ASTRONOMICAL PHENOMENA

FOR THE YEAR

2020

Prepared Jointly by
The Nautical Almanac Office
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and

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FOR THE YEAR 2020

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PREDICTED PERIHELION PASSAGES OF COMETS, 2020

Periodic comet	Perihelion date T	Perihelion distance q(au)	Period P(yr)
101P/Chernykh	Jan. 13	2·35	13·9
114P/Wiseman-Skiff	Jan. 14	1·58	6·6
321P/SOHO	Jan. 17	0·05	3·7
210P/Christensen	Apr. 8	0·53	5·6
87P/Bus	May 9	2·10	6·3
84P/Giclas	June 3	1·72	6·6
2P/Encke	June 25	0·34	3·3
249P/LINEAR	June 29	0·50	4·5
85P/Boethin	July 29	1·13	11·3
115P/Maury	July 29	2·06	8·8
257P/Catalina	Sept. 10	2·14	7·3
88P/Howell	Sept. 26	1·35	5·4
184P/Lovas	Oct. 26	1·70	7·3
91P/Russell	Nov. 9	2·60	7·6
156P/Russell-LINEAR	Nov. 17	1·33	6·4
162P/Siding Spring	Dec. 7	1·29	5·4
141P/Machholz	Dec. 16	0·81	5·3
P/2009 Q4 (Boattini)	Dec. 26	1·31	5·5

The astronomical data in this booklet are expressed in the scale of universal time (UT); this is also known as Greenwich mean time (GMT) and is the standard time of the Greenwich meridian (0° of longitude). A time in UT may be converted to local mean time by the addition of east longitude (or subtraction of west longitude), where the longitude of the place is expressed in time-measure at the rate of 1 hour for every 15°. The differences between standard times and UT are indicated in the chart on page 22; local clock times may, however, differ from these standard times, especially in summer when clocks are often advanced by 1 hour.

PRINCIPAL PHENOMENA OF SUN AND MOON, 2020

THE SUN

		d	h				d	h	m			d	h	m
Perigee	... Jan.	5	08	Equinoxes	... Mar.	20	03	50	...	... Sept.	22	13	31
Apogee	... July	4	12	Solstices	... June	20	21	44	...	... Dec.	21	10	02

PHASES OF THE MOON

Lunation	New Moon				First Quarter				Full Moon				Last Quarter			
		d	h	m		d	h	m		d	h	m		d	h	m
1200					Jan.	3	04	45	Jan.	10	19	21	Jan.	17	12	58
1201	Jan.	24	21	42	Feb.	2	01	42	Feb.	9	07	33	Feb.	15	22	17
1202	Feb.	23	15	32	Mar.	2	19	57	Mar.	9	17	48	Mar.	16	09	34
1203	Mar.	24	09	28	Apr.	1	10	21	Apr.	8	02	35	Apr.	14	22	56
1204	Apr.	23	02	26	Apr.	30	20	38	May	7	10	45	May	14	14	03
1205	May	22	17	39	May	30	03	30	June	5	19	12	June	13	06	24
1206	June	21	06	41	June	28	08	16	July	5	04	44	July	12	23	29
1207	July	20	17	33	July	27	12	33	Aug.	3	15	59	Aug.	11	16	45
1208	Aug.	19	02	42	Aug.	25	17	58	Sept.	2	05	22	Sept.	10	09	26
1209	Sept.	17	11	00	Sept.	24	01	55	Oct.	1	21	05	Oct.	10	00	40
1210	Oct.	16	19	31	Oct.	23	13	23	Oct.	31	14	49	Nov.	8	13	46
1211	Nov.	15	05	07	Nov.	22	04	45	Nov.	30	09	30	Dec.	8	00	37
1212	Dec.	14	16	17	Dec.	21	23	41	Dec.	30	03	28				

ECLIPSES

A penumbral eclipse of the Moon	Jan. 10	N.W. North America, W. Pacific Ocean, most of Australasia, Asia, Europe, Africa, E. South America, N.E. North America
A penumbral eclipse of the Moon	June 5	Western Pacific Ocean, Australasia, Asia (except N. and E. Russia), Antarctica, Europe (except northernmost parts), Africa, E. and S. South America
An annular eclipse of the Sun	June 21	Africa (except W. and S. parts), S.E. Europe, Middle East, Asia (except N and E Russia), Indonesia, Micronesia
A penumbral eclipse of the Moon	July 5	Africa (except N.E. parts), most of S. and W. Europe, Antarctica, The Americas (except N. parts), most of Polynesia, New Zealand
A penumbral eclipse of the Moon	Nov. 30	N.W. Europe, The Americas, Oceania, Australasia, most of Asia
A total eclipse of the Sun	Dec. 14	Southern Pacific Ocean, Galapogos Islands, South America (except N. parts), parts of Antarctica, parts of S.W. Africa

For further details see pages 64–83

MOON AT PERIGEE

	d	h		d	h		d	h
Jan.	13	20	June	3	04	Oct.	17	00
Feb.	10	20	June	30	02	Nov.	14	12
Mar.	10	06	July	25	05	Dec.	12	21
Apr.	7	18	Aug.	21	11			
May	6	03	Sept.	18	14			

MOON AT APOGEE

	d	h		d	h		d	h
Jan.	2	02	May	18	08	Oct.	3	17
Jan.	29	21	June	15	01	Oct.	30	19
Feb.	26	12	July	12	19	Nov.	27	00
Mar.	24	15	Aug.	9	14	Dec.	24	17
Apr.	20	19	Sept.	6	06			

OCCULTATIONS OF PLANETS AND BRIGHT STARS BY THE MOON

Date	d	h	Body	Areas of Visibility
Jan.	23	03	Jupiter	Madagascar, Kerguelen Islands, southern and eastern Australia, New Zealand, south and eastern Melanesia, south western Polynesia
Feb.	2	09	Vesta	Southern Asia, eastern Afghanistan, northern Philippines, China, Japan, eastern Russia, Alaska, western Canada
Feb.	13	10	Juno	North America (except north eastern Canada), Central America, Caribbean, northern South America
Feb.	18	13	Mars	North America (except north western Canada and Alaska), most of Central America, Caribbean, northernmost South America, Southernmost tip of Greenland, Azores
Feb.	19	20	Jupiter	Antarctica, southernmost South America
Feb.	20	08	Pluto	South easternmost South America, Antarctica, Kerguelen Islands, south westernmost tip of Australia
Mar.	1	06	Vesta	Western and northern Australia, eastern Indonesia, north western Melanesia, Micronesia, Hawaii
Mar.	18	08	Mars	Southernmost South America, South Georgia, Antarctica, Kerguelen Islands
Mar.	18	15	Pluto	Most of Antarctica
Mar.	29	07	Vesta	Southern Indian Ocean, Indonesia, parts of South East Asia, Philippines, Micronesia, northern Polynesia (except Hawaii)
Apr.	14	22	Pluto	Part of the Antarctic Peninsula
Apr.	26	11	Vesta	Central and north eastern Africa, most of Middle East, southern Kazakhstan, N. and central India, China, most of South East Asia, Philippines, southern Japan
May	24	15	Vesta	Most of North America (except western coast, Alaska and north western Canada), northern Caribbean, Greenland, most of Europe (except southernmost parts), western Russia, northern Middle East
June	19	09	Venus	Azores, Canary Islands, north and eastern Canada, Greenland, north western half of Europe, northern and central Russia, northern Mongolia
Aug.	2	06	Pluto	Most of East Antarctica
Aug.	9	08	Mars	Most of West Antarctica, south eastern South America, Ascension Island
Aug.	29	11	Pluto	Queen Maud Land, most of West Antarctica
Sept.	6	05	Mars	Central and north eastern South America, Cape Verde Is., northern Africa, southernmost Europe
Oct.	3	03	Mars	South and south easternmost South America, most of West Antarctica, Ascension Island, south western Africa
Dec.	7	22	Vesta	Most of eastern and northern Europe, Russia (except north eastern parts), China (except south western parts), Japan, northern Philippines, Micronesia
Dec.	12	21	Venus	Easternmost Russia, Hawaii, western North America

Maps showing the areas of visibility may be found on AsA-Online.

GEOCENTRIC PHENOMENA

MERCURY

	d h	d h	d h	d h
Superior conjunction ...	Jan. 10 15	May 4 22	Aug. 17 15	Dec. 20 03
Greatest elongation East	Feb. 10 14 (18°)	June 4 13 (24°)	Oct. 1 16 (26°)	—
Stationary	Feb. 16 10	June 17 20	Oct. 14 04	—
Inferior conjunction ...	Feb. 26 02	July 1 03	Oct. 25 18	—
Stationary	Mar. 9 08	July 12 07	Nov. 3 08	—
Greatest elongation West	Mar. 24 02 (28°)	July 22 15 (20°)	Nov. 10 17 (19°)	—

VENUS

	d h		d h
Greatest elongation East	Mar. 24 22 (46°)	Stationary	June 24 18
Greatest illuminated extent	Apr. 28 01	Greatest illuminated extent	July 10 08
Stationary	May 13 10	Greatest elongation West	Aug. 13 00 (46°)
Inferior conjunction ...	June 3 18		

EARTH

	d h		d h m		d h m
Perihelion ...	Jan. 5 08	Equinoxes ...	Mar. 20 03 50	... ...	Sept. 22 13 31
Aphelion ...	July 4 12	Solstices ...	June 20 21 44	... ...	Dec. 21 10 02

SUPERIOR PLANETS

	Conjunction	Stationary	Opposition	Stationary
	d h	d h	d h	d h
Mars	—	Sept. 9 18	Oct. 13 23	Nov. 15 19
Jupiter	—	May 14 18	July 14 08	Sept. 13 00
Saturn	Jan. 13 15	May 11 09	July 20 22	Sept. 29 03
Uranus	Apr. 26 09	Aug. 15 17	Oct. 31 16 |	Jan. 11 07
Neptune	Mar. 8 12	June 23 18	Sept. 11 20	Nov. 29 09

The vertical bars indicate where the dates for the planet are not in chronological order.

HELIOCENTRIC PHENOMENA

	Perihelion	Aphelion	Ascending Node	Greatest Lat. North	Descending Node	Greatest Lat. South
Mercury	Feb. 12	Mar. 27	Feb. 7	Feb. 22	Mar. 16	Jan. 19
	May 10	June 23	May 5	May 20	June 12	Apr. 16
	Aug. 6	Sept. 19	Aug. 1	Aug. 16	Sept. 8	July 13
	Nov. 2	Dec. 16	Oct. 28	Nov. 12	Dec. 5	Oct. 9
Venus	Mar. 20	July 10	Feb. 15	Apr. 10	June 5	Aug. 1
	Oct. 30	—	Sept. 26	Nov. 21	—	—
Mars	Aug. 3	—	Dec. 2	—	Feb. 1 |	July 8

Jupiter: Descending Node, Feb. 26
Saturn: Descending Node, Feb. 13
Uranus, Neptune: None in 2020

VISIBILITY OF PLANETS

MERCURY can only be seen low in the east before sunrise, or low in the west after sunset (about the time of beginning or end of civil twilight). It is visible in the mornings between the following approximate dates: March 4 to April 27, July 10 to August 9 and November 1 to December 3. The planet is brighter at the end of each period, (the best conditions in northern latitudes occur in mid-November and in southern latitudes from mid-March to early April). It is visible in the evenings between the following approximate dates: January 24 to February 19, May 12 to June 22 and August 27 to October 20. The planet is brighter at the beginning of each period, (the best conditions in northern latitudes occur in the first half of February and from late May to early June and in southern latitudes from mid-September to mid-October).

VENUS is a brilliant object in the evening sky from the beginning of the year until late May when it becomes too close to the Sun for observation. In the second week of June it reappears in the morning sky where it stays until the end of the year. Venus is in conjunction with Mercury on May 22.

MARS rises well before sunrise in Libra at the beginning of the year, when it can only be seen in the morning sky. Its westward elongation gradually increases as it moves through Scorpius, Ophiuchus (passing 5° N of Antares on January 17), Sagittarius, Capricornus, Aquarius, and into Pisces in late June, when it can be seen for more than half the night. In early July it moves into Cetus and late that month returns to Pisces, in which constellation it remains for the rest of the year. Mars is at opposition on October 13, when it can be seen throughout the night. Mars is in conjunction with Jupiter on March 20 and with Saturn on March 31.

