·900	+0·043	·72045	·67422	+ ·16329	·64355	·27969	−0·317	1·248	0·542
0030·5	93·046	0·986	·71946	·68519	− ·03823	·65411	·29717	+0·074	1·274	0·579
0040·5	109·238	+1·853	0·71878	2·69281	−0·23671	+0·61304	+0·29120	+0·462	−1·197	−0·569
0050·5	125·468	2·574	·71846	·69644	·41646	·52346	·26218	0·814	1·024	0·513
0060·5	141·718	3·090	·71852	·69575	·56320	·39239	·21239	1·101	0·767	0·415
0070·5	157·970	3·359	·71896	·69080	·66532	·23023	·14577	1·298	0·449	0·284
0080·5	174·198	+3·361	0·71975	2·68203	−0·71483	+0·04986	+0·06761	+1·390	−0·097	−0·132
0090·5	190·379	3·096	·72081	·67017	·70798	− ·13446	− ·01588	1·371	+0·260	+0·031
0100·5	206·497	2·589	·72207	·65623	·64556	·30823	·09812	1·244	0·594	0·189
0110·5	222·541	1·881	·72342	·64133	·53273	·45794	·17272	1·021	0·877	0·331
0120·5	238·510	+1·031	0·72477	2·62664	−0·37852	−0·57211	−0·23390	+0·721	+1·090	+0·446
0130·5	254·414	+0·104	·72600	·61330	− ·19506	·64209	·27702	+0·370	1·217	0·525
0140·5	270·267	−0·827	·72702	·60229	+ ·00339	·66275	·29886	−0·006	1·251	0·564
0150·5	286·089	1·694	·72776	·59438	·20160	·63268	·29784	0·379	1·190	0·560
0160·5	301·899	−2·431	0·72816	2·59015	+0·38443	−0·55435	−0·27408	−0·722	+1·041	+0·515
0170·5	317·714	2·984	·72818	·58986	·53798	·43380	·22946	1·011	0·815	0·431
0180·5	333·549	3·312	·72784	·59357	·65056	·28021	·16736	1·224	0·527	0·315
0190·5	349·413	3·388	·72715	·60098	·71352	− ·10525	·09249	1·346	+0·199	0·174
0200·5	5·313	−3·207	0·72616	2·61160	+0·72191	+0·07775	−0·01056	−1·367	−0·147	+0·020
0210·5	21·251	2·779	·72495	·62466	·67486	·25477	+ ·07218	1·285	0·485	−0·137
0220·5	37·231	2·135	·72362	·63921	·57574	·41211	·14935	1·102	0·789	0·286
0230·5	53·257	1·323	·72226	·65414	·43196	·53747	·21492	0·832	1·035	0·414
0240·5	69·330	−0·405	0·72098	2·66828	+0·25449	+0·62089	+0·26372	−0·492	−1·202	−0·510
0250·5	85·453	+0·548	·71988	·68050	+ ·05707	·65560	·29183	−0·111	1·275	0·567
0260·5	101·625	1·460	·71905	·68978	− ·14484	·63866	·29694	+0·283	1·246	0·579
0270·5	117·838	2·257	·71856	·69533	·33529	·57122	·27858	0·655	1·117	0·545
0280·5	134·082	+2·876	0·71844	2·69668	−0·49918	+0·45854	+0·23816	+0·976	−0·897	−0·466

Julian Date	Heliocentric Longitude l	Heliocentric Latitude b	Radius Vector r	$\frac{1}{r^3}$	Heliocentric Equatorial Co-ordinates x	y	z	Attractions on the Sun Earth only X	Y	Z
243/4	°	°								
9800·5	42·640	−0·002	0·99131	1·02653	+0·72923	+0·61608	+0·26715	−0·672	−0·568	−0·246
9810·5	52·693	·002	·98897	·03383	·59941	·72169	·31295	·557	·670	·291
9820·5	62·789	·002	·98696	·04016	·45130	·80528	·34920	·422	·752	·326
