

In correcting for longitude to give the UT, it is sufficiently accurate to add or subtract 24^{h} , changing the Greenwich date by one day, to find the following or preceding phenomenon.

Examples. The UT of beginning of morning twilight and sunrise for longitudes $E.135^{\circ}39'$, and of sunset and end of evening twilight for longitude $W.115^{\circ}13'$, are required in latitude $N.33^{\circ}20'$ on 2004 January 1.

	Twilight	Sunrise		Sunset	Twilight
	h m	h m		h m	h m
Page A6, nearest date Jan. 2					
Latitude $N.33^{\circ}20'$ (interpolate)	06 37	07 04		17 04	17 31
Longitude (page A166)	$E.135^{\circ}39'$	$-9\ 03$		$W.115^{\circ}13'$	$+7\ 41$
UT	<u>21 34</u>	<u>22 01</u>		<u>00 45</u>	<u>01 12</u>

Civil twilight begins and ends when the Sun is 6° below the horizon; this is an arbitrary condition, and other depressions of the Sun consistent with the degrees of illumination required should be used for planning purposes. Different levels of illumination can be defined to correspond to other depressions and, in particular, nautical twilight begins and ends when the Sun is 12° below the horizon. The degree of illumination at the beginning and end of nautical twilight (in good conditions and in the absence of other illumination) is such that general outlines of ground objects are visible, although the horizon is probably indistinct, all detailed operations have become impossible and all the navigational stars can be seen.

The graphs on pages A146–A150 enable the times to be found for any twilight which corresponds to a depression of the Sun of less than 12° .

12. *Moonrise and Moonset.* Since the interval between successive moonrises or moonsets varies (and is generally greater than 24^{h}), times of rise or set must be interpolated from their tabular values on the meridian of Greenwich to the meridian of the observer. Interpolation from UT to LMT may be accomplished by using the half-daily differences tabulated in the column headed "Diff." and table, "Interpolation of Moonrise, Moonset for Longitude", printed on the flap (F4). The table is entered with Diff. and longitude, and the reduction to LMT, selected without interpolation, is applied to the tabular UT with the same sign as the Diff. for west longitudes and with the opposite sign for east longitudes. This interpolation cannot be made in extreme conditions, when a symbol (*) is given in the Diff. column.

It may happen that an interpolated time so found is for the day before or after that required, in which case the time on the date required can be determined by adding, or subtracting, twice the Diff. and advancing, or decreasing, the date by a day. Each month there will be one day (near last quarter) on which there is no moonrise, and another (near first quarter) on which there is no moonset; when this happens for the Greenwich meridian, the time of the next phenomenon is listed twice, the first time with a value greater than 24^{h} to indicate that the phenomenon occurs on the following day. This is done to provide a starting point for the calculation of the times of the phenomena in other longitudes.

Examples. The UT of moonrise and moonset are required for (i) latitude $N.55^{\circ}00'$, longitude $E.173^{\circ}37'$ and (ii) latitude $S.25^{\circ}10'$, longitude $W.53^{\circ}55'$, on 2004 January 23.

	(i) Moonrise	(i) Moonset		(ii) Moonrise	(ii) Moonset
	d h m m	d h m m		d h m m	d h m m
2004 Jan. 23 (daily pages, A7)					
Latitude $N.55^{\circ}00'$	Jan. 23 09 36 09	Jan. 23 18 16 45	$S.25^{\circ}10'$	Jan. 23 06 58 33	Jan. 23 20 35 20
Table (flap F4)	<u>- 10</u>	<u>- 45</u>		<u>+ 12</u>	<u>+ 7</u>
LMT	Jan. 23 09 26	Jan. 23 17 31		Jan. 23 07 10	Jan. 23 20 42
Long. (p. A166)	$E.173^{\circ}37'$	$- 11\ 34$	$W.53^{\circ}55'$	$+ 3\ 36$	$+ 3\ 36$
UT	Jan. 22 21 52	Jan. 23 05 57		Jan. 23 10 46	Jan. 24 00 18
Twice Diff.	<u>+ 18</u>				<u>- 40</u>
UT + or - 1 day	Jan. 23 22 10				Jan. 22 23 38

The example (ii) Moonset shows that no moonset occurs in this position on January 23.