JUPITER can be seen in the second week of January just before sunrise in Sagittarius. Its westward elongation gradually increases and from late April it can be seen for more than half the night. It is at opposition on July 14 when it is visible throughout the night. Its eastward elongation then decreases and from mid-October it can only be seen in the evening sky passing into Capricornus in late December. Jupiter is in conjunction with Mars on March 20 and with Saturn on December 21.

SATURN can be seen at the end of January just before sunrise in Sagittarius. Its westward elongation gradually increases, passing into Capricornus during the second half of March, and from the end of April can be seen for more than half the night. It returns to Sagittarius in early July and is at opposition on July 20 when it is visible throughout the night. Its eastward elongation then decreases and from late October it can only be seen in the evening sky, passing again into Capricornus in mid-December. Saturn is in conjunction with Mars on March 31 and with Jupiter on December 21.

URANUS is visible at the beginning of the year in Aries, in which constellation it remains throughout the year. From mid-January until early April it can only be seen in the evening sky. It then becomes too close to the Sun for observation reappearing in mid-May in the morning sky. It is at opposition on October 31 when it is visible throughout the night, after which its eastward elongation gradually decreases.

NEPTUNE is visible at the beginning of the year in the evening sky in Aquarius and remains in this constellation throughout the year. In mid-February it becomes too close to the Sun for observation and reappears in late March in the morning sky. Neptune is at opposition on September 11 and from mid-December can only be seen in the evening sky.

DO NOT CONFUSE (1) Jupiter with Mars in the second half of March, with Saturn in late April to early June and early November to the end of December; on all occasions Jupiter is the brighter object. (2) Mars with Saturn from late March to early April when Saturn is the brighter object. (3) Mercury with Venus in the fourth week of May when Venus is the brighter object.

VISIBILITY OF PLANETS IN MORNING AND EVENING TWILIGHT

	Morning		Evening	
Venus			January 1	– May 28
	June 11	– December 31		
Mars	January 1	– October 13	October 13	– December 31
Jupiter	January 10	– July 14	July 14	– December 31
Saturn	January 31	– July 20	July 20	– December 31

VISIBILITY OF PLANETS

The planet diagram on page 9 shows, in graphical form for any date during the year, the local mean times of meridian passage of the Sun, of the five planets, Mercury, Venus, Mars, Jupiter and Saturn, and of every 2^h of right ascension. Intermediate lines, corresponding to particular stars, may be drawn in by the user if desired. The diagram is intended to provide a general picture of the availability of planets and stars for observation during the year.

On each side of the line marking the time of meridian passage of the Sun, a band 45^m wide is shaded to indicate that planets and most stars crossing the meridian within 45^m of the Sun are generally too close to the Sun for observation.

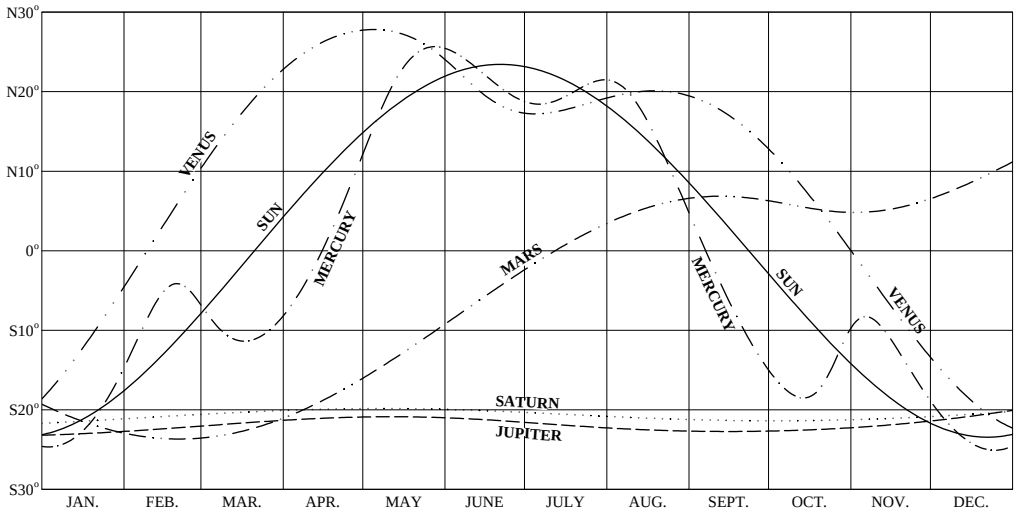
For any date the diagram provides immediately the local mean time of meridian passage of the Sun, planets and stars, and thus the following information:

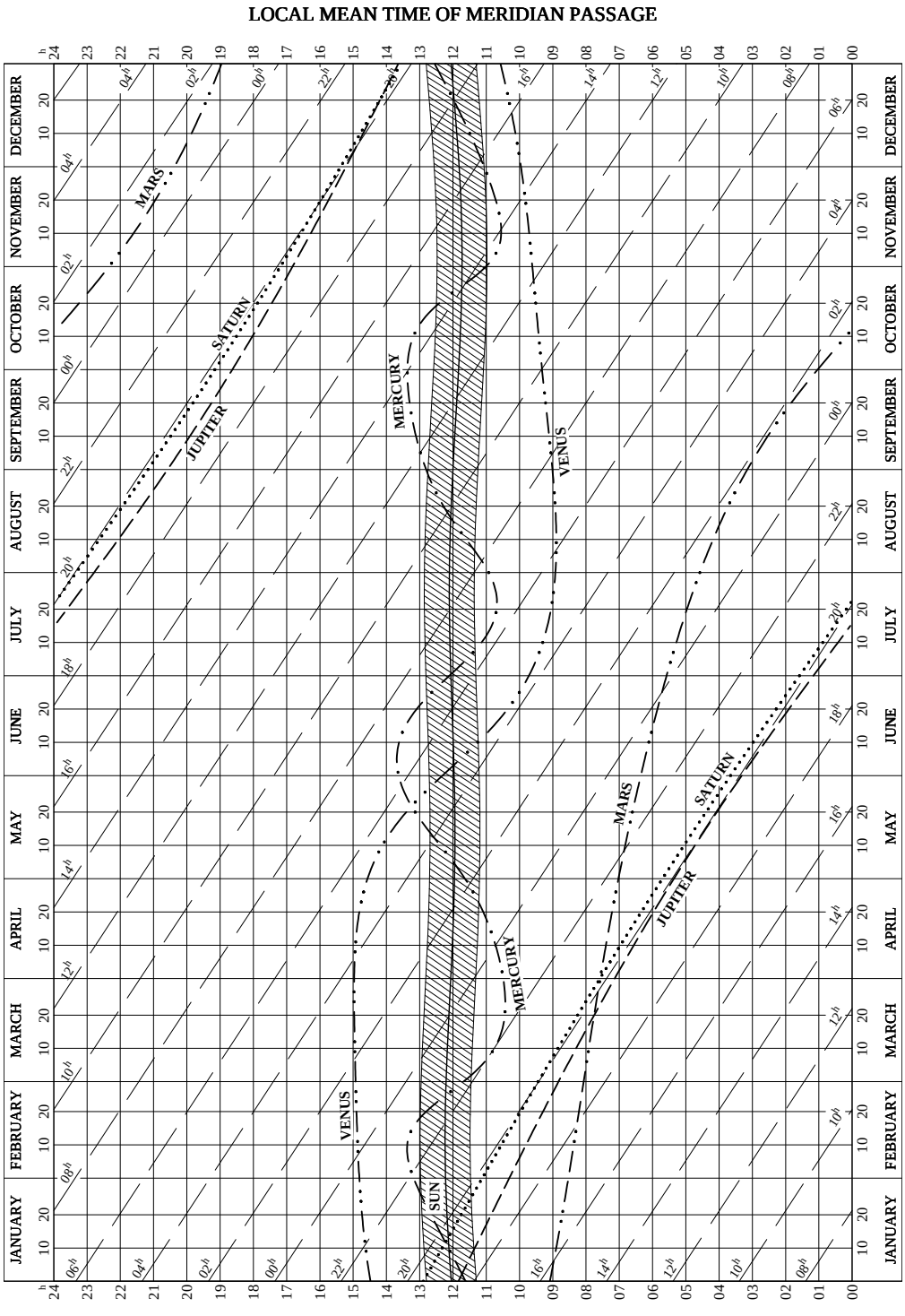
a) whether a planet or star is too close to the Sun for observation;
b) visibility of a planet or star in the morning or evening;
c) location of a planet or star during twilight;
d) proximity of planets to stars or other planets.

When the meridian passage of a body occurs at midnight, it is close to opposition to the Sun and is visible all night, and may be observed in both morning and evening twilights. As the time of meridian passage decreases, the body ceases to be observable in the morning, but its altitude above the eastern horizon during evening twilight gradually increases until it is on the meridian at evening twilight. From then onwards the body is observable above the western horizon, its altitude at evening twilight gradually decreasing, until it becomes too close to the Sun for observation. When it again becomes visible, it is seen in the morning twilight, low in the east. Its altitude at morning twilight gradually increases until meridian passage occurs at the time of morning twilight, then as the time of meridian passage decreases to 0^h, the body is observable in the west in the morning twilight with a gradually decreasing altitude, until it once again reaches opposition.

Notes on the visibility of the planets are given on page 7. Further information on the visibility of planets may be obtained from the diagram below which shows, in graphical form for any date during the year, the declinations of the bodies plotted on the planet diagram on page 9.

DECLINATION OF SUN AND PLANETS, 2020




LOCAL MEAN TIME OF MERIDIAN PASSAGE
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
SUN
MERCURY
VENUS
MARS
JUPITER
SATURN
LOCAL MEAN TIME OF MERIDIAN PASSAGE

ELONGATIONS AND MAGNITUDES OF PLANETS AT 0^h UT

Date	Mercury		Venus	
	Elong.	Mag.	Elong.	Mag.
	°		°	
Jan. −3	W. 8	−0·8	E. 34	−3·9
2	W. 5	−1·0	E. 35	−4·0
7	W. 3	−1·2	E. 36	−4·0
12	E. 2	−1·4	E. 37	−4·0
17	E. 5	−1·3	E. 38	−4·0
22	E. 8	−1·1	E. 39	−4·0
27	E. 11	−1·1	E. 39	−4·1
Feb. 1	E. 14	−1·0	E. 40	−4·1
6	E. 17	−0·9	E. 41	−4·1
11	E. 18	−0·6	E. 42	−4·2
16	E. 16	+0·4	E. 43	−4·2
21	E. 10	+2·6	E. 43	−4·2
26	E. 4	·	E. 44	−4·3
Mar. 2	W. 11	+3·2	E. 45	−4·3
7	W. 18	+1·6	E. 45	−4·3
12	W. 24	+0·7	E. 46	−4·4
17	W. 26	+0·4	E. 46	−4·4
22	W. 28	+0·2	E. 46	−4·5
27	W. 28	+0·1	E. 46	−4·5
Apr. 1	W. 27	0·0	E. 46	−4·5
6	W. 25	−0·1	E. 46	−4·6
11	W. 22	−0·2	E. 45	−4·6
16	W. 19	−0·4	E. 44	−4·7
21	W. 15	−0·7	E. 43	−4·7
26	W. 10	−1·1	E. 41	−4·7
May 1	W. 5	−1·8	E. 38	−4·7
6	E. 1	−2·3	E. 35	−4·7
11	E. 7	−1·6	E. 31	−4·7
16	E. 13	−1·1	E. 26	−4·6
21	E. 18	−0·7	E. 20	−4·4
26	E. 21	−0·3	E. 14	−4·1
31	E. 23	0·0	E. 6	·
June 5	E. 24	+0·5	W. 2	·
10	E. 23	+1·0	W. 10	−4·1
15	E. 20	+1·7	W. 17	−4·2
20	E. 16	+2·7	W. 23	−4·5
25	E. 10	+4·1	W. 29	−4·6
30	E. 5	·	W. 33	−4·7