9830·5	72·924	·002	·98534	·04530	·28934	·86415	·37473	·272	·811	·352
9840·5	83·087	−0·002	0·98416	1·04905	+0·11846	+0·89636	+0·38870	−0·112	−0·845	−0·366
9850·5	93·269	·002	·98347	·05128	−·05609	·90082	·39063	+·053	·851	·369
9860·5	103·461	·002	·98328	·05189	·22889	·87733	·38045	·216	·829	·360
9870·5	113·651	·002	·98360	·05086	·39459	·82661	·35845	·373	·780	·338
9880·5	123·830	−0·002	0·98442	1·04824	−0·54805	+0·75025	+0·32534	+0·516	−0·707	−0·306
9890·5	133·986	·001	·98571	·04412	·68457	·65068	·28216	·642	·610	·265
9900·5	144·112	·001	·98744	·03865	·79999	·53106	·23029	·746	·496	·215
9910·5	154·198	−·001	·98954	·03203	·89089	·39515	·17136	·826	·366	·159
9920·5	164·238	0·000	0·99196	1·02452	−0·95466	+0·24721	+0·10721	+0·879	−0·228	−0·099
9930·5	174·227	·000	·99461	·01635	·98956	+·09178	+·03981	·904	−·084	−·036
9940·5	184·161	·000	0·99741	1·00780	·99479	−·06640	−·02879	·901	+·060	+·026
9950·5	194·038	+·001	1·00029	0·99914	·97041	·22261	·09653	·871	·200	·087
9960·5	203·859	+0·001	1·00315	0·99062	−0·91742	−0·37227	−0·16142	+0·816	+0·331	+0·144
9970·5	213·625	·002	·00590	·98250	·83759	·51105	·22161	·739	·451	·196
9980·5	223·339	·002	·00848	·97499	·73347	·63500	·27536	·642	·556	·241
9990·5	233·006	·002	·01080	·96827	·60823	·74069	·32119	·529	·644	·279
0000·5	242·631	+0·002	1·01281	0·96253	−0·46560	−0·82520	−0·35784	+0·403	+0·714	+0·309
0010·5	252·222	·002	·01445	·95788	·30974	·88627	·38432	·267	·763	·331
0020·5	261·786	·002	·01567	·95444	−·14511	·92227	·39993	+·124	·791	·343
0030·5	271·331	·002	·01643	·95228	+·02361	·93228	·40427	−·020	·798	·346
0040·5	280·866	+0·002	1·01673	0·95144	+0·19167	−0·91608	−0·39725	−0·164	+0·783	+0·340
0050·5	290·400	·002	·01655	·95194	·35434	·87414	·37906	·303	·748	·324
0060·5	299·942	·002	·01590	·95379	·50705	·80764	·35023	·434	·692	·300
0070·5	309·500	·002	·01479	·95691	·64549	·71840	·31153	·555	·618	·268
0080·5	319·084	+0·001	1·01325	0·96127	+0·76568	−0·60886	−0·26403	−0·661	+0·526	+0·228
0090·5	328·700	·001	·01134	·96675	·86414	·48204	·20904	·750	·419	·182
0100·5	338·356	+·001	·00909	·97323	·93794	·34147	·14808	·820	·299	·129
0110·5	348·058	·000	·00657	·98055	0·98478	·19109	·08287	·867	·168	·073
0120·5	357·810	0·000	1·00385	0·98853	+1·00312	−0·03519	−0·01527	−0·891	+0·031	+0·014
0130·5	7·617	−·001	1·00102	0·99696	0·99218	+·12174	+·05278	·889	−·109	−·047
0140·5	17·480	·001	0·99814	1·00559	·95205	·27507	·11928	·860	·248	·108
0150·5	27·400	·001	·99532	·01418	·88366	·42024	·18222	·805	·383	·166