UT	SUN		ARIES	VENUS-3.9		JUPITER-2.2		SATURN0.8		MOON		Lat.	Moon-rise	Diff.
	GHA	Dec.	GHA	GHA	Dec.	GHA	Dec.	GHA	Dec.	GHA	Dec.			
00 00	179 48.8	N23 21.6	264 54.4	197 28	N21 02	234 15	N11 15	74 18	S 1 48	343 54	S21 31	N		
10	182 18.8	21.7	267 24.8	199 58		236 45		76 48		346 19	30	h	m	m
20	184 48.8	21.7	269 55.2	202 28		239 15		79 19		348 43	29	72		*
30	187 18.7	• 21.7	272 25.6	204 57	• •	241 46	• •	81 49	• •	351 08	• 28	70	■	*
40	189 48.7	21.7	274 56.0	207 27		244 16		84 19		353 32	• 27	68	{00 20	* -11
50	192 18.7	21.7	277 26.4	209 57		246 46		86 50		355 56	26	66	23 17	00
01 00	194 48.7	N23 21.7	279 56.8	212 27	N21 03	249 17	N11 15	89 20	S 1 48	358 21	S21 25	64	22 54	+05
10	197 18.7	21.7	282 27.3	214 57		251 47		91 51		0 45	24	62	22 36	+08
20	199 48.6	21.7	284 57.7	217 27		254 17		94 21		3 10	23	60	22 20	+10
30	202 18.6	• 21.8	287 28.1	219 57	• •	256 48	• •	96 51	• •	5 34	• 22	58	22 07	+12
40	204 48.6	21.8	289 58.5	222 27		259 18		99 22		7 59	21	56	21 56	+13
50	207 18.6	21.8	292 28.9	224 56		261 48		101 52		10 23	20	54	21 46	+15
02 00	209 48.5	N23 21.8	294 59.3	227 26	N21 03	264 19	N11 15	104 23	S 1 48	12 47	S21 19	52	21 37	+16
10	212 18.5	21.8	297 29.7	229 56		266 49		106 53		15 12	18	50	21 29	+16
20	214 48.5	21.8	300 00.1	232 26		269 19		109 23		17 36	17	45	21 12	+18
30	217 18.5	• 21.8	302 30.5	234 56	• •	271 50	• •	111 54	• •	20 01	• 16	40	20 58	+20
40	219 48.5	21.9	305 01.0	237 26		274 20		114 24		22 25	15	35	20 47	+21
50	222 18.4	21.9	307 31.4	239 56		276 50		116 55		24 50	14	30	20 36	+22
03 00	224 48.4	N23 21.9	310 01.8	242 26	N21 04	279 21	N11 15	119 25	S 1 48	27 14	S21 13	20	20 18	+23
10	227 18.4	21.9	312 32.2	244 55		281 51		121 56		29 39	12	10	20 03	+25
20	229 48.4	21.9	315 02.6	247 25		284 21		124 26		32 03	11	0	19 48	+26
30	232 18.3	• 21.9	317 33.0	249 55	• •	286 52	• •	126 56	• •	34 28	• 10	10	19 33	+27
40	234 48.3	21.9	320 03.4	252 25		289 22		129 27		36 52	09	20	19 17	+29
50	237 18.3	21.9	322 33.8	254 55		291 52		131 57		39 17	08	30	18 59	+31
04 00	239 48.3	N23 22.0	325 04.2	257 25	N21 04	294 23	N11 15	134 28	S 1 48	41 41	S21 07	35	18 49	+32
10	242 18.3	22.0	327 34.7	259 55		296 53		136 58		44 06	06	40	18 37	+33
20	244 48.2	22.0	330 05.1	262 25		299 23		139 28		46 30	05	45	18 22	+34
30	247 18.2	• 22.0	332 35.5	264 54	• •	301 54	• •	141 59	• •	48 54	• 04	50	18 05	+36
40	249 48.2	22.0	335 05.9	267 24		304 24		144 29		51 19	03	52	17 56	+37
50	252 18.2	22.0	337 36.3	269 54		306 54		147 00		53 43	02	54	17 47	+38
05 00	254 48.1	N23 22.0	340 06.7	272 24	N21 05	309 25	N11 16	149 30	S 1 48	56 08	S21 01	56	17 37	+39
10	257 18.1	22.0	342 37.1	274 54		311 55		152 00		58 32	21 00	58	17 24	+40
20	259 48.1	22.0	345 07.5	277 24		314 25		154 31		60 57	20 59	60	17 10	+42
30	262 18.1	• 22.1	347 37.9	279 54	• •	316 56	• •	157 01	• •	63 21	• 58	S		
40	264 48.1	22.1	350 08.3	282 24		319 26		159 32		65 46	57			
50	267 18.0	22.1	352 38.8	284 53		321 57		162 02		68 10	56			
06 00	269 48.0	N23 22.1	355 09.2	287 23	N21 05	324 27	N11 16	164 32	S 1 48	70 35	S20 55	Moon's P. in A.		
10	272 18.0	22.1	357 39.6	289 53		326 57		167 03		72 59	54	A	C	A
20	274 48.0	22.1	0 10.0	292 23		329 28		169 33		75 24	53	I	O	I
30	277 17.9	• 22.1	2 40.4	294 53	• •	331 58	• •	172 04	• •	77 48	• 52	t	+	t
40	279 47.9	22.2	5 10.8	297 23		334 28		174 34		80 13	51	0	58	55
50	282 17.9	22.2	7 41.2	299 53		336 59		177 05		82 38	50	10	57	56
07 00	284 47.9	N23 22.2	10 11.6	302 23	N21 06	339 29	N11 16	179 35	S 1 48	85 02	S20 49	15	57	57
10	287 17.9	22.2	12 42.0	304 52		341 59		182 05		87 27	48	18	56	58
20	289 47.8	22.2	15 12.5	307 22		344 30		184 36		89 51	47	21	55	59
30	292 17.8	• 22.2	17 42.9	309 52	• •	347 00	• •	187 06	• •	92 16	• 46	23	54	60
40	294 47.8	22.2	20 13.3	312 22		349 30		189 37		94 40	45	25	53	61
50	297 17.8	22.3	22 43.7	314 52		352 01		192 07		97 05	43	26	52	62
08 00	299 47.7	N23 22.3	25 14.1	317 22	N21 07	354 31	N11 16	194 37	S 1 48	99 29	S20 42	28	51	63
10	302 17.7	22.3	27 44.5	319 52		357 01		197 08		101 54	41	30	50	64
20	304 47.7	22.3	30 14.9	322 22		359 32		199 38		104 18	40	32	49	65
30	307 17.7	• 22.3	32 45.3	324 51	• •	2 02	• •	202 09	• •	106 43	• 39	33	48	66
40	309 47.7	22.3	35 15.7	327 21		4 32		204 39		109 07	38	35	48	67
50	312 17.6	22.3	37 46.2	329 51		7 03		207 09		111 32	37	37	47	68
09 00	314 47.6	N23 22.3	40 16.6	332 21	N21 07	9 33	N11 16	209 40	S 1 48	113 56	S20 36	38	46	69
10	317 17.6	22.4	42 47.0	334 51		12 03		212 10		116 21	35	40	45	70
20	319 47.6	22.4	45 17.4	337 21		14 34		214 41		118 46	34	41	44	71
30	322 17.5	• 22.4	47 47.8	339 51	• •	17 04	• •	217 11	• •	121 10	• 33	43	43	72
40	324 47.5	22.4	50 18.2	342 21		19 34		219 41		123 35	31	44	42	73
50	327 17.5	22.4	52 48.6	344 50		22 05		222 12		125 59	30	46	41	74
10 00	329 47.5	N23 22.4	55 19.0	347 20	N21 08	24 35	N11 16	224 42	S 1 48	128 24	S20 29	47	40	75
10	332 17.4	22.4	57 49.4	349 50		27 05		227 13		130 48	28	48	39	76
20	334 47.4	22.4	60 19.8	352 20		29 36		229 43		133 13	27	50	38	77
30	337 17.4	• 22.5	62 50.3	354 50	• •	32 06	• •	232 14	• •	135 38	• 26	51	37	78
40	339 47.4	22.5	65 20.7	357 20		34 36		234 44		138 02	25	52	36	79
50	342 17.4	22.5	67 51.1	359 50		37 07		237 14		140 27	24	53	35	80
11 00	344 47.3	N23 22.5	70 21.5	2 20	N21 08	39 37	N11 16	239 45	S 1 48	142 51	S20 22	55	34	
10	347 17.3	22.5	72 51.9	4 49		42 07		242 15		145 16	21	56	33	
20	349 47.3	22.5	75 22.3	7 19		44 38		244 46		147 40	20	55	33	
30	352 17.3	• 22.5	77 52.7	9 49	• •	47 08	• •	247 16	• •	150 05	• 19			
40	354 47.2	22.5	80 23.1	12 19		49 38		249 46		152 30	18	Sun SD 15'7		
50	357 17.2	22.5	82 53.5	14 49		52 09		252 17		154 54	17	Moon SD 16'		
Rate	14 59.9	N0 00.1		14 59.3	N0 00.6	15 02.0	N0 00.2	15 02.5	0 00.0	14 27.0	N0 06.3*	Moon ill. 98% -		