Date	Mercury		Venus	
	Elong.	Mag.	Elong.	Mag.
	°		°	
June 30	E. 5	·	W. 33	−4·7
July 5	W. 8	+4·6	W. 37	−4·7
10	W. 13	+2·9	W. 39	−4·7
15	W. 18	+1·6	W. 41	−4·7
20	W. 20	+0·6	W. 43	−4·6
25	W. 20	−0·1	W. 44	−4·6
30	W. 18	−0·7	W. 45	−4·6
Aug. 4	W. 14	−1·1	W. 45	−4·5
9	W. 9	−1·4	W. 46	−4·5
14	W. 4	−1·8	W. 46	−4·4
19	E. 2	−1·9	W. 46	−4·4
24	E. 6	−1·3	W. 45	−4·3
29	E. 11	−0·8	W. 45	−4·3
Sept. 3	E. 14	−0·5	W. 45	−4·3
8	E. 18	−0·3	W. 44	−4·2
13	E. 20	−0·2	W. 43	−4·2
18	E. 23	−0·1	W. 43	−4·2
23	E. 24	−0·1	W. 42	−4·1
28	E. 26	0·0	W. 41	−4·1
Oct. 3	E. 26	0·0	W. 40	−4·1
8	E. 25	+0·1	W. 39	−4·1
13	E. 22	+0·5	W. 38	−4·0
18	E. 16	+1·5	W. 37	−4·0
23	E. 6	+4·1	W. 36	−4·0
28	W. 5	+4·5	W. 35	−4·0
Nov. 2	W. 14	+1·1	W. 34	−4·0
7	W. 18	−0·3	W. 33	−4·0
12	W. 19	−0·7	W. 32	−3·9
17	W. 18	−0·7	W. 31	−3·9
22	W. 15	−0·7	W. 30	−3·9
27	W. 13	−0·7	W. 29	−3·9
Dec. 2	W. 10	−0·8	W. 27	−3·9
7	W. 7	−0·9	W. 26	−3·9
12	W. 5	−1·0	W. 25	−3·9
17	W. 2	−1·2	W. 24	−3·9
22	E. 2	−1·3	W. 23	−3·9
27	E. 4	−1·1	W. 22	−3·9
32	E. 7	−1·0	W. 20	−3·9

SELECTED DWARF AND MINOR PLANETS

	Conjunction	Stationary	Opposition	Stationary
Ceres	Jan. 13	July 13	Aug. 28	Oct. 23
Pallas	—	May 11	July 13	Sept. 2
Juno	Nov. 8	Feb. 13	Apr. 2	May 27
Vesta	July 5	—	—	Jan. 1
Pluto	Jan. 13	Apr. 26	July 15	Oct. 4

ELONGATIONS AND MAGNITUDES OF PLANETS AT 0^h UT

Date	Mars		Jupiter		Saturn		Uranus		Neptune	
	Elong.	Mag.	Elong.	Mag.	Elong.	Mag.	Elong.	Mag.	Elong.	Mag.
	°		°		°		°		°	
Jan. **−8**	W. 38	+1·6	E. 4	−1·8	E. 20	+0·6	E. 122	+5·7	E. 75	+7·9
2	W. 42	+1·6	W. 4	−1·8	E. 10	+0·5	E. 112	+5·7	E. 65	+7·9
12	W. 45	+1·5	W. 12	−1·8	E. 1	+0·5	E. 101	+5·8	E. 55	+7·9
22	W. 49	+1·4	W. 20	−1·9	W. 8	+0·5	E. 91	+5·8	E. 45	+7·9
Feb. **1**	W. 52	+1·4	W. 28	−1·9	W. 17	+0·6	E. 81	+5·8	E. 36	+7·9
11	W. 55	+1·3	W. 36	−1·9	W. 26	+0·6	E. 71	+5·8	E. 26	+8·0
21	W. 59	+1·2	W. 44	−1·9	W. 35	+0·6	E. 62	+5·8	E. 16	+8·0
Mar. **2**	W. 62	+1·1	W. 52	−2·0	W. 44	+0·7	E. 52	+5·8	E. 6	+8·0
12	W. 65	+1·0	W. 60	−2·0	W. 53	+0·7	E. 42	+5·9	W. 3	+8·0
22	W. 68	+0·9	W. 69	−2·1	W. 62	+0·7	E. 33	+5·9	W. 13	+8·0
Apr. **1**	W. 71	+0·8	W. 77	−2·1	W. 71	+0·7	E. 23	+5·9	W. 22	+8·0
11	W. 74	+0·7	W. 86	−2·2	W. 80	+0·6	E. 14	+5·9	W. 32	+8·0
21	W. 77	+0·5	W. 95	−2·3	W. 90	+0·6	E. 5	+5·9	W. 41	+7·9
May **1**	W. 79	+0·4	W. 104	−2·3	W. 99	+0·6	W. 4	+5·9	W. 51	+7·9
11	W. 82	+0·3	W. 114	−2·4	W. 109	+0·5	W. 13	+5·9	W. 60	+7·9
21	W. 85	+0·1	W. 123	−2·5	W. 119	+0·5	W. 22	+5·9	W. 70	+7·9
31	W. 88	0·0	W. 133	−2·6	W. 128	+0·4	W. 32	+5·9	W. 79	+7·9
June **10**	W. 91	−0·2	W. 143	−2·6	W. 138	+0·4	W. 41	+5·9	W. 89	+7·9
20	W. 94	−0·3	W. 154	−2·7	W. 148	+0·3	W. 50	+5·8	W. 98	+7·9
30	W. 98	−0·5	W. 165	−2·7	W. 159	+0·2	W. 59	+5·8	W. 108	+7·9
July **10**	W. 101	−0·7	W. 175	−2·7	W. 169	+0·2	W. 68	+5·8	W. 117	+7·9
20	W. 105	−0·8	E. 174	−2·7	W. 179	+0·1	W. 77	+5·8	W. 127	+7·8
30	W. 110	−1·0	E. 163	−2·7	E. 171	+0·1	W. 87	+5·8	W. 137	+7·8
Aug. **9**	W. 115	−1·3	E. 152	−2·7	E. 160	+0·2	W. 96	+5·8	W. 146	+7·8
19	W. 122	−1·5	E. 142	−2·6	E. 150	+0·2	W. 106	+5·7	W. 156	+7·8
29	W. 129	−1·7	E. 132	−2·6	E. 140	+0·3	W. 116	+5·7	W. 166	+7·8
Sept. **8**	W. 138	−2·0	E. 122	−2·5	E. 130	+0·3	W. 125	+5·7	W. 176	+7·8
18	W. 148	−2·2	E. 112	−2·4	E. 120	+0·4	W. 135	+5·7	E. 174	+7·8
28	W. 159	−2·4	E. 102	−2·4	E. 110	+0·5	W. 145	+5·7	E. 164	+7·8
Oct. **8**	W. 171	−2·6	E. 93	−2·3	E. 100	+0·5	W. 156	+5·7	E. 154	+7·8
18	E. 174	−2·5	E. 84	−2·2	E. 91	+0·5	W. 166	+5·7	E. 144	+7·8
28	E. 162	−2·3	E. 75	−2·2	E. 81	+0·6	W. 176	+5·7	E. 133	+7·8
Nov. **7**	E. 151	−1·9	E. 67	−2·1	E. 72	+0·6	E. 173	+5·7	E. 123	+7·9
17	E. 140	−1·6	E. 58	−2·1	E. 62	+0·6	E. 163	+5·7	E. 113	+7·9
27	E. 131	−1·3	E. 50	−2·0	E. 53	+0·6	E. 152	+5·7	E. 103	+7·9
Dec. **7**	E. 123	−0·9	E. 42	−2·0	E. 44	+0·6	E. 142	+5·7	E. 93	+7·9
17	E. 116	−0·6	E. 34	−2·0	E. 34	+0·6	E. 132	+5·7	E. 83	+7·9
27	E. 110	−0·4	E. 26	−2·0	E. 25	+0·6	E. 121	+5·7	E. 73	+7·9
37	E. 104	−0·1	E. 18	−1·9	E. 16	+0·6	E. 111	+5·7	E. 63	+7·9

VISUAL MAGNITUDES OF SELECTED DWARF & MINOR PLANETS

	Jan. 2	Feb. 11	Mar. 22	May 1	June 10	July 20	Aug. 29	Oct. 8	Nov. 17	Dec. 27
Ceres	8·9	9·1	9·3	9·2	8·9	8·2	7·7	8·3	8·9	9·2
Pallas	10·2	10·3	10·3	10·1	9·7	9·6	9·9	10·3	10·5	10·6
Juno	10·6	10·2	9·7	10·1	10·8	11·2	11·5	11·4	11·4	11·5
Vesta	7·4	8·1	8·4	8·5	8·3	8·2	8·4	8·3	8·0	7·4
Pluto	14·7	14·7	14·8	14·8	14·7	14·5	14·7	14·8	14·8	14·7

CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h		
Jan.	1	21	Vesta stationary	
	2	02	Moon at apogee	
	3	05	FIRST QUARTER	
	4	18	Uranus 5° N. of Moon	
	5	08	Earth at perihelion	
	10	15	Mercury in superior conjunction	
	10	19	FULL MOON	Penumbral Eclipse
	11	07	Uranus stationary	
	13	13	Pluto in conjunction with Sun	
	13	15	Saturn in conjunction with Sun	
	13	18	Ceres in conjunction with Sun	
	13	20	Moon at perigee	
	17	04	Mars 5° N. of *Antares*	
	17	13	LAST QUARTER	
	20	19	Mars 2° S. of Moon	
	23	03	Jupiter 0°.4 N. of Moon	Occn.
	24	22	NEW MOON	
	27	19	Venus 0°.08 S. of Neptune	
	28	06	Neptune 4° N. of Moon	
	28	07	Venus 4° N. of Moon	
	29	21	Moon at apogee	
Feb.	1	03	Uranus 5° N. of Moon	
	2	02	FIRST QUARTER	
	2	09	Vesta 0°.5 S. of Moon	Occn.
	9	08	FULL MOON	
	10	14	Mercury greatest elong. E. (18°)	
	10	20	Moon at perigee	
	13	07	Juno stationary	
	13	10	Juno 0°.6 S. of Moon	Occn.
	15	22	LAST QUARTER	
	16	10	Mercury stationary	
	18	13	Mars 0°.8 S. of Moon	Occn.
	19	20	Jupiter 0°.9 N. of Moon	Occn.
	20	08	Pluto 0°.7 N. of Moon	Occn.
	20	14	Saturn 1°.7 N. of Moon	
	23	16	NEW MOON	
	26	02	Mercury in inferior conjunction	
	26	12	Moon at apogee	
	27	12	Venus 6° N. of Moon	
	28	12	Uranus 4° N. of Moon	
Mar.	1	06	Vesta 0°.1 N. of Moon	Occn.
	2	20	FIRST QUARTER	
	8	12	Neptune in conjunction with Sun	
	9	08	Mercury stationary	
	9	15	Venus 2° N. of Uranus	
	9	18	FULL MOON	
	10	06	Moon at perigee	
Mar.	16	10	LAST QUARTER	
	18	08	Mars 0°.7 N. of Moon	Occn.
	18	10	Jupiter 1°.5 N. of Moon	
	18	15	Pluto 0°.9 N. of Moon	Occn.
	19	00	Saturn 2° N. of Moon	
	20	04	Equinox	
	20	06	Mars 0°.7 S. of Jupiter	
	21	18	Mercury 4° N. of Moon	
	24	02	Mercury greatest elong. W. (28°)	
	24	09	NEW MOON	
	24	15	Moon at apogee	
	24	22	Venus greatest elong. E. (46°)	
	26	21	Uranus 4° N. of Moon	
	28	11	Venus 7° N. of Moon	
	29	07	Vesta 0°.2 N. of Moon	Occn.
	31	11	Mars 0°.9 S. of Saturn	
Apr.	1	10	FIRST QUARTER	
	2	20	Juno at opposition	
	3	15	Mercury 1°.4 S. of Neptune	
	7	18	Moon at perigee	
	8	03	FULL MOON	
	14	22	Pluto 1°.2 N. of Moon	Occn.
	14	23	Jupiter 2° N. of Moon	
	14	23	LAST QUARTER	
	15	09	Saturn 2° N. of Moon	
	16	05	Mars 2° N. of Moon	
	17	20	Venus 10° N. of *Aldebaran*	
	19	07	Neptune 4° N. of Moon	
	20	19	Moon at apogee	
	23	02	NEW MOON	
	26	09	Uranus in conjunction with Sun	
	26	11	Vesta 0°.1 S. of Moon	Occn.
	26	13	Pluto stationary	
	26	15	Venus 6° N. of Moon	
	28	01	Venus greatest illuminated extent	
	30	21	FIRST QUARTER	
May	4	22	Mercury in superior conjunction	
	6	03	Moon at perigee	
	7	11	FULL MOON	
	11	09	Saturn stationary	
	11	11	Pallas stationary	
	12	10	Jupiter 2° N. of Moon	
	12	18	Saturn 3° N. of Moon	
	13	10	Venus stationary	
	14	14	LAST QUARTER	
	14	18	Jupiter stationary	
	15	02	Mars 3° N. of Moon	
	16	15	Neptune 4° N. of Moon	
	17	09	Mercury 7° N. of *Aldebaran*	
	18	08	Moon at apogee	
	20	16	Uranus 4° N. of Moon	

CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h		
May	22	08	Mercury 0°.9 S. of Venus	
	22	18	NEW MOON	
	24	03	Venus 4° N. of Moon	
	24	11	Mercury 3° N. of Moon	
	24	15	Vesta 0°.6 S. of Moon	Occn.
	27	14	Juno stationary	
	30	03	FIRST QUARTER	
June	3	04	Moon at perigee	
	3	18	Venus in inferior conjunction	
	4	13	Mercury greatest elong. E. (24°)	
	5	19	FULL MOON	Penumbral Eclipse
	8	17	Jupiter 2° N. of Moon	
	9	02	Saturn 3° N. of Moon	
	12	12	Mars 1°.7 S. of Neptune	
	12	23	Neptune 4° N. of Moon	
	13	00	Mars 3° N. of Moon	
	13	06	LAST QUARTER	
	15	01	Moon at apogee	
	17	02	Uranus 4° N. of Moon	
	17	20	Mercury stationary	
	19	09	Venus 0°.7 S. of Moon	Occn.
	20	22	Solstice	
	21	07	NEW MOON	Eclipse
	23	18	Neptune stationary	
	24	18	Venus stationary	
	28	08	FIRST QUARTER	
	30	02	Moon at perigee	
July	1	03	Mercury in inferior conjunction	
	4	12	Earth at aphelion	
	5	05	FULL MOON	Penumbral Eclipse
	5	06	Vesta in conjunction with Sun	
	5	22	Jupiter 1°.9 N. of Moon	
	6	09	Saturn 2° N. of Moon	
	10	07	Neptune 4° N. of Moon	
	10	08	Venus greatest illuminated extent	
	11	20	Mars 2° N. of Moon	
	12	07	Mercury stationary	
	12	07	Venus 1°.0 N. of *Aldebaran*	
	12	19	Moon at apogee	
	12	23	LAST QUARTER	
	13	02	Ceres stationary	
	13	02	Pallas at opposition	
	14	08	Jupiter at opposition	
	14	12	Uranus 4° N. of Moon	
	15	19	Pluto at opposition	
	17	07	Venus 3° S. of Moon	
	19	04	Mercury 4° S. of Moon	
	20	18	NEW MOON	
	20	22	Saturn at opposition	
	22	15	Mercury greatest elong. W. (20°)	

	d	h		
July	25	05	Moon at perigee	
	27	13	FIRST QUARTER	
Aug.	2	00	Jupiter 1°.5 N. of Moon	
	2	06	Mercury 7° S. of *Pollux*	
	2	06	Pluto 1°.1 N. of Moon	Occn.
	2	13	Saturn 2° N. of Moon	
	3	16	FULL MOON	
	6	15	Neptune 4° N. of Moon	
	9	08	Mars 0°.8 N. of Moon	Occn.
	9	14	Moon at apogee	
	10	21	Uranus 4° N. of Moon	
	11	17	LAST QUARTER	
	13	00	Venus greatest elong. W. (46°)	
	15	13	Venus 4° S. of Moon	
	15	17	Uranus stationary	
	17	15	Mercury in superior conjunction	
	19	03	NEW MOON	
	21	11	Moon at perigee	
	25	18	FIRST QUARTER	
	28	12	Ceres at opposition	
	29	02	Jupiter 1°.4 N. of Moon	
	29	11	Pluto 1°.2 N. of Moon	Occn.
	29	17	Saturn 2° N. of Moon	
Sept.	1	17	Venus 9° S. of *Pollux*	
	2	05	FULL MOON	
	2	13	Pallas stationary	
	2	21	Neptune 4° N. of Moon	
	6	05	Mars 0°.03 S. of Moon	Occn.
	6	06	Moon at apogee	
	7	04	Uranus 3° N. of Moon	
	9	18	Mars stationary	
	10	09	LAST QUARTER	
	11	20	Neptune at opposition	
	13	00	Jupiter stationary	
	14	05	Venus 4° S. of Moon	
	17	11	NEW MOON	
	18	14	Moon at perigee	
	18	22	Mercury 6° S. of Moon	
	22	09	Mercury 0°.3 N. of *Spica*	
	22	14	Equinox	
	24	02	FIRST QUARTER	
	25	07	Jupiter 1°.6 N. of Moon	
	25	21	Saturn 2° N. of Moon	
	29	03	Saturn stationary	
	30	02	Neptune 4° N. of Moon	
Oct.	1	16	Mercury greatest elong. E. (26°)	
	1	21	FULL MOON	
	3	00	Venus 0°.09 S. of *Regulus*	

CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h		
Oct.	3	03	Mars 0°.7 N. of Moon	Occn.
	3	17	Moon at apogee	
	4	06	Pluto stationary	
	4	09	Uranus 3° N. of Moon	
	6	14	Mars closest approach	
	10	01	LAST QUARTER	
	13	23	Mars at opposition	
	14	00	Venus 4° S. of Moon	
	14	04	Mercury stationary	
	16	20	NEW MOON	
	17	00	Moon at perigee	
	17	19	Mercury 7° S. of Moon	
	22	17	Jupiter 2° N. of Moon	
	23	03	Ceres stationary	
	23	04	Saturn 3° N. of Moon	
	23	13	FIRST QUARTER	
	25	18	Mercury in inferior conjunction	
	27	06	Neptune 4° N. of Moon	
	29	16	Mars 3° N. of Moon	
	30	19	Moon at apogee	
	31	13	Uranus 3° N. of Moon	
	31	15	FULL MOON	
	31	16	Uranus at opposition	
Nov.	3	08	Mercury stationary	
	8	09	Juno in conjunction with Sun	
	8	14	LAST QUARTER	
	10	17	Mercury greatest elong. W. (19°)	
	12	21	Venus 3° S. of Moon	
	13	21	Mercury 1°.7 S. of Moon	
	14	12	Moon at perigee	
	15	05	NEW MOON	

	d	h		
Nov.	15	13	Venus 4° N. of *Spica*	
	15	19	Mars stationary	
	19	09	Jupiter 2° N. of Moon	
	19	15	Saturn 3° N. of Moon	
	22	05	FIRST QUARTER	
	23	12	Neptune 5° N. of Moon	
	25	20	Mars 5° N. of Moon	
	27	00	Moon at apogee	
	27	17	Uranus 3° N. of Moon	
	29	09	Neptune stationary	
	30	09	FULL MOON	Penumbral Eclipse
Dec.	7	22	Vesta 0°.5 S. of Moon	Occn.
	8	01	LAST QUARTER	
	12	21	Moon at perigee	
	12	21	Venus 0°.8 S. of Moon	Occn.
	14	16	NEW MOON	Eclipse
	17	04	Jupiter 3° N. of Moon	
	17	05	Saturn 3° N. of Moon	
	20	03	Mercury in superior conjunction	
	20	20	Neptune 5° N. of Moon	
	21	10	Solstice	
	21	14	Jupiter 0°.1 S. of Saturn	
	22	00	FIRST QUARTER	
	23	01	Venus 6° N. of *Antares*	
	23	19	Mars 6° N. of Moon	
	24	17	Moon at apogee	
	24	23	Uranus 3° N. of Moon	
	30	03	FULL MOON	

CHRONOLOGICAL CYCLES AND ERAS

Dominical Letter	ED	Julian Period (year of)	6733
Epact	5	Roman Indiction	13
Golden Number (Lunar Cycle)	VII	Solar Cycle	13

All dates are given in terms of the Gregorian calendar in which 2020 January 14 corresponds to 2020 January 1 of the Julian calendar.

ERA	YEAR	BEGINS	ERA	YEAR	BEGINS
Byzantine	7529	Sept. 14	Japanese	2680	Jan. 1
Jewish (A.M.)*	5781	Sept. 18	Seleucidæ (Grecian)	2332	Sept. 14 (or Oct. 14)
Chinese (gēng zǐ)		Jan. 25			
Roman (A.U.C.)	2773	Jan. 14	Saka (Indian)	1942	Mar. 21
Nabonassar	2769	Apr. 18	Diocletian (Coptic)	1737	Sept. 11
			Islamic (Hegira)*	1442	Aug. 19

* Year begins at sunset

RELIGIOUS CALENDARS

Epiphany	Jan. 6	Ascension Day	May 21
Ash Wednesday	Feb. 26	Whit Sunday—Pentecost	May 31
Palm Sunday	Apr. 5	Trinity Sunday	June 7
Good Friday	Apr. 10	First Sunday in Advent	Nov. 29
Easter Day	Apr. 12	Christmas Day (Friday)	Dec. 25
First Day of Passover (Pesach)	Apr. 9	Day of Atonement (Yom Kippur)	Sept. 28
Feast of Weeks (Shavuot)	May 29	First day of Tabernacles (Succoth)	Oct. 3
Jewish New Year‡ (Rosh Hashanah)	Sept. 19	Festival of Lights (Hanukkah)	Dec. 11
First day of Ramadân‡	Apr. 24	Islamic New Year‡	Aug. 20
First day of Shawwal‡	May 24		

‡The Jewish and Islamic dates above are tabular dates, which begin at sunset on the previous evening and end at sunset on the date tabulated. In practice, the dates of Islamic fasts and festivals are determined by an actual sighting of the appropriate new Moon.

CIVIL CALENDAR—UNITED STATES OF AMERICA

New Year's Day	Jan. 1	Labor Day	Sept. 7
Martin Luther King's Birthday	Jan. 20	Columbus Day	Oct. 12
Washington's Birthday	Feb. 17	General Election Day	Nov. 3
Memorial Day	May 25	Veterans Day	Nov. 11
Independence Day	July 4	Thanksgiving Day	Nov. 26

CIVIL CALENDAR—UNITED KINGDOM

Accession of Queen Elizabeth II	Feb. 6	Birthday of Prince Philip, Duke of Edinburgh	June 10
St David (Wales)	Mar. 1	The Queen's Official Birthday†	June 13
Commonwealth Day	Mar. 9	Remembrance Sunday	Nov. 8
St Patrick (Ireland)	Mar. 17	Birthday of the Prince of Wales	Nov. 14
Birthday of Queen Elizabeth II	Apr. 21	St Andrew (Scotland)	Nov. 30
St George (England)	Apr. 23		
Coronation Day	June 2		

†Date subject to confirmation

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
Day of Month	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year
1	Wed.	1	Sat.	32	Sun.	61	Wed.	92	Fri.	122	Mon.	153
2	Thu.	2	Sun.	33	Mon.	62	Thu.	93	Sat.	123	Tue.	154
3	Fri.	3	Mon.	34	Tue.	63	Fri.	94	Sun.	124	Wed.	155
4	Sat.	4	Tue.	35	Wed.	64	Sat.	95	Mon.	125	Thu.	156
5	Sun.	5	Wed.	36	Thu.	65	Sun.	96	Tue.	126	Fri.	157
6	Mon.	6	Thu.	37	Fri.	66	Mon.	97	Wed.	127	Sat.	158
7	Tue.	7	Fri.	38	Sat.	67	Tue.	98	Thu.	128	Sun.	159
8	Wed.	8	Sat.	39	Sun.	68	Wed.	99	Fri.	129	Mon.	160
9	Thu.	9	Sun.	40	Mon.	69	Thu.	100	Sat.	130	Tue.	161
10	Fri.	10	Mon.	41	Tue.	70	Fri.	101	Sun.	131	Wed.	162
11	Sat.	11	Tue.	42	Wed.	71	Sat.	102	Mon.	132	Thu.	163
12	Sun.	12	Wed.	43	Thu.	72	Sun.	103	Tue.	133	Fri.	164
13	Mon.	13	Thu.	44	Fri.	73	Mon.	104	Wed.	134	Sat.	165
14	Tue.	14	Fri.	45	Sat.	74	Tue.	105	Thu.	135	Sun.	166
15	Wed.	15	Sat.	46	Sun.	75	Wed.	106	Fri.	136	Mon.	167
16	Thu.	16	Sun.	47	Mon.	76	Thu.	107	Sat.	137	Tue.	168
17	Fri.	17	Mon.	48	Tue.	77	Fri.	108	Sun.	138	Wed.	169
18	Sat.	18	Tue.	49	Wed.	78	Sat.	109	Mon.	139	Thu.	170
19	Sun.	19	Wed.	50	Thu.	79	Sun.	110	Tue.	140	Fri.	171
20	Mon.	20	Thu.	51	Fri.	80	Mon.	111	Wed.	141	Sat.	172
21	Tue.	21	Fri.	52	Sat.	81	Tue.	112	Thu.	142	Sun.	173
22	Wed.	22	Sat.	53	Sun.	82	Wed.	113	Fri.	143	Mon.	174
23	Thu.	23	Sun.	54	Mon.	83	Thu.	114	Sat.	144	Tue.	175
24	Fri.	24	Mon.	55	Tue.	84	Fri.	115	Sun.	145	Wed.	176
25	Sat.	25	Tue.	56	Wed.	85	Sat.	116	Mon.	146	Thu.	177
26	Sun.	26	Wed.	57	Thu.	86	Sun.	117	Tue.	147	Fri.	178
27	Mon.	27	Thu.	58	Fri.	87	Mon.	118	Wed.	148	Sat.	179
28	Tue.	28	Fri.	59	Sat.	88	Tue.	119	Thu.	149	Sun.	180
29	Wed.	29	Sat.	60	Sun.	89	Wed.	120	Fri.	150	Mon.	181
30	Thu.	30			Mon.	90	Thu.	121	Sat.	151	Tue.	182
31	Fri.	31			Tue.	91			Sun.	152		