0160·5	37·375	−0·002	0·99262	1·02246	+0·78882	+0·55281	+0·23972	−0·725	−0·508	−0·220
0170·5	47·402	·002	·99014	·03016	·67018	·66870	·28997	·620	·619	·268
0180·5	57·477	·002	·98796	·03702	·53117	·76426	·33141	·495	·712	·309
0190·5	67·593	·002	·98613	·04280	·37590	·83642	·36270	·352	·784	·340
0200·5	77·742	−0·002	0·98472	1·04728	+0·20907	+0·88284	+0·38283	−0·197	−0·831	−0·360
0210·5	87·915	·002	·98377	·05031	+·03579	·90197	·39113	−·034	·851	·369
0220·5	98·103	·002	·98332	·05176	−·13861	·89314	·38730	+·131	·844	·366
0230·5	108·296	·002	·98338	·05158	·30870	·85659	·37145	·292	·809	·351
0240·5	118·481	−0·002	0·98394	1·04977	−0·46921	+0·79346	+0·34408	+0·443	−0·748	−0·324
0250·5	128·650	·002	·98499	·04641	·61519	·70575	·30604	·578	·663	·288
0260·5	138·793	·001	·98650	·04163	·74218	·59624	·25856	·695	·558	·242
0270·5	148·900	·001	·98841	·03559	·84635	·46840	·20312	·787	·436	·189
0280·5	158·965	−0·001	0·99067	1·02852	−0·92466	+0·32623	+0·14147	+0·854	−0·301	−0·131

Julian Date	Heliocentric Longitude	Heliocentric Latitude	Radius Vector	$\frac{1}{r^3}$	Heliocentric Equatorial Co-ordinates			Attractions on the Sun Venus only		
	l	b	r		x	y	z	X	Y	Z
244	°	°								
0280·5	134·082	+2·876	0·71844	2·69668	−0·49918	+0·45854	+0·23816	+0·976	−0·897	−0·466
0290·5	150·336	3·265	·71871	·69367	·62350	·30951	·17885	1·218	0·605	0·349
0300·5	166·578	3·394	·71934	·68659	·69846	+ ·13598	·10539	1·361	−0·265	0·205
0310·5	182·784	3·253	·72028	·67603	·71827	− ·04830	+ ·02360	1·394	+0·094	−0·046
0320·5	198·933	+2·855	0·72147	2·66287	−0·68159	−0·22880	−0·06006	+1·316	+0·442	+0·116
0330·5	215·012	2·235	·72280	·64820	·59154	·39139	·13901	1·136	0·752	0·267
0340·5	231·015	1·444	·72417	·63319	·45544	·52353	·20715	0·870	1·000	0·396
0350·5	246·947	+0·545	·72547	·61900	·28407	·61514	·25926	0·540	1·168	0·492
0360·5	262·821	−0·393	0·72661	2·60672	−0·09081	−0·65939	−0·29141	+0·172	+1·247	+0·551
0370·5	278·653	1·299	·72750	·59723	+ ·10942	·65310	·30122	−0·206	1·230	0·567
0380·5	294·464	2·105	·72806	·59121	·30130	·59693	·28803	0·566	1·122	0·541
0390·5	310·273	2·750	·72826	·58909	·47023	·49527	·25288	0·883	0·930	0·475
0400·5	326·096	−3·188	0·72808	2·59098	+0·60335	−0·35591	−0·19849	−1·134	+0·669	+0·373
0410·5	341·944	3·385	·72754	·59679	·69050	·18943	·12897	1·300	0·357	0·243
0420·5	357·825	3·324	·72667	·60609	·72492	− ·00849	− ·04961	1·370	+0·016	+0·094
0430·5	13·745	3·009	·72554	·61824	·70380	+ ·17309	+ ·03355	1·336	−0·329	−0·064
0440·5	29·705	−2·462	0·72425	2·63234	+0·62849	+0·34133	+0·11412	−1·200	−0·652	−0·218