UT	SUN		ARIES	VENUS-3.9		JUPITER-2.2		SATURN0.8		MOON		Lat.	Moon-set	Diff.
	GHA	Dec.	GHA	GHA	Dec.	GHA	Dec.	GHA	Dec.	GHA	Dec.			
12 00	359 47.2	N23 22.6	85 24.0	17 19	N21 09	54 39	N11 17	254 47	S 1 48	157 19	S20 16	N		
10	2 17.2	22.6	87 54.4	19 49		57 09		257 18		159 43	14	°	h	m
20	4 47.2	22.6	90 24.8	22 19		59 40		259 48		162 08	13	72	■	*
30	7 17.1	22.6	92 55.2	24 48	• •	62 10	• •	262 18	• •	164 33	12	70	■	*
40	9 47.1	22.6	95 25.6	27 18		64 40		264 49		166 57	11	68	02 02	*
50	12 17.1	22.6	97 56.0	29 48		67 11		267 19		169 22	10	66	03 06	+55
13 00	14 47.1	N23 22.6	100 26.4	32 18	N21 09	69 41	N11 17	269 50	S 1 48	171 46	S20 09	64	03 40	+47
10	17 17.0	22.6	102 56.8	34 48		72 11		272 20		174 11	07	62	04 05	+43
20	19 47.0	22.7	105 27.2	37 18		74 42		274 50		176 36	06	60	04 25	+41
30	22 17.0	22.7	107 57.7	39 48	• •	77 12	• •	277 21	• •	179 00	05	58	04 41	+40
40	24 47.0	22.7	110 28.1	42 18		79 42		279 51		181 25	04	56	04 55	+38
50	27 17.0	22.7	112 58.5	44 47		82 13		282 22		183 50	03	54	05 07	+37
14 00	29 46.9	N23 22.7	115 28.9	47 17	N21 10	84 43	N11 17	284 52	S 1 48	186 14	S20 01	52	05 17	+36
10	32 16.9	22.7	117 59.3	49 47		87 13		287 23		188 39	20 00	50	05 27	+36
20	34 46.9	22.7	120 29.7	52 17		89 44		289 53		191 03	19 59	45	05 46	+34
30	37 16.9	22.7	123 00.1	54 47	• •	92 14	• •	292 23	• •	193 28	18	40	06 02	+33
40	39 46.8	22.8	125 30.5	57 17		94 44		294 54		195 53	17	35	06 15	+32
50	42 16.8	22.8	128 00.9	59 47		97 15		297 24		198 17	16	30	06 27	+31
15 00	44 46.8	N23 22.8	130 31.3	62 17	N21 10	99 45	N11 17	299 55	S 1 48	200 42	S19 54	20	06 47	+30
10	47 16.8	22.8	133 01.8	64 46		102 15		302 25		203 07	53	10	07 04	+28
20	49 46.8	22.8	135 32.2	67 16		104 46		304 55		205 31	52	0	07 20	+27
30	52 16.7	22.8	138 02.6	69 46	• •	107 16	• •	307 26	• •	207 56	51	10	07 36	+26
40	54 46.7	22.8	140 33.0	72 16		109 46		309 56		210 21	49	20	07 53	+25
50	57 16.7	22.8	143 03.4	74 46		112 17		312 27		212 45	48	30	08 12	+24
16 00	59 46.7	N23 22.8	145 33.8	77 16	N21 11	114 47	N11 17	314 57	S 1 48	215 10	S19 47	35	08 23	+23
10	62 16.6	22.9	148 04.2	79 46		117 17		317 27		217 35	46	40	08 36	+22
20	64 46.6	22.9	150 34.6	82 16		119 48		319 58		219 59	45	45	08 52	+21
30	67 16.6	22.9	153 05.0	84 45	• •	122 18	• •	322 28	• •	222 24	43	50	09 10	+19
40	69 46.6	22.9	155 35.5	87 15		124 48		324 59		224 49	42	52	09 19	+18
50	72 16.6	22.9	158 05.9	89 45		127 19		327 29		227 13	41	54	09 28	+17
17 00	74 46.5	N23 22.9	160 36.3	92 15	N21 11	129 49	N11 17	329 59	S 1 48	229 38	S19 40	56	09 39	+16
10	77 16.5	22.9	163 06.7	94 45		132 19		332 30		232 03	38	58	09 52	+15
20	79 46.5	22.9	165 37.1	97 15		134 50		335 00		234 27	37	60	10 06	+13
30	82 16.5	22.9	168 07.5	99 45	• •	137 20	• •	337 31	• •	236 52	36	S		
40	84 46.4	23.0	170 37.9	102 15		139 50		340 01		239 17	35			
50	87 16.4	23.0	173 08.3	104 44		142 21		342 31		241 41	33			
18 00	89 46.4	N23 23.0	175 38.7	107 14	N21 12	144 51	N11 18	345 02	S 1 48	244 06	S19 32	Moon's P. in A.		
10	92 16.4	23.0	178 09.1	109 44		147 21		347 32		246 31	31	A	C	A
20	94 46.4	23.0	180 39.6	112 14		149 52		350 03		248 55	30	I	O	C
30	97 16.3	23.0	183 10.0	114 44	• •	152 22	• •	352 33	• •	251 20	28	t	+	+
40	99 46.3	23.0	185 40.4	117 14		154 52		355 04		253 45	27	0	57	55
50	102 16.3	23.0	188 10.8	119 44		157 23		357 34		256 09	26	10	56	56
19 00	104 46.3	N23 23.1	190 41.2	122 14	N21 13	159 53	N11 18	0 04	S 1 48	258 34	S19 25	15	55	57
10	107 16.2	23.1	193 11.6	124 43		162 23		2 35		260 59	23	18	54	59
20	109 46.2	23.1	195 42.0	127 13		164 54		5 05		263 24	22	21	53	60
30	112 16.2	23.1	198 12.4	129 43	• •	167 24	• •	7 36	• •	265 48	21	24	52	61
40	114 46.2	23.1	200 42.8	132 13		169 54		10 06		268 13	19	26	51	62
50	117 16.2	23.1	203 13.3	134 43		172 25		12 36		270 38	18	28	50	63
20 00	119 46.1	N23 23.1	205 43.7	137 13	N21 13	174 55	N11 18	15 07	S 1 48	273 02	S19 17	30	49	64
10	122 16.1	23.1	208 14.1	139 43		177 25		17 37		275 27	16	32	48	65
20	124 46.1	23.1	210 44.5	142 13		179 56		20 08		277 52	14	34	47	66
30	127 16.1	23.2	213 14.9	144 42	• •	182 26	• •	22 38	• •	280 17	13	36	46	67
40	129 46.0	23.2	215 45.3	147 12		184 56		25 08		282 41	12	37	45	68
50	132 16.0	23.2	218 15.7	149 42		187 27		27 39		285 06	10	39	44	69
21 00	134 46.0	N23 23.2	220 46.1	152 12	N21 14	189 57	N11 18	30 09	S 1 48	287 31	S19 09	40	43	70
10	137 16.0	23.2	223 16.5	154 42		192 27		32 40		289 55	08	42	42	71
20	139 45.9	23.2	225 47.0	157 12		194 58		35 10		292 20	06	43	41	72
30	142 15.9	23.2	228 17.4	159 42	• •	197 28	• •	37 40	• •	294 45	05	44	40	73
40	144 45.9	23.2	230 47.8	162 12		199 58		40 11		297 10	04	45	39	74
50	147 15.9	23.2	233 18.2	164 41		202 29		42 41		299 34	02	46	38	75
22 00	149 45.9	N23 23.3	235 48.6	167 11	N21 14	204 59	N11 18	45 12	S 1 48	301 59	S19 01	47	37	76
10	152 15.8	23.3	238 19.0	169 41		207 29		47 42		304 24	19 00	49	36	77
20	154 45.8	23.3	240 49.4	172 11		210 00		50 13		306 49	18 58	50	35	78
30	157 15.8	23.3	243 19.8	174 41	• •	212 30	• •	52 43	• •	309 13	17	51	34	79
40	159 45.8	23.3	245 50.2	177 11		215 00		55 13		311 38	16	53	33	80
50	162 15.7	23.3	248 20.6	179 41		217 31		57 44		314 03	15	54	32	
23 00	164 45.7	N23 23.3	250 51.1	182 11	N21 15	220 01	N11 18	60 14	S 1 48	316 28	S18 53	55	31	
10	167 15.7	23.3	253 21.5	184 40		222 31		62 45		318 52	52	56	30	
20	169 45.7	23.3	255 51.9	187 10		225 02		65 15		321 17	50	57	29	
30	172 15.7	23.3	258 22.3	189 40	• •	227 32	• •	67 45	• •	323 42	49			
40	174 45.6	23.4	260 52.7	192 10		230 02		70 16		326 07	48			
50	177 15.6	23.4	263 23.1	194 40		232 33		72 46		328 32	46			
Rate	14 59.9	N0 00.1		14 59.2	N0 00.5	15 02.0	N0 00.2	15 02.5	0 00.0	14 28.1	N0 07.5			