JULIAN DATE, 2020

0^h UT	JD	0^h UT	JD	0^h UT	JD
Jan. 0	245 8848·5	May 0	245 8969·5	Sept. 0	245 9092·5
Feb. 0	245 8879·5	June 0	245 9000·5	Oct. 0	245 9122·5
Mar. 0	245 8908·5	July 0	245 9030·5	Nov. 0	245 9153·5
Apr. 0	245 8939·5	Aug. 0	245 9061·5	Dec. 0	245 9183·5

400-day date, JD 245 9200·5 = 2020 December 17·0

Standard epoch, 1900 January 0, 12^h UT = JD 241 5020·0
Standard epoch, B1950·0 = 1950 Jan. 0·923 = JD 243 3282·423
B2020·0 = 2020 Jan. 0·877 = JD 245 8849·377

Standard epoch, J2000·0 = 2000 Jan. 1·5 = JD 245 1545·0
J2020·5 = 2020 July 2·125 = JD 245 9032·625

	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
Day of Month	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year
1	Wed.	183	Sat.	214	Tue.	245	Thu.	275	Sun.	306	Tue.	336
2	Thu.	184	Sun.	215	Wed.	246	Fri.	276	Mon.	307	Wed.	337
3	Fri.	185	Mon.	216	Thu.	247	Sat.	277	Tue.	308	Thu.	338
4	Sat.	186	Tue.	217	Fri.	248	Sun.	278	Wed.	309	Fri.	339
5	Sun.	187	Wed.	218	Sat.	249	Mon.	279	Thu.	310	Sat.	340
6	Mon.	188	Thu.	219	Sun.	250	Tue.	280	Fri.	311	Sun.	341
7	Tue.	189	Fri.	220	Mon.	251	Wed.	281	Sat.	312	Mon.	342
8	Wed.	190	Sat.	221	Tue.	252	Thu.	282	Sun.	313	Tue.	343
9	Thu.	191	Sun.	222	Wed.	253	Fri.	283	Mon.	314	Wed.	344
10	Fri.	192	Mon.	223	Thu.	254	Sat.	284	Tue.	315	Thu.	345
11	Sat.	193	Tue.	224	Fri.	255	Sun.	285	Wed.	316	Fri.	346
12	Sun.	194	Wed.	225	Sat.	256	Mon.	286	Thu.	317	Sat.	347
13	Mon.	195	Thu.	226	Sun.	257	Tue.	287	Fri.	318	Sun.	348
14	Tue.	196	Fri.	227	Mon.	258	Wed.	288	Sat.	319	Mon.	349
15	Wed.	197	Sat.	228	Tue.	259	Thu.	289	Sun.	320	Tue.	350
16	Thu.	198	Sun.	229	Wed.	260	Fri.	290	Mon.	321	Wed.	351
17	Fri.	199	Mon.	230	Thu.	261	Sat.	291	Tue.	322	Thu.	352
18	Sat.	200	Tue.	231	Fri.	262	Sun.	292	Wed.	323	Fri.	353
19	Sun.	201	Wed.	232	Sat.	263	Mon.	293	Thu.	324	Sat.	354
20	Mon.	202	Thu.	233	Sun.	264	Tue.	294	Fri.	325	Sun.	355
21	Tue.	203	Fri.	234	Mon.	265	Wed.	295	Sat.	326	Mon.	356
22	Wed.	204	Sat.	235	Tue.	266	Thu.	296	Sun.	327	Tue.	357
23	Thu.	205	Sun.	236	Wed.	267	Fri.	297	Mon.	328	Wed.	358
24	Fri.	206	Mon.	237	Thu.	268	Sat.	298	Tue.	329	Thu.	359
25	Sat.	207	Tue.	238	Fri.	269	Sun.	299	Wed.	330	Fri.	360
26	Sun.	208	Wed.	239	Sat.	270	Mon.	300	Thu.	331	Sat.	361
27	Mon.	209	Thu.	240	Sun.	271	Tue.	301	Fri.	332	Sun.	362
28	Tue.	210	Fri.	241	Mon.	272	Wed.	302	Sat.	333	Mon.	363
29	Wed.	211	Sat.	242	Tue.	273	Thu.	303	Sun.	334	Tue.	364
30	Thu.	212	Sun.	243	Wed.	274	Fri.	304	Mon.	335	Wed.	365
31	Fri.	213	Mon.	244			Sat.	305			Thu.	366

MEAN SIDEREAL TIME, 2020

Greenwich mean sidereal time at 0^h UT

	h		h		h		h
Jan. 0	6·6091	Apr. 0	12·5887	July 0	18·5683	Oct. 0	0·6136
Feb. 0	8·6461	May 0	14·5600	Aug. 0	20·6053	Nov. 0	2·6506
Mar. 0	10·5517	June 0	16·5970	Sept. 0	22·6423	Dec. 0	4·6219

Greenwich mean sidereal time (GMST) on day d of month at hour t UT

$$= \text{GMST at } 0^h \text{ UT on day } 0 + 0^h.065\,71\,d + 1^h.002\,74\,t$$

$$\text{Local mean sidereal time} = \text{GMST} \begin{matrix} + \text{ east} \\ - \text{ west} \end{matrix} \text{ longitude}$$

AT 0^h UNIVERSAL TIME

Date	Equation of time	Declination	Date	Equation of time	Declination	Date	Equation of time	Declination	Date	Equation of time	Declination
	m s	° ′		m s	° ′		m s	° ′		m s	° ′
Jan. 0	−02 36	−23 08	**Feb. 15**	−14 09	−12 56	**Apr. 1**	−03 54	+04 38	**May 17**	+03 36	+19 23
1	03 05	23 04	**16**	14 06	12 35	**2**	03 36	05 01	**18**	03 34	19 36
2	03 34	22 59	**17**	14 03	12 15	**3**	03 18	05 24	**19**	03 31	19 49
3	04 02	22 53	**18**	13 59	11 54	**4**	03 01	05 47	**20**	03 28	20 02
4	04 29	22 48	**19**	13 54	11 33	**5**	02 43	06 10	**21**	03 24	20 14
5	−04 57	−22 41	**20**	−13 49	−11 11	**6**	−02 26	+06 33	**22**	+03 19	+20 26
6	05 24	22 35	**21**	13 43	10 50	**7**	02 09	06 55	**23**	03 14	20 38
7	05 50	22 28	**22**	13 36	10 28	**8**	01 52	07 18	**24**	03 09	20 49
8	06 16	22 20	**23**	13 29	10 06	**9**	01 36	07 40	**25**	03 03	21 00
9	06 41	22 12	**24**	13 21	09 44	**10**	01 20	08 02	**26**	02 57	21 10
10	−07 06	−22 04	**25**	−13 12	−09 22	**11**	−01 04	+08 24	**27**	+02 50	+21 20
11	07 31	21 55	**26**	13 03	09 00	**12**	00 48	08 46	**28**	02 42	21 30
12	07 55	21 46	**27**	12 53	08 37	**13**	00 33	09 08	**29**	02 35	21 39
13	08 18	21 36	**28**	12 43	08 15	**14**	00 18	09 30	**30**	02 26	21 48
14	08 40	21 26	**29**	12 32	07 52	**15**	−00 03	09 51	**31**	02 18	21 57
15	−09 02	−21 15	**Mar. 1**	−12 21	−07 29	**16**	+00 11	+10 13	**June 1**	+02 09	+22 05
16	09 24	21 05	**2**	12 09	07 07	**17**	00 25	10 34	**2**	01 59	22 13
17	09 44	20 53	**3**	11 56	06 44	**18**	00 39	10 55	**3**	01 50	22 20
18	10 04	20 41	**4**	11 43	06 21	**19**	00 52	11 16	**4**	01 40	22 28
19	10 24	20 29	**5**	11 30	05 57	**20**	01 04	11 36	**5**	01 29	22 34
20	−10 42	−20 17	**6**	−11 16	−05 34	**21**	+01 16	+11 57	**6**	+01 18	+22 41
21	11 00	20 04	**7**	11 02	05 11	**22**	01 28	12 17	**7**	01 07	22 46
22	11 17	19 51	**8**	10 47	04 47	**23**	01 40	12 37	**8**	00 56	22 52
23	11 34	19 37	**9**	10 32	04 24	**24**	01 50	12 57	**9**	00 45	22 57
24	11 50	19 23	**10**	10 17	04 00	**25**	02 01	13 16	**10**	00 33	23 02
25	−12 04	−19 09	**11**	−10 01	−03 37	**26**	+02 11	+13 36	**11**	+00 21	+23 06
26	12 19	18 54	**12**	09 45	03 13	**27**	02 20	13 55	**12**	+00 08	23 10
27	12 32	18 39	**13**	09 29	02 50	**28**	02 29	14 14	**13**	−00 04	23 13
28	12 44	18 23	**14**	09 12	02 26	**29**	02 37	14 33	**14**	00 17	23 16
29	12 56	18 08	**15**	08 56	02 02	**30**	02 45	14 51	**15**	00 29	23 19
30	−13 07	−17 52	**16**	−08 39	−01 39	**May 1**	+02 53	+15 09	**16**	−00 42	+23 21
31	13 17	17 35	**17**	08 21	01 15	**2**	03 00	15 27	**17**	00 55	23 23
Feb. 1	13 26	17 19	**18**	08 04	00 51	**3**	03 06	15 45	**18**	01 08	23 24
2	13 34	17 02	**19**	07 47	00 28	**4**	03 12	16 02	**19**	01 22	23 25
3	13 42	16 44	**20**	07 29	−00 04	**5**	03 17	16 19	**20**	01 35	23 26
4	−13 49	−16 27	**21**	−07 11	+00 20	**6**	+03 22	+16 36	**21**	−01 48	+23 26
5	13 54	16 09	**22**	06 53	00 44	**7**	03 26	16 53	**22**	02 01	23 26
6	13 59	15 51	**23**	06 36	01 07	**8**	03 30	17 09	**23**	02 14	23 25
7	14 04	15 32	**24**	06 18	01 31	**9**	03 33	17 25	**24**	02 27	23 24
8	14 07	15 14	**25**	06 00	01 55	**10**	03 35	17 41	**25**	02 40	23 23
9	−14 10	−14 55	**26**	−05 42	+02 18	**11**	+03 37	+17 57	**26**	−02 53	+23 21
10	14 11	14 36	**27**	05 23	02 42	**12**	03 38	18 12	**27**	03 05	23 19
11	14 12	14 16	**28**	05 05	03 05	**13**	03 39	18 27	**28**	03 18	23 16
12	14 13	13 56	**29**	04 47	03 28	**14**	03 39	18 41	**29**	03 30	23 13
13	14 12	13 37	**30**	04 29	03 52	**15**	03 39	18 55	**30**	03 42	23 09
14	−14 11	−13 16	**31**	−04 11	+04 15	**16**	+03 38	+19 09	**July 1**	−03 53	+23 05
15	−14 09	−12 56	**Apr. 1**	−03 54	+04 38	**17**	+03 36	+19 23	**2**	−04 05	+23 01