0450·5	45·710	1·722	·72287	·64735	·50455	·48315	·18586	0·969	0·928	0·357
0460·5	61·761	−0·846	·72154	·66212	·34136	·58735	·24312	0·659	1·134	0·469
0470·5	77·862	+0·100	·72033	·67546	+ ·15146	·64559	·28136	−0·294	1·253	0·546
0480·5	94·013	+1·041	0·71937	2·68627	−0·05034	+0·65305	+0·29746	+0·098	−1·272	−0·580
0490·5	110·210	1·901	·71871	·69367	·24815	·60895	·29008	0·485	1·190	0·567
0500·5	126·443	2·611	·71841	·69700	·42631	·51664	·25974	0·834	1·011	0·508
0510·5	142·696	3·114	·71850	·69598	·57068	·38337	·20880	1·116	0·750	0·408
0520·5	158·948	+3·367	0·71897	2·69068	−0·66983	+0·21973	+0·14132	+1·307	−0·429	−0·276
0530·5	175·175	3·352	·71979	·68158	·71601	+ ·03871	+ ·06266	1·393	−0·075	−0·122
0540·5	191·353	3·072	·72088	·66943	·70575	− ·14538	− ·02094	1·366	+0·281	+0·041
0550·5	207·467	2·551	·72216	·65526	·64012	·31807	·10291	1·233	0·613	0·198
0560·5	223·506	+1·833	0·72353	2·64020	−0·52451	−0·46595	−0·17684	+1·004	+0·892	+0·339
0570·5	239·470	0·976	·72488	·62545	·36818	·57766	·23706	0·701	1·100	0·451
0580·5	255·368	+0·048	·72611	·61212	− ·18342	·64480	·27898	+0·347	1·222	0·529
0590·5	271·217	−0·882	·72713	·60119	+ ·01544	·66241	·29948	−0·029	1·250	0·565
0600·5	287·035	−1·743	0·72785	2·59346	+0·21313	−0·62935	−0·29707	−0·401	+1·184	+0·559
0610·5	302·843	2·470	·72822	·58946	·39457	·54830	·27200	0·741	1·030	0·511
0620·5	318·657	3·011	·72822	·58947	·54597	·42550	·22622	1·025	0·799	0·425
0630·5	334·491	3·324	·72785	·59347	·65579	·27029	·16322	1·234	0·508	0·307
0640·5	350·356	−3·385	0·72712	2·60120	+0·71560	−0·09448	−0·08777	−1·350	+0·178	+0·166
0650·5	6·257	3·188	·72611	·61213	·72067	+ ·08855	− ·00561	1·365	−0·168	+0·011
0660·5	22·197	2·746	·72488	·62545	·67039	·26477	+ ·07698	1·277	0·504	−0·147
0670·5	38·180	2·091	·72353	·64019	·56837	·42054	·15361	1·088	0·805	0·294
0680·5	54·209	−1·271	0·72216	2·65524	+0·42223	+0·54366	+0·21832	−0·813	−1·047	−0·420
0690·5	70·287	−0·348	·72088	·66941	·24316	·62433	·26599	0·471	1·209	0·515
0700·5	86·414	+0·604	·71979	·68155	+ ·04502	·65601	·29278	−0·088	1·276	0·569
0710·5	102·590	1·511	·71897	·69067	− ·15666	·63598	·29649	+0·306	1·241	0·579
0720·5	118·808	+2·300	0·71850	2·69598	−0·34595	+0·56566	+0·27675	+0·676	−1·106	−0·541
0730·5	135·054	2·906	·71841	·69701	·50782	·45052	·23509	0·993	0·881	0·460
0740·5	151·310	3·281	·71870	·69370	·62943	·29966	·17479	1·230	0·585	0·341
0750·5	167·551	3·393	·71936	·68632	·70122	+ ·12508	·10065	1·366	−0·244	0·196
0760·5	183·755	+3·236	0·72033	2·67551	−0·71764	−0·05939	+0·01856	+1·393	+0·115	−0·036