Sun SD 15'7
 Moon SD 16'
 Moon ill. 96% -

UT	SUN		ARIES	VENUS-3.9		JUPITER-2.2		SATURN0.8		MOON		Lat.	Moon-rise	Diff.	
	GHA	Dec.	GHA	GHA	Dec.	GHA	Dec.	GHA	Dec.	GHA	Dec.				
00 00	179 45.6	N23 23.4	265 53.5	197 10	N21 15	235 03	N11 19	75 17	S 1 48	330 56	S18 45	N			
10	182 15.6	23.4	268 23.9	199 40		237 33		77 47		333 21	44		h	m	
20	184 45.5	23.4	270 54.3	202 10		240 04		80 17		335 46	42	72	*		
30	187 15.5	23.4	273 24.8	204 39		242 34		82 48		338 11	41	70	{	{	
40	189 45.5	23.4	275 55.2	207 09		245 04		85 18		340 35	40	68	23	35	
50	192 15.5	23.4	278 25.6	209 39		247 35		87 49		343 00	38	66	23	16	
01 00	194 45.5	N23 23.4	280 56.0	212 09	N21 16	250 05	N11 19	90 19	S 1 48	345 25	S18 37	64	23	00	
10	197 15.4	23.5	283 26.4	214 39		252 35		92 49		347 50	36	62	22	48	
20	199 45.4	23.5	285 56.8	217 09		255 06		95 20		350 15	34	60	22	37	
30	202 15.4	23.5	288 27.2	219 39		257 36		97 50		352 39	33	58	22	27	
40	204 45.4	23.5	290 57.6	222 09		260 06		100 21		355 04	31	56	22	19	
50	207 15.3	23.5	293 28.0	224 38		262 37		102 51		357 29	30	54	22	11	
02 00	209 45.3	N23 23.5	295 58.5	227 08	N21 16	265 07	N11 19	105 21	S 1 48	359 54	S18 29	52	22	05	
10	212 15.3	23.5	298 28.9	229 38		267 37		107 52		2 19	27	50	21	58	
20	214 45.3	23.5	300 59.3	232 08		270 08		110 22		4 44	26	45	21	45	
30	217 15.3	23.5	303 29.7	234 38		272 38		112 53		7 08	24	40	21	34	
40	219 45.2	23.5	306 00.1	237 08		275 08		115 23		9 33	23	35	21	25	
50	222 15.2	23.6	308 30.5	239 38		277 39		117 54		11 58	22	30	21	17	
03 00	224 45.2	N23 23.6	311 00.9	242 08	N21 17	280 09	N11 19	120 24	S 1 48	14 23	S18 20	20	21	03	
10	227 15.2	23.6	313 31.3	244 37		282 39		122 54		16 48	19	10	20	50	
20	229 45.1	23.6	316 01.7	247 07		285 10		125 25		19 12	17	0	20	39	
30	232 15.1	23.6	318 32.1	249 37		287 40		127 55		21 37	16	10	20	27	
40	234 45.1	23.6	321 02.6	252 07		290 10		130 26		24 02	15	10	20	27	
50	237 15.1	23.6	323 33.0	254 37		292 41		132 56		26 27	13	20	20	14	
04 00	239 45.1	N23 23.6	326 03.4	257 07	N21 17	295 11	N11 19	135 26	S 1 48	28 52	S18 12	30	20	00	
10	242 15.0	23.6	328 33.8	259 37		297 41		137 57		31 17	10	35	19	51	
20	244 45.0	23.7	331 04.2	262 07		300 12		140 27		33 42	09	40	19	42	
30	247 15.0	23.7	333 34.6	264 36		302 42		142 58		36 06	08	45	19	31	
40	249 45.0	23.7	336 05.0	267 06		305 12		145 28		38 31	06	50	19	17	
50	252 14.9	23.7	338 35.4	269 36		307 43		147 58		40 56	05	52	19	10	
05 00	254 44.9	N23 23.7	341 05.8	272 06	N21 18	310 13	N11 19	150 29	S 1 48	43 21	S18 03	54	19	03	
10	257 14.9	23.7	343 36.3	274 36		312 43		152 59		45 46	02	56	18	55	
20	259 44.9	23.7	346 06.7	277 06		315 14		155 30		48 11	18 00	58	18	46	
30	262 14.8	23.7	348 37.1	279 36		317 44		158 00		50 35	17 59	60	18	36	
40	264 44.8	23.7	351 07.5	282 05		320 14		160 30		53 00	58	S			
50	267 14.8	23.7	353 37.9	284 35		322 45		163 01		55 25	56				
06 00	269 44.8	N23 23.8	356 08.3	287 05	N21 18	325 15	N11 19	165 31	S 1 48	57 50	S17 55	Moon's P. in A.			
10	272 14.8	23.8	358 38.7	289 35		327 46		168 02		60 15	53	A	C	A	
20	274 44.7	23.8	1 09.1	292 05		330 16		170 32		62 40	52	I	O	C	
30	277 14.7	23.8	3 39.5	294 35		332 46		173 03		65 05	50	t	O	R	
40	279 44.7	23.8	6 10.0	297 05		335 17		175 33		67 30	49	0	57	55	
50	282 14.7	23.8	8 40.4	299 35		337 47		178 03		69 54	47	10	56	56	
07 00	284 44.6	N23 23.8	11 10.8	302 04	N21 19	340 17	N11 20	180 34	S 1 48	72 19	S17 46	15	57	57	
10	287 14.6	23.8	13 41.2	304 34		342 48		183 04		74 44	45	18	55	59	
20	289 44.6	23.8	16 11.6	307 04		345 18		185 35		77 09	43	21	54	60	
30	292 14.6	23.8	18 42.0	309 34		347 48		188 05		79 34	42	24	53	61	
40	294 44.6	23.9	21 12.4	312 04		350 19		190 35		81 59	40	26	52	62	
50	297 14.5	23.9	23 42.8	314 34		352 49		193 06		84 24	39	28	51	63	
08 00	299 44.5	N23 23.9	26 13.2	317 04	N21 19	355 19	N11 20	195 36	S 1 48	86 49	S17 37	30	50	64	
10	302 14.5	23.9	28 43.6	319 34		357 50		198 07		89 14	36	32	49	65	
20	304 44.5	23.9	31 14.1	322 03		0 20		200 37		91 39	34	34	48	66	
30	307 14.4	23.9	33 44.5	324 33		2 50		203 07		94 03	33	36	47	67	
40	309 44.4	23.9	36 14.9	327 03		5 21		205 38		96 28	31	37	46	68	
50	312 14.4	23.9	38 45.3	329 33		7 51		208 08		98 53	30	39	45	69	
09 00	314 44.4	N23 23.9	41 15.7	332 03	N21 20	10 21	N11 20	210 39	S 1 48	101 18	S17 28	40	44	70	
10	317 14.4	23.9	43 46.1	334 33		12 52		213 09		103 43	27	42	43	71	
20	319 44.3	23.9	46 16.5	337 03		15 22		215 39		106 08	25	44	42	72	
30	322 14.3	24.0	48 46.9	339 33		17 52		218 10		108 33	24	45	41	73	
40	324 44.3	24.0	51 17.3	342 02		20 23		220 40		110 58	22	47	41	74	
50	327 14.3	24.0	53 47.8	344 32		22 53		223 11		113 23	21	48	40	75	
10 00	329 44.2	N23 24.0	56 18.2	347 02	N21 20	25 23	N11 20	225 41	S 1 48	115 48	S17 19	46	39	76	
10	332 14.2	24.0	58 48.6	349 32		27 54		228 11		118 13	18	47	38	77	
20	334 44.2	24.0	61 19.0	352 02		30 24		230 42		120 38	16	49	37	78	
30	337 14.2	24.0	63 49.4	354 32		32 54		233 12		123 03	15	50	36	79	
40	339 44.2	24.0	66 19.8	357 02		35 25		235 43		125 28	13	51	35	80	
50	342 14.1	24.0	68 50.2	359 32		37 55		238 13		127 52	12	53	34		
11 00	344 44.1	N23 24.0	71 20.6	2 01	N21 21	40 25	N11 20	240 44	S 1 48	130 17	S17 10	54	33		
10	347 14.1	24.1	73 51.0	4 31		42 56		243 14		132 42	09	55	32		
20	349 44.1	24.1	76 21.5	7 01		45 26		245 44		135 07	07	56			
30	352 14.0	24.1	78 51.9	9 31		47 56		248 15		137 32	06				
40	354 44.0	24.1	81 22.3	12 01		50 27		250 45		139 57	04	Sun SD	15:7		
50	357 14.0	24.1	83 52.7	14 31		52 57		253 16		142 22	03	Moon SD	15'		
Rate	14 59.9	N0 00.1		14 59.2	N0 00.5	15 02.0	N0 00.2	15 02.4	0 00.0	14 29.2	N0 08.6				Moon ill. 93% -