Equation of time = apparent time − mean time

AT 0^h UNIVERSAL TIME

Date	Equation of time	Declination	Date	Equation of time	Declination	Date	Equation of time	Declination	Date	Equation of time	Declination
	m s	° ′		m s	° ′		m s	° ′		m s	° ′
July 1	−03 53	+23 05	**Aug. 16**	−04 17	+13 39	**Oct. 1**	+10 20	−03 17	**Nov. 16**	+15 15	−18 47
2	04 05	23 01	**17**	04 04	13 20	**2**	10 40	03 40	**17**	15 03	19 02
3	04 16	22 56	**18**	03 51	13 01	**3**	10 59	04 03	**18**	14 51	19 17
4	04 26	22 51	**19**	03 38	12 41	**4**	11 17	04 26	**19**	14 38	19 31
5	04 37	22 45	**20**	03 24	12 22	**5**	11 36	04 50	**20**	14 24	19 44
6	−04 47	+22 40	**21**	−03 09	+12 02	**6**	+11 53	−05 13	**21**	+14 09	−19 58
7	04 56	22 33	**22**	02 54	11 42	**7**	12 11	05 36	**22**	13 53	20 11
8	05 06	22 27	**23**	02 39	11 21	**8**	12 28	05 58	**23**	13 37	20 23
9	05 15	22 19	**24**	02 23	11 01	**9**	12 45	06 21	**24**	13 20	20 36
10	05 23	22 12	**25**	02 06	10 40	**10**	13 01	06 44	**25**	13 02	20 47
11	−05 31	+22 04	**26**	−01 49	+10 19	**11**	+13 16	−07 07	**26**	+12 44	−20 59
12	05 39	21 56	**27**	01 32	09 58	**12**	13 32	07 29	**27**	12 24	21 10
13	05 46	21 47	**28**	01 15	09 37	**13**	13 46	07 52	**28**	12 04	21 21
14	05 53	21 38	**29**	00 57	09 16	**14**	14 00	08 14	**29**	11 44	21 31
15	05 59	21 29	**30**	00 38	08 54	**15**	14 14	08 36	**30**	11 22	21 41
16	−06 05	+21 19	**31**	−00 19	+08 33	**16**	+14 27	−08 58	**Dec. 1**	+11 00	−21 50
17	06 10	21 09	**Sept. 1**	00 00	08 11	**17**	14 39	09 20	**2**	10 37	21 59
18	06 15	20 59	**2**	+00 19	07 49	**18**	14 51	09 42	**3**	10 14	22 08
19	06 19	20 48	**3**	00 38	07 27	**19**	15 02	10 04	**4**	09 50	22 16
20	06 23	20 37	**4**	00 58	07 05	**20**	15 13	10 25	**5**	09 26	22 24
21	−06 26	+20 25	**5**	+01 18	+06 43	**21**	+15 22	−10 47	**6**	+09 01	−22 31
22	06 29	20 13	**6**	01 39	06 21	**22**	15 32	11 08	**7**	08 35	22 38
23	06 31	20 01	**7**	01 59	05 58	**23**	15 40	11 29	**8**	08 09	22 44
24	06 32	19 49	**8**	02 20	05 36	**24**	15 48	11 50	**9**	07 42	22 50
25	06 33	19 36	**9**	02 41	05 13	**25**	15 55	12 11	**10**	07 15	22 56
26	−06 33	+19 23	**10**	+03 02	+04 51	**26**	+16 02	−12 31	**11**	+06 48	−23 01
27	06 33	19 09	**11**	03 23	04 28	**27**	16 08	12 52	**12**	06 20	23 05
28	06 32	18 55	**12**	03 44	04 05	**28**	16 13	13 12	**13**	05 52	23 10
29	06 30	18 41	**13**	04 05	03 42	**29**	16 17	13 32	**14**	05 23	23 13
30	06 28	18 27	**14**	04 26	03 19	**30**	16 21	13 51	**15**	04 54	23 17
31	−06 25	+18 12	**15**	+04 48	+02 56	**31**	+16 24	−14 11	**16**	+04 25	−23 19
Aug. 1	06 21	17 57	**16**	05 09	02 33	**Nov. 1**	16 26	14 30	**17**	03 56	23 22
2	06 17	17 42	**17**	05 30	02 10	**2**	16 27	14 49	**18**	03 26	23 23
3	06 12	17 26	**18**	05 52	01 46	**3**	16 27	15 08	**19**	02 56	23 25
4	06 07	17 10	**19**	06 13	01 23	**4**	16 27	15 27	**20**	02 27	23 26
5	−06 01	+16 54	**20**	+06 34	+01 00	**5**	+16 26	−15 45	**21**	+01 57	−23 26
6	05 54	16 38	**21**	06 55	00 36	**6**	16 23	16 03	**22**	01 27	23 26
7	05 47	16 21	**22**	07 17	+00 13	**7**	16 20	16 21	**23**	00 57	23 26
8	05 39	16 04	**23**	07 38	−00 10	**8**	16 17	16 38	**24**	+00 27	23 25
9	05 31	15 47	**24**	07 59	00 34	**9**	16 12	16 55	**25**	−00 02	23 23
10	−05 22	+15 29	**25**	+08 19	−00 57	**10**	+16 06	−17 12	**26**	−00 32	−23 21
11	05 12	15 11	**26**	08 40	01 20	**11**	16 00	17 29	**27**	01 02	23 19
12	05 02	14 53	**27**	09 01	01 44	**12**	15 53	17 45	**28**	01 31	23 16
13	04 52	14 35	**28**	09 21	02 07	**13**	15 45	18 01	**29**	02 00	23 13
14	04 41	14 17	**29**	09 41	02 30	**14**	15 36	18 17	**30**	02 29	23 09
15	−04 29	+13 58	**30**	+10 01	−02 54	**15**	+15 26	−18 32	**31**	−02 58	−23 05
16	−04 17	+13 39	**Oct. 1**	+10 20	−03 17	**16**	+15 15	−18 47	**32**	−03 26	−23 00

$$\text{UT of transit} = 12^h \begin{matrix} - \text{ east} \\ + \text{ west} \end{matrix} \text{ longitude} - \text{equation of time}$$

AT 0^h UNIVERSAL TIME

Date	*Polaris* GHA	σ Oct GHA	Date	*Polaris* GHA	σ Oct GHA	Date	*Polaris* GHA	σ Oct GHA	Date	*Polaris* GHA	σ Oct GHA
	° ′	° ′		° ′	° ′		° ′	° ′		° ′	° ′
Jan. 0	54 38	138 08	**Feb. 15**	100 19	183 30	**Apr. 1**	145 57	228 42	**May 17**	191 20	273 49
1	55 38	139 07	**16**	101 19	184 29	**2**	146 57	229 41	**18**	192 19	274 48
2	56 38	140 07	**17**	102 19	185 28	**3**	147 56	230 40	**19**	193 18	275 47
3	57 37	141 06	**18**	103 18	186 27	**4**	148 56	231 39	**20**	194 17	276 46
4	58 37	142 05	**19**	104 18	187 26	**5**	149 55	232 38	**21**	195 16	277 45
5	59 36	143 05	**20**	105 17	188 25	**6**	150 54	233 37	**22**	196 15	278 44
6	60 36	144 04	**21**	106 17	189 24	**7**	151 54	234 35	**23**	197 14	279 43
7	61 35	145 03	**22**	107 17	190 23	**8**	152 53	235 34	**24**	198 12	280 41
8	62 35	146 02	**23**	108 16	191 22	**9**	153 52	236 33	**25**	199 11	281 40
9	63 34	147 02	**24**	109 16	192 21	**10**	154 52	237 32	**26**	200 10	282 39
10	64 34	148 01	**25**	110 15	193 20	**11**	155 51	238 31	**27**	201 09	283 38
11	65 33	149 00	**26**	111 15	194 19	**12**	156 50	239 30	**28**	202 08	284 37
12	66 33	149 59	**27**	112 15	195 18	**13**	157 49	240 29	**29**	203 07	285 35
13	67 32	150 58	**28**	113 14	196 17	**14**	158 49	241 28	**30**	204 06	286 34
14	68 32	151 58	**29**	114 14	197 16	**15**	159 48	242 26	**31**	205 05	287 33
15	69 31	152 57	**Mar. 1**	115 14	198 15	**16**	160 47	243 25	**June 1**	206 04	288 32
16	70 31	153 56	**2**	116 13	199 14	**17**	161 46	244 24	**2**	207 03	289 31
17	71 31	154 55	**3**	117 13	200 13	**18**	162 46	245 23	**3**	208 01	290 30
18	72 30	155 54	**4**	118 12	201 12	**19**	163 45	246 22	**4**	209 00	291 29
19	73 30	156 54	**5**	119 12	202 11	**20**	164 44	247 21	**5**	209 59	292 28
20	74 29	157 53	**6**	120 11	203 10	**21**	165 44	248 20	**6**	210 58	293 26
21	75 29	158 52	**7**	121 11	204 09	**22**	166 43	249 18	**7**	211 57	294 25
22	76 28	159 51	**8**	122 10	205 08	**23**	167 42	250 17	**8**	212 55	295 24
23	77 28	160 50	**9**	123 10	206 07	**24**	168 41	251 16	**9**	213 54	296 23
24	78 28	161 49	**10**	124 09	207 06	**25**	169 40	252 15	**10**	214 53	297 22
25	79 27	162 49	**11**	125 09	208 05	**26**	170 39	253 14	**11**	215 52	298 21
26	80 27	163 48	**12**	126 09	209 04	**27**	171 39	254 13	**12**	216 51	299 19
27	81 26	164 47	**13**	127 08	210 03	**28**	172 38	255 12	**13**	217 50	300 18
28	82 26	165 46	**14**	128 08	211 02	**29**	173 37	256 10	**14**	218 48	301 17
29	83 26	166 45	**15**	129 07	212 01	**30**	174 36	257 09	**15**	219 47	302 16
30	84 25	167 44	**16**	130 06	213 00	**May 1**	175 35	258 08	**16**	220 46	303 15
31	85 25	168 43	**17**	131 06	213 59	**2**	176 34	259 07	**17**	221 45	304 14
Feb. 1	86 25	169 43	**18**	132 05	214 58	**3**	177 33	260 06	**18**	222 44	305 13
2	87 24	170 42	**19**	133 05	215 56	**4**	178 32	261 05	**19**	223 42	306 12
3	88 24	171 41	**20**	134 04	216 55	**5**	179 32	262 03	**20**	224 41	307 11
4	89 24	172 40	**21**	135 04	217 54	**6**	180 31	263 02	**21**	225 40	308 09
5	90 23	173 39	**22**	136 03	218 53	**7**	181 30	264 01	**22**	226 38	309 08
6	91 23	174 38	**23**	137 03	219 52	**8**	182 29	265 00	**23**	227 37	310 07
7	92 22	175 37	**24**	138 02	220 51	**9**	183 28	265 59	**24**	228 36	311 06
8	93 22	176 36	**25**	139 02	221 50	**10**	184 27	266 58	**25**	229 35	312 05
9	94 21	177 35	**26**	140 01	222 49	**11**	185 26	267 56	**26**	230 33	313 04
10	95 21	178 34	**27**	141 01	223 48	**12**	186 25	268 55	**27**	231 32	314 03
11	96 21	179 33	**28**	142 00	224 47	**13**	187 24	269 54	**28**	232 31	315 02
12	97 21	180 33	**29**	142 59	225 46	**14**	188 23	270 53	**29**	233 30	316 01
13	98 20	181 32	**30**	143 59	226 45	**15**	189 22	271 52	**30**	234 28	316 59
14	99 20	182 31	**31**	144 58	227 43	**16**	190 21	272 51	**July 1**	235 27	317 58
15	100 19	183 30	**Apr. 1**	145 57	228 42	**17**	191 20	273 49	**2**	236 26	318 57