UT	SUN		ARIES	VENUS-3.9		JUPITER-2.2		SATURN0.8		MOON		Lat.	Moon-set	Diff.
	GHA	Dec.	GHA	GHA	Dec.	GHA	Dec.	GHA	Dec.	GHA	Dec.			
12 00	359 44.0	N23 24.1	86 23.1	17 01	N21 22	55 27	N11 20	255 46	S 1 48	144 47	S17 01	N		
10	2 14.0	24.1	88 53.5	19 31		57 58		258 16		147 12	17 00	o	h	m
20	4 43.9	24.1	91 23.9	22 00		60 28		260 47		149 37	16 58	72	■	*
30	7 13.9	• 24.1	93 54.3	24 30	• •	62 58	• •	263 17	• •	152 02	• 57	70	03 40	*
40	9 43.9	24.1	96 24.7	27 00		65 29		265 48		154 27	55	68	04 26	+65
50	12 13.9	24.1	98 55.1	29 30		67 59		268 18		156 52	54	66	04 56	+54
13 00	14 43.8	N23 24.2	101 25.6	32 00	N21 22	70 29	N11 21	270 48	S 1 48	159 17	S16 52	64	05 18	+49
10	17 13.8	24.2	103 56.0	34 30		73 00		273 19		161 42	51	62	05 36	+45
20	19 43.8	24.2	106 26.4	37 00		75 30		275 49		164 07	49	60	05 51	+43
30	22 13.8	• 24.2	108 56.8	39 30	• •	78 00	• •	278 20	• •	166 32	• 48	58	06 03	+41
40	24 43.7	24.2	111 27.2	41 59		80 31		280 50		168 57	46	56	06 14	+39
50	27 13.7	24.2	113 57.6	44 29		83 01		283 20		171 22	44	54	06 23	+38
14 00	29 43.7	N23 24.2	116 28.0	46 59	N21 23	85 31	N11 21	285 51	S 1 48	173 47	S16 43	52	06 31	+37
10	32 13.7	24.2	118 58.4	49 29		88 02		288 21		176 12	41	50	06 39	+36
20	34 43.7	24.2	121 28.8	51 59		90 32		290 52		178 37	40	45	06 55	+34
30	37 13.6	• 24.2	123 59.3	54 29	• •	93 02	• •	293 22	• •	181 02	• 38	40	07 08	+32
40	39 43.6	24.2	126 29.7	56 59		95 33		295 53		183 27	37	35	07 19	+31
50	42 13.6	24.3	129 00.1	59 29		98 03		298 23		185 52	35	30	07 29	+30
15 00	44 43.6	N23 24.3	131 30.5	61 58	N21 23	100 33	N11 21	300 53	S 1 48	188 17	S16 34	20	07 45	+28
10	47 13.5	24.3	134 00.9	64 28		103 04		303 24		190 42	32	10	07 59	+27
20	49 43.5	24.3	136 31.3	66 58		105 34		305 54		193 07	30	0	08 13	+25
30	52 13.5	• 24.3	139 01.7	69 28	• •	108 04	• •	308 25	• •	195 32	• 29	10	08 26	+24
40	54 43.5	24.3	141 32.1	71 58		110 35		310 55		197 57	27	20	08 40	+22
50	57 13.5	24.3	144 02.5	74 28		113 05		313 25		200 22	26	30	08 56	+21
16 00	59 43.4	N23 24.3	146 33.0	76 58	N21 24	115 35	N11 21	315 56	S 1 48	202 47	S16 24	35	09 05	+20
10	62 13.4	24.3	149 03.4	79 27		118 06		318 26		205 12	23	35	09 16	+18
20	64 43.4	24.3	151 33.8	81 57		120 36		320 57		207 37	21	40	09 28	+16
30	67 13.4	• 24.3	154 04.2	84 27	• •	123 06	• •	323 27	• •	210 02	• 20	50	09 43	+15
40	69 43.3	24.4	156 34.6	86 57		125 37		325 57		212 27	18	50	09 58	+14
50	72 13.3	24.4	159 05.0	89 27		128 07		328 28		214 52	16	52	09 58	+13
17 00	74 43.3	N23 24.4	161 35.4	91 57	N21 24	130 37	N11 21	330 58	S 1 48	217 17	S16 15	54	10 06	+12
10	77 13.3	24.4	164 05.8	94 27		133 08		333 29		219 42	13	58	10 16	+10
20	79 43.3	24.4	166 36.2	96 57		135 38		335 59		222 07	12	60	10 27	+09
30	82 13.2	• 24.4	169 06.6	99 26	• •	138 08	• •	338 29	• •	224 32	• 10	S		
40	84 43.2	24.4	171 37.1	101 56		140 39		341 00		226 57	08			
50	87 13.2	24.4	174 07.5	104 26		143 09		343 30		229 22	07			
18 00	89 43.2	N23 24.4	176 37.9	106 56	N21 25	145 39	N11 21	346 01	S 1 48	231 47	S16 05	Moon's P. in A.		
10	92 13.1	24.4	179 08.3	109 26		148 10		348 31		234 13	04	A	C	
20	94 43.1	24.4	181 38.7	111 56		150 40		351 01		236 38	02	A	C	
30	97 13.1	• 24.4	184 09.1	114 26	• •	153 10	• •	353 32	• •	239 03	16 00	A	C	
40	99 43.1	24.5	186 39.5	116 56		155 41		356 02		241 28	15 59	0	55	32
50	102 13.1	24.5	189 09.9	119 25		158 11		358 33		243 53	57	10	56	31
19 00	104 43.0	N23 24.5	191 40.3	121 55	N21 25	160 41	N11 21	1 03	S 1 48	246 18	S15 56	15	55	30
10	107 13.0	24.5	194 10.8	124 25		163 12		3 34		248 43	54	18	54	29
20	109 43.0	24.5	196 41.2	126 55		165 42		6 04		251 08	52	21	53	28
30	112 13.0	• 24.5	199 11.6	129 25	• •	168 12	• •	8 34	• •	253 33	• 51	24	52	27
40	114 42.9	24.5	201 42.0	131 55		170 43		11 05		255 58	49	26	51	26
50	117 12.9	24.5	204 12.4	134 25		173 13		13 35		258 23	48	28	50	25
20 00	119 42.9	N23 24.5	206 42.8	136 55	N21 26	175 43	N11 22	16 06	S 1 48	260 48	S15 46	30	49	24
10	122 12.9	24.5	209 13.2	139 24		178 14		18 36		263 13	44	32	48	23
20	124 42.8	24.5	211 43.6	141 54		180 44		21 06		265 38	43	34	47	22
30	127 12.8	• 24.5	214 14.0	144 24	• •	183 14	• •	23 37	• •	268 04	• 41	36	46	21
40	129 42.8	24.6	216 44.5	146 54		185 45		26 07		270 29	39	37	45	20
50	132 12.8	24.6	219 14.9	149 24		188 15		28 38		272 54	38	40	44	19
21 00	134 42.8	N23 24.6	221 45.3	151 54	N21 26	190 45	N11 22	31 08	S 1 48	275 19	S15 36	42	42	18
10	137 12.7	24.6	224 15.7	154 24		193 16		33 38		277 44	35	43	41	17
20	139 42.7	24.6	226 46.1	156 54		195 46		36 09		280 09	33	43	40	16
30	142 12.7	• 24.6	229 16.5	159 23	• •	198 16	• •	38 39	• •	282 34	• 31	44	37	15
40	144 42.7	24.6	231 46.9	161 53		200 47		41 10		284 59	30	45	36	14
50	147 12.6	24.6	234 17.3	164 23		203 17		43 40		287 24	28	46	35	13
22 00	149 42.6	N23 24.6	236 47.7	166 53	N21 27	205 47	N11 22	46 10	S 1 48	289 49	S15 26	47	34	12
10	152 12.6	24.6	239 18.1	169 23		208 18		48 41		292 15	25	48	33	11
20	154 42.6	24.6	241 48.6	171 53		210 48		51 11		294 40	23	49	32	10
30	157 12.6	• 24.6	244 19.0	174 23	• •	213 18	• •	53 42	• •	297 05	• 21	50	31	09
40	159 42.5	24.7	246 49.4	176 53		215 49		56 12		299 30	20	51	30	08
50	162 12.5	24.7	249 19.8	179 22		218 19		58 42		301 55	18	53	29	07
23 00	164 42.5	N23 24.7	251 50.2	181 52	N21 27	220 49	N11 22	61 13	S 1 48	304 20	S15 17	54	28	06
10	167 12.5	24.7	254 20.6	184 22		223 20		63 43		306 45	15	55	27	05
20	169 42.4	24.7	256 51.0	186 52		225 50		66 14		309 10	13	56	26	04
30	172 12.4	• 24.7	259 21.4	189 22	• •	228 20	• •	68 44	• •	311 36	• 12	Sun SD	15'7	
40	174 42.4	24.7	261 51.8	191 52		230 51		71 15		314 01	10	Moon SD	15'	
50	177 12.4	24.7	264 22.3	194 22		233 21		73 45		316 26	08	Moon ill.	90%	-
Rate	14 59.9	NO 00.1		14 59.2	NO 00.5	15 02.0	NO 00.2	15 02.4	0 00.0	14 30.3	NO 09.6			