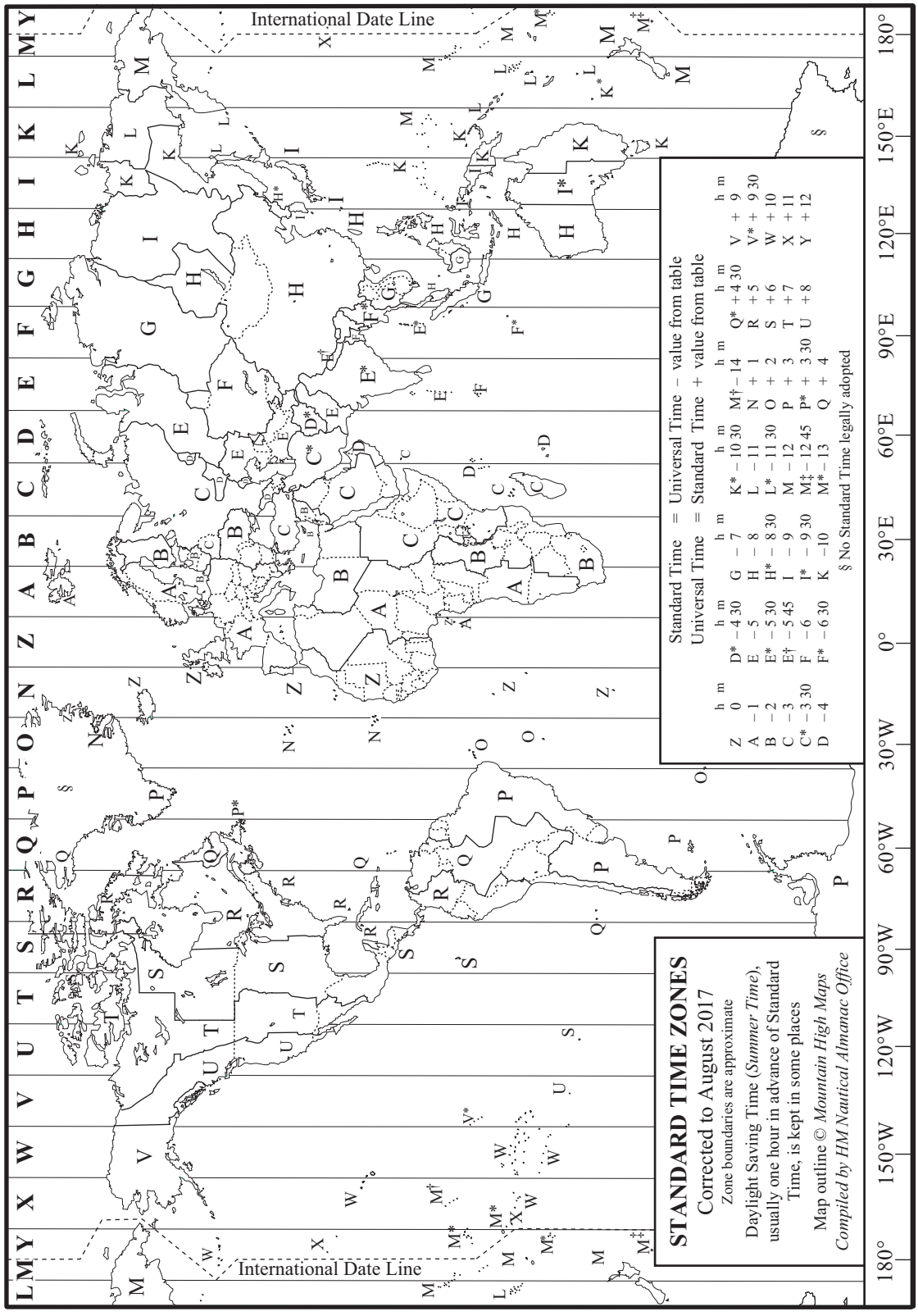
The dates between Jan. 0 and Dec. 32 below are the dates when p changes to the next value.

Polar Distance (p) *Polaris*: Jan. 0 39′ Dec. 32
σ Octantis: Jan. 0 67′ Jan. 24 68′ Oct. 11 67′ Dec. 5 68′ Dec. 32

AT 0^h UNIVERSAL TIME

Date	*Polaris* GHA	σ Oct GHA	Date	*Polaris* GHA	σ Oct GHA	Date	*Polaris* GHA	σ Oct GHA	Date	*Polaris* GHA	σ Oct GHA
	° ′	° ′		° ′	° ′		° ′	° ′		° ′	° ′
July 1	235 27	317 58	**Aug. 16**	280 25	3 13	**Oct. 1**	325 25	48 37	**Nov. 16**	10 36	94 09
2	236 26	318 57	**17**	281 23	4 12	**2**	326 24	49 37	**17**	11 35	95 08
3	237 24	319 56	**18**	282 22	5 11	**3**	327 23	50 36	**18**	12 34	96 08
4	238 23	320 55	**19**	283 21	6 10	**4**	328 21	51 35	**19**	13 33	97 07
5	239 21	321 54	**20**	284 19	7 09	**5**	329 20	52 35	**20**	14 33	98 06
6	240 20	322 53	**21**	285 18	8 08	**6**	330 19	53 34	**21**	15 32	99 06
7	241 19	323 52	**22**	286 17	9 07	**7**	331 18	54 33	**22**	16 31	100 05
8	242 18	324 51	**23**	287 15	10 07	**8**	332 16	55 33	**23**	17 30	101 04
9	243 16	325 50	**24**	288 14	11 06	**9**	333 15	56 32	**24**	18 29	102 04
10	244 15	326 49	**25**	289 13	12 05	**10**	334 14	57 31	**25**	19 29	103 03
11	245 14	327 48	**26**	290 11	13 04	**11**	335 13	58 31	**26**	20 28	104 03
12	246 12	328 47	**27**	291 10	14 03	**12**	336 12	59 30	**27**	21 27	105 02
13	247 11	329 46	**28**	292 08	15 03	**13**	337 11	60 29	**28**	22 26	106 02
14	248 10	330 45	**29**	293 07	16 02	**14**	338 10	61 29	**29**	23 26	107 01
15	249 08	331 44	**30**	294 06	17 01	**15**	339 09	62 28	**30**	24 25	108 00
16	250 07	332 43	**31**	295 04	18 00	**16**	340 07	63 27	**Dec. 1**	25 24	109 00
17	251 06	333 42	**Sept. 1**	296 03	18 59	**17**	341 06	64 27	**2**	26 23	109 59
18	252 04	334 41	**2**	297 02	19 58	**18**	342 05	65 26	**3**	27 22	110 58
19	253 03	335 40	**3**	298 01	20 58	**19**	343 04	66 26	**4**	28 22	111 58
20	254 01	336 39	**4**	298 59	21 57	**20**	344 03	67 25	**5**	29 21	112 57
21	255 00	337 37	**5**	299 58	22 56	**21**	345 02	68 25	**6**	30 20	113 56
22	255 59	338 36	**6**	300 57	23 55	**22**	346 01	69 24	**7**	31 20	114 56
23	256 57	339 35	**7**	301 55	24 55	**23**	346 59	70 23	**8**	32 19	115 55
24	257 56	340 34	**8**	302 54	25 54	**24**	347 58	71 23	**9**	33 18	116 55
25	258 55	341 33	**9**	303 53	26 53	**25**	348 57	72 22	**10**	34 18	117 54
26	259 54	342 32	**10**	304 51	27 52	**26**	349 56	73 21	**11**	35 17	118 53
27	260 52	343 31	**11**	305 50	28 52	**27**	350 55	74 21	**12**	36 16	119 53
28	261 51	344 31	**12**	306 49	29 51	**28**	351 54	75 20	**13**	37 16	120 52
29	262 49	345 30	**13**	307 47	30 50	**29**	352 53	76 20	**14**	38 15	121 51
30	263 48	346 29	**14**	308 46	31 49	**30**	353 52	77 19	**15**	39 14	122 51
31	264 47	347 28	**15**	309 45	32 48	**31**	354 51	78 18	**16**	40 13	123 50
Aug. 1	265 45	348 27	**16**	310 43	33 48	**Nov. 1**	355 50	79 18	**17**	41 13	124 49
2	266 44	349 26	**17**	311 42	34 47	**2**	356 49	80 17	**18**	42 12	125 49
3	267 42	350 25	**18**	312 41	35 46	**3**	357 48	81 17	**19**	43 12	126 48
4	268 41	351 24	**19**	313 40	36 46	**4**	358 47	82 16	**20**	44 11	127 47
5	269 40	352 23	**20**	314 39	37 45	**5**	359 46	83 15	**21**	45 11	128 47
6	270 38	353 22	**21**	315 37	38 44	**6**	0 45	84 15	**22**	46 10	129 46
7	271 37	354 21	**22**	316 36	39 43	**7**	1 44	85 14	**23**	47 10	130 45
8	272 36	355 20	**23**	317 35	40 43	**8**	2 43	86 14	**24**	48 09	131 45
9	273 34	356 19	**24**	318 33	41 42	**9**	3 42	87 13	**25**	49 08	132 44
10	274 33	357 18	**25**	319 32	42 41	**10**	4 42	88 12	**26**	50 08	133 43
11	275 32	358 17	**26**	320 31	43 41	**11**	5 41	89 12	**27**	51 07	134 42
12	276 30	359 16	**27**	321 30	44 40	**12**	6 40	90 11	**28**	52 07	135 42
13	277 29	0 16	**28**	322 28	45 39	**13**	7 39	91 11	**29**	53 06	136 41
14	278 27	1 15	**29**	323 27	46 38	**14**	8 38	92 10	**30**	54 06	137 40
15	279 26	2 14	**30**	324 26	47 38	**15**	9 37	93 09	**31**	55 05	138 40
16	280 25	3 13	**Oct. 1**	325 25	48 37	**16**	10 36	94 09	**32**	56 04	139 39

Form the quantities $C = p \cos$ (local hour angle) and $S = p \sin$ (local hour angle) then
Latitude $= h_0 - C + 0{\cdot}0087\, S^2 \tan h_0$,
Azimuth of *Polaris* $= -S/\cos h_0$ and Azimuth of σ Octantis $= 180^\circ + S/\cos h_0$, where p and h_0 are in degrees and h_0 is the observed altitude corrected for atmospheric refraction and instrument error.


International Date Line
International Date Line
STANDARD TIME ZONES
Corrected to August 2017
Zone boundaries are approximate
Daylight Saving Time (Summer Time), usually one hour in advance of Standard Time, is kept in some places
Map outline © Mountain High Maps
Compiled by HM Nautical Almanac Office
Standard Time = Universal Time – value from table
Universal Time = Standard Time + value from table
Z 0 D* –4 30 G –7 K* –10 30 M† –14 Q* +4 30 V +9
A –1 E –5 H –8 L –11 N +1 R +5 V* +9 30
B –2 E* –5 30 H* –8 30 L* –11 30 O +2 S +6 W +10
C –3 E† –5 45 I –9 M –12 P +3 T +7 X +11
C* –3 30 F –6 I* –9 30 M‡ –12 45 P* +3 30 U +8 Y +12
D –4 F* –6 30 K –10 M* –13 Q +4
§ No Standard Time legally adopted
180° 150°W 120°W 90°W 60°W 30°W 0° 30°E 60°E 90°E 120°E 150°E 180°

The times of sunrise and sunset (pages 24–31) and of moonrise and moonset (pages 32–63) are the instants when the upper limbs of the Sun and Moon appear to lie on the horizon for an observer at sea-level. In both cases a fixed allowance of 34′ has been made for refraction; a further allowance of 16′ has been made for the semidiameter of the Sun, while for the Moon the actual value of semidiameter *minus* horizontal parallax has been used. No allowance has been made for the phase of the Moon. The observed times may differ from the tabular times because of variations in refraction and the relative heights of the observer and horizon.

The tabular values are for the universal time (UT) of the phenomena on the Greenwich meridian (longitude 0°). To a first approximation the UT at another longitude is given by subtracting the longitude, expressed in time-measure, if east of Greenwich, or by adding, if west of Greenwich. Alternatively the tables may be regarded as giving the approximate local mean time on all meridians. These times may be converted to standard time by applying the appropriate differences, as indicated in the note on page 4. Linear interpolation may be used to obtain the times for non-tabular latitudes.

In the case of the Sun it may be necessary to interpolate (mentally) to obtain the UT for an intermediate date, but a further interpolation for longitude is not normally required. In the case of the Moon the values must normally be interpolated for longitude, as well as for latitude, since the changes in the tabular values from one day to the next are usually large. The interpolating factor is equal to one twenty-fourth of the longitude if expressed in hours and decimals of an hour; linear interpolation is usually adequate.