UT	SUN		ARIES	VENUS-3.9		JUPITER-2.2		SATURN0.8		MOON		Lat.	Moon-rise	Diff.
	GHA	Dec.	GHA	GHA	Dec.	GHA	Dec.	GHA	Dec.	GHA	Dec.			
00 00	179 42.4	N23 24.7	266 52.7	196 51	N21 28	235 51	N11 22	76 15	S 1 49	318 51	S15 07	N		
10	182 12.3	24.7	269 23.1	199 21		238 22		78 46		321 16	05		h m	m
20	184 42.3	24.7	271 53.5	201 51		240 52		81 16		323 41	03	72	{00 31	* -14
30	187 12.3	• 24.7	274 23.9	204 21	• •	243 22	• •	83 47	• •	326 06	• 02	70	23 39	-09
40	189 42.3	24.7	276 54.3	206 51		245 53		86 17		328 32	15 00	68	23 25	-04
50	192 12.2	24.8	279 24.7	209 21		248 23		88 47		330 57	14 58	66	23 13	-01
01 00	194 42.2	N23 24.8	281 55.1	211 51	N21 28	250 53	N11 22	91 18	S 1 49	333 22	S14 57	64	23 04	+01
10	197 12.2	24.8	284 25.5	214 21		253 24		93 48		335 47	55	62	22 55	+03
20	199 42.2	24.8	286 55.9	216 50		255 54		96 19		338 12	53	60	22 48	+05
30	202 12.2	• 24.8	289 26.4	219 20	• •	258 25	• •	98 49	• •	340 37	• 52	58	22 42	+07
40	204 42.1	24.8	291 56.8	221 50		260 55		101 19		343 02	50	56	22 36	+08
50	207 12.1	24.8	294 27.2	224 20		263 25		103 50		345 28	48	54	22 31	+09
02 00	209 42.1	N23 24.8	296 57.6	226 50	N21 29	265 56	N11 22	106 20	S 1 49	347 53	S14 47	52	22 26	+10
10	212 12.1	24.8	299 28.0	229 20		268 26		108 51		350 18	45	50	22 22	+11
20	214 42.0	24.8	301 58.4	231 50		270 56		111 21		352 43	43	45	22 13	+13
30	217 12.0	• 24.8	304 28.8	234 20	• •	273 27	• •	113 51	• •	355 08	• 42	40	22 05	+15
40	219 42.0	24.8	306 59.2	236 49		275 57		116 22		357 33	40	35	21 59	+16
50	222 12.0	24.8	309 29.6	239 19		278 27		118 52		359 59	38	30	21 53	+17
03 00	224 41.9	N23 24.9	312 00.1	241 49	N21 29	280 58	N11 23	121 23	S 1 49	2 24	S14 36	20	21 43	+19
10	227 11.9	24.9	314 30.5	244 19		283 28		123 53		4 49	35	10	21 34	+21
20	229 41.9	24.9	317 00.9	246 49		285 58		126 23		7 14	33	0	21 25	+23
30	232 11.9	• 24.9	319 31.3	249 19	• •	288 29	• •	128 54	• •	9 39	• 31	10	21 17	+24
40	234 41.9	24.9	322 01.7	251 49		290 59		131 24		12 05	30	20	21 08	+26
50	237 11.8	24.9	324 32.1	254 19		293 29		133 55		14 30	28	30	20 58	+28
04 00	239 41.8	N23 24.9	327 02.5	256 48	N21 30	296 00	N11 23	136 25	S 1 49	16 55	S14 26	35	20 52	+30
10	242 11.8	24.9	329 32.9	259 18		298 30		138 56		19 20	25	40	20 45	+31
20	244 41.8	24.9	332 03.3	261 48		301 00		141 26		21 45	23	45	20 37	+33
30	247 11.7	• 24.9	334 33.8	264 18	• •	303 31	• •	143 56	• •	24 11	• 21	50	20 28	+35
40	249 41.7	24.9	337 04.2	266 48		306 01		146 27		26 36	19	52	20 23	+36
50	252 11.7	24.9	339 34.6	269 18		308 31		148 57		29 01	18	54	20 18	+37
05 00	254 41.7	N23 24.9	342 05.0	271 48	N21 30	311 02	N11 23	151 28	S 1 49	31 26	S14 16	56	20 13	+38
10	257 11.7	24.9	344 35.4	274 18		313 32		153 58		33 51	14	58	20 07	+40
20	259 41.6	25.0	347 05.8	276 47		316 02		156 28		36 17	13	60	20 00	+41
30	262 11.6	• 25.0	349 36.2	279 17	• •	318 33	• •	158 59	• •	38 42	• 11	S		
40	264 41.6	25.0	352 06.6	281 47		321 03		161 29		41 07	09			
50	267 11.6	25.0	354 37.0	284 17		323 33		164 00		43 32	07			
06 00	269 41.5	N23 25.0	357 07.4	286 47	N21 31	326 04	N11 23	166 30	S 1 49	45 57	S14 06	Moon's P. in A.		
10	272 11.5	25.0	359 37.9	289 17		328 34		169 00		48 23	04	A	C	A
20	274 41.5	25.0	2 08.3	291 47		331 04		171 31		50 48	02	I	O	I
30	277 11.5	• 25.0	4 38.7	294 16	• •	333 35	• •	174 01	• •	53 13	14 01	t	+	+
40	279 41.5	25.0	7 09.1	296 46		336 05		176 32		55 38	13 59	0	56	56
50	282 11.4	25.0	9 39.5	299 16		338 35		179 02		58 04	57	10	55	57
07 00	284 41.4	N23 25.0	12 09.9	301 46	N21 31	341 06	N11 23	181 32	S 1 49	60 29	S13 55	15	54	58
10	287 11.4	25.0	14 40.3	304 16		343 36		184 03		62 54	54	18	53	59
20	289 41.4	25.0	17 10.7	306 46		346 06		186 33		65 19	52	21	52	60
30	292 11.3	• 25.0	19 41.1	309 16	• •	348 37	• •	189 04	• •	67 45	• 50	24	51	62
40	294 41.3	25.1	22 11.6	311 46		351 07		191 34		70 10	49	26	50	63
50	297 11.3	25.1	24 42.0	314 15		353 37		194 04		72 35	47	28	49	64
08 00	299 41.3	N23 25.1	27 12.4	316 45	N21 32	356 08	N11 23	196 35	S 1 49	75 00	S13 45	30	48	65
10	302 11.2	25.1	29 42.8	319 15		358 38		199 05		77 26	43	32	47	66
20	304 41.2	25.1	32 13.2	321 45		1 08		201 36		79 51	42	34	46	67
30	307 11.2	• 25.1	34 43.6	324 15	• •	3 39	• •	204 06	• •	82 16	• 40	36	45	68
40	309 41.2	25.1	37 14.0	326 45		6 09		206 37		84 41	38	38	44	69
50	312 11.2	25.1	39 44.4	329 15		8 39		209 07		87 07	36	41	43	70
09 00	314 41.1	N23 25.1	42 14.8	331 45	N21 32	11 10	N11 24	211 37	S 1 49	89 32	S13 35	42	41	71
10	317 11.1	25.1	44 45.3	334 14		13 40		214 08		91 57	33	44	40	72
20	319 41.1	25.1	47 15.7	336 44		16 10		216 38		94 22	31	46	39	73
30	322 11.1	• 25.1	49 46.1	339 14	• •	18 41	• •	219 09	• •	96 48	• 29	48	37	74
40	324 41.0	25.1	52 16.5	341 44		21 11		221 39		99 13	28	49	36	75
50	327 11.0	25.1	54 46.9	344 14		23 41		224 09		101 38	26	51	35	76
10 00	329 41.0	N23 25.1	57 17.3	346 44	N21 33	26 12	N11 24	226 40	S 1 49	104 03	S13 24	52	34	77
10	332 11.0	25.2	59 47.7	349 14		28 42		229 10		106 29	22	53	33	78
20	334 41.0	25.2	62 18.1	351 44		31 12		231 41		108 54	21	54	32	79
30	337 10.9	• 25.2	64 48.5	354 13	• •	33 43	• •	234 11	• •	111 19	• 19	55	31	80
40	339 40.9	25.2	67 18.9	356 43		36 13		236 41		113 45	17	56	30	
50	342 10.9	25.2	69 49.4	359 13		38 43		239 12		116 10	15	57	29	
11 00	344 40.9	N23 25.2	72 19.8	1 43	N21 33	41 14	N11 24	241 42	S 1 49	118 35	S13 14	58	28	
10	347 10.8	25.2	74 50.2	4 13		43 44		244 13		121 00	12	59	27	
20	349 40.8	25.2	77 20.6	6 43		46 14		246 43		123 26	10	60	26	
30	352 10.8	• 25.2	79 51.0	9 13	• •	48 45	• •	249 13	• •	125 51	• 08	61	25	
40	354 40.8	25.2	82 21.4	11 43		51 15		251 44		128 16	06	Sun SD	15'7	
50	357 10.8	25.2	84 51.8	14 12		53 45		254 14		130 42	05	Moon SD	15'	
Rate	14 59.9	0 00.0		14 59.2	N0 00.5	15 02.0	N0 00.2	15 02.4	0 00.0	14 31.3	N0 10.3			Moon ill. 87% -