Example

To find the times of sunrise and sunset and of moonrise and moonset on 2020 February 7 at latitude N 38° 55′, longitude W 77° 15′. The longitude expressed in time-measure is W $05^{h}\ 09^{m}$. The difference between standard time and UT is -5^{h} in this case.

The relevant tabular values in UT for longitude 0° are as follows:

	Sunrise		Sunset		Moonrise		Moonset	
	+35°	+40°	+35°	+40°	+35°	+40°	+35°	+40°
d	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 4	06 57	07 06	17 31	17 22				
8	06 54	07 02	17 35	17 27				
Feb. 7					15 36	15 22	05 27	05 42
8					16 45	16 32	06 21	06 35

Interpolating factor for latitude is 3° 55′/ 5° = 0·78
for date for Sun is $3^{d}/4^{d}$ = 0·75
for long. for Moon is $5^{h}\cdot15/24^{h}$ = 0·21

	Sunrise		Sunset		Moonrise		Moonset	
Interpolation to:	d	h m	h m		d	h m	h m	
Latitude N 38° 55′	**Feb. 4**	07 04	17 24		**Feb. 7**	15 25	05 39	
N 38° 55′	**8**	07 00	17 29		**8**	16 35	06 32	
Local mean time	**7**	07 01	17 28		**7**	15 40	05 50	
Adjustment to:								
Universal time	**7**	12 10	22 37		**7**	20 49	10 59	
Standard time	**7**	07 10	17 37		**7**	15 49	05 59	

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. −1	3 23	3 53	4 15	4 33	4 48	5 01	5 22	5 41	5 59	6 16	6 34	6 55	7 07	7 21
3	3 28	3 57	4 19	4 36	4 51	5 03	5 25	5 43	6 01	6 18	6 36	6 56	7 08	7 22
7	3 33	4 01	4 23	4 40	4 54	5 06	5 27	5 46	6 02	6 19	6 37	6 57	7 09	7 22
11	3 40	4 07	4 27	4 44	4 58	5 10	5 30	5 48	6 04	6 20	6 37	6 57	7 08	7 21
15	3 47	4 12	4 32	4 48	5 01	5 13	5 33	5 50	6 06	6 21	6 38	6 57	7 08	7 20
19	3 54	4 19	4 37	4 53	5 05	5 17	5 35	5 52	6 07	6 22	6 38	6 56	7 06	7 18
23	4 02	4 25	4 43	4 57	5 10	5 20	5 38	5 54	6 08	6 22	6 38	6 55	7 05	7 16
27	4 11	4 32	4 49	5 02	5 14	5 24	5 41	5 55	6 09	6 23	6 37	6 53	7 03	7 13
31	4 19	4 39	4 54	5 07	5 18	5 27	5 43	5 57	6 10	6 23	6 36	6 51	7 00	7 10
Feb. 4	4 28	4 46	5 00	5 12	5 22	5 31	5 46	5 58	6 10	6 22	6 35	6 49	6 57	7 06
8	4 36	4 53	5 06	5 17	5 26	5 34	5 48	6 00	6 11	6 22	6 33	6 46	6 54	7 02
12	4 45	5 00	5 12	5 22	5 30	5 37	5 50	6 01	6 11	6 21	6 31	6 43	6 50	6 57
16	4 54	5 07	5 18	5 27	5 34	5 41	5 52	6 02	6 11	6 20	6 29	6 40	6 46	6 52
20	5 02	5 14	5 24	5 31	5 38	5 44	5 54	6 02	6 10	6 18	6 27	6 36	6 41	6 47
24	5 11	5 21	5 29	5 36	5 42	5 47	5 56	6 03	6 10	6 17	6 24	6 32	6 36	6 42
28	5 19	5 28	5 35	5 41	5 45	5 50	5 57	6 03	6 09	6 15	6 21	6 28	6 32	6 36
Mar. 3	5 28	5 35	5 40	5 45	5 49	5 53	5 59	6 04	6 09	6 13	6 18	6 23	6 26	6 30
7	5 36	5 41	5 46	5 49	5 53	5 55	6 00	6 04	6 08	6 11	6 15	6 19	6 21	6 24
11	5 44	5 48	5 51	5 54	5 56	5 58	6 01	6 04	6 07	6 09	6 12	6 14	6 16	6 17
15	5 52	5 54	5 56	5 58	5 59	6 01	6 02	6 04	6 06	6 07	6 08	6 09	6 10	6 11
19	6 00	6 01	6 02	6 02	6 03	6 03	6 04	6 04	6 04	6 05	6 05	6 05	6 05	6 05
23	6 08	6 07	6 07	6 06	6 06	6 05	6 05	6 04	6 03	6 02	6 01	6 00	5 59	5 58
27	6 15	6 13	6 12	6 10	6 09	6 08	6 06	6 04	6 02	6 00	5 58	5 55	5 53	5 52
31	6 23	6 20	6 17	6 14	6 12	6 10	6 07	6 04	6 01	5 58	5 54	5 50	5 48	5 45
Apr. 4	6 31	6 26	6 22	6 18	6 15	6 13	6 08	6 04	6 00	5 55	5 51	5 45	5 42	5 39

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. −1	20 41	20 12	19 49	19 32	19 17	19 04	18 42	18 23	18 06	17 49	17 31	17 10	16 57	16 43
3	20 40	20 11	19 50	19 32	19 18	19 05	18 44	18 25	18 08	17 51	17 33	17 12	17 00	16 47
7	20 38	20 10	19 49	19 32	19 18	19 05	18 45	18 26	18 10	17 53	17 36	17 15	17 04	16 50
11	20 35	20 08	19 48	19 31	19 17	19 05	18 45	18 28	18 11	17 55	17 38	17 19	17 07	16 54
15	20 31	20 05	19 46	19 30	19 17	19 05	18 45	18 29	18 13	17 57	17 41	17 22	17 11	16 59
19	20 26	20 02	19 43	19 28	19 15	19 04	18 45	18 29	18 14	17 59	17 43	17 25	17 15	17 03
23	20 20	19 57	19 40	19 25	19 13	19 03	18 45	18 30	18 15	18 01	17 46	17 29	17 19	17 08
27	20 13	19 52	19 36	19 22	19 11	19 01	18 44	18 30	18 16	18 03	17 49	17 32	17 23	17 12
31	20 06	19 47	19 32	19 19	19 08	18 59	18 43	18 30	18 17	18 04	17 51	17 36	17 27	17 17
Feb. 4	19 59	19 41	19 27	19 15	19 05	18 57	18 42	18 29	18 17	18 06	17 53	17 39	17 31	17 22
8	19 50	19 34	19 21	19 11	19 02	18 54	18 40	18 28	18 18	18 07	17 55	17 43	17 35	17 27
12	19 42	19 27	19 16	19 06	18 58	18 51	18 38	18 28	18 18	18 08	17 58	17 46	17 39	17 32
16	19 33	19 20	19 09	19 01	18 53	18 47	18 36	18 26	18 17	18 09	17 59	17 49	17 43	17 36
20	19 24	19 12	19 03	18 55	18 49	18 43	18 33	18 25	18 17	18 09	18 01	17 52	17 47	17 41
24	19 14	19 04	18 56	18 50	18 44	18 39	18 31	18 23	18 17	18 10	18 03	17 55	17 51	17 46
28	19 05	18 56	18 50	18 44	18 39	18 35	18 28	18 22	18 16	18 10	18 04	17 58	17 54	17 50
Mar. 3	18 55	18 48	18 42	18 38	18 34	18 31	18 25	18 20	18 15	18 11	18 06	18 01	17 58	17 54
7	18 45	18 39	18 35	18 32	18 29	18 26	18 22	18 18	18 14	18 11	18 07	18 03	18 01	17 59
11	18 35	18 31	18 28	18 25	18 23	18 21	18 18	18 16	18 13	18 11	18 09	18 06	18 05	18 03
15	18 24	18 22	18 20	18 19	18 18	18 17	18 15	18 13	18 12	18 11	18 10	18 09	18 08	18 07
19	18 14	18 13	18 13	18 12	18 12	18 12	18 11	18 11	18 11	18 11	18 11	18 11	18 11	18 11
23	18 04	18 05	18 05	18 06	18 06	18 07	18 08	18 09	18 10	18 11	18 12	18 13	18 14	18 15
27	17 54	17 56	17 58	17 59	18 01	18 02	18 04	18 06	18 09	18 11	18 13	18 16	18 18	18 20
31	17 44	17 47	17 50	17 53	17 55	17 57	18 01	18 04	18 07	18 11	18 14	18 18	18 21	18 24
Apr. 4	17 34	17 39	17 43	17 47	17 50	17 53	17 57	18 02	18 06	18 10	18 15	18 21	18 24	18 28

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. −1	7 21	7 28	7 34	7 42	7 50	7 58	8 08	8 19	8 32	8 46	9 03	9 24	9 51	10 31
3	7 22	7 28	7 35	7 42	7 50	7 58	8 08	8 19	8 31	8 45	9 01	9 22	9 48	10 25
7	7 22	7 28	7 34	7 41	7 49	7 57	8 07	8 17	8 29	8 42	8 58	9 18	9 42	10 16
11	7 21	7 27	7 33	7 40	7 48	7 56	8 05	8 14	8 26	8 39	8 54	9 12	9 35	10 06
15	7 20	7 26	7 32	7 38	7 45	7 53	8 02	8 11	8 22	8 34	8 48	9 06	9 27	9 54
19	7 18	7 24	7 30	7 36	7 42	7 50	7 58	8 07	8 17	8 29	8 42	8 58	9 17	9 42
23	7 16	7 21	7 27	7 32	7 39	7 46	7 53	8 02	8 11	8 22	8 34	8 49	9 07	9 29
27	7 13	7 18	7 23	7 29	7 35	7 41	7 48	7 56	8 05	8 15	8 26	8 40	8 56	9 16
31	7 10	7 14	7 19	7 24	7 30	7 36	7 42	7 50	7 58	8 07	8 17	8 30	8 44	9 02
Feb. 4	7 06	7 10	7 15	7 19	7 24	7 30	7 36	7 43	7 50	7 58	8 08	8 19	8 32	8 47
8	7 02	7 06	7 10	7 14	7 19	7 24	7 29	7 35	7 42	7 49	7 58	8 08	8 19	8 33
12	6 57	7 01	7 04	7 08	7 12	7 17	7 22	7 27	7 33	7 40	7 48	7 56	8 06	8 18
16	6 52	6 55	6 59	7 02	7 06	7 10	7 14	7 19	7 24	7 30	7 37	7 45	7 53	8 04
20	6 47	6 50	6 53	6 56	6 59	7 02	7 06	7 10	7 15	7 20	7 26	7 32	7 40	7 49
24	6 42	6 44	6 46	6 49	6 52	6 55	6 58	7 01	7 05	7 10	7 15	7 20	7 27	7 34
28	6 36	6 38	6 40	6 42	6 44	6 47	6 49	6 52	6 55	6 59	7 03	7 08	7 13	7 19
Mar. 3	6 30	6 31	6 33	6 35	6 36	6 38	6 41	6 43	6 45	6 48	6 51	6 55	6 59	7 04
7	6 24	6 25	6 26	6 27	6 29	6 30	6 32	6 33	6 35	6 37	6 40	6 42	6 45	6 49
11	6 17	6 18	6 19	6 20	6 21	6 22	6 23	6 24	6 25	6 26	6 28	6 29	6 31	6 33
15	6 11	6 11	6 12	6 12	6 12	6 13	6 13	6 14	6 14	6 15	6 16	6 16	6 17	6 18
19	6 05	6 05	6 04	6 04	6 04	6 04	6 04	6 04	6 04	6 04	6 04	6 03	6 03	6 03
23	5 58	5 58	5 57	5 57	5 56	5 56	5 55	5 54	5 53	5 52	5 51	5 50	5 49	5 47
27	5 52	5 51	5 50	5 49	5 48	5 47	5 46	5 44	5 43	5 41	5 39	5 37	5 35	5 32
31	5 45	5 44	5 43	5 41	5 40	5 38	5 36	5 34	5 32	5 30	5 27	5 24	5 21	5 17
Apr. 4	5 39	5 37	5 35	5 34	5 32	5 30	5 27	5 25	5 22	5 19	5 15	5 11	5 06	5 01

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. −1	16 43	16 37	16 30	16 23	16 15	16 06	15 57	15 46	15 33	15 19	15 02	14 41	14 13	13 34
3	16 47	16 41	16 34	16 27	16 19	16 10	16 01	15 50	15 38	15 24	15 07	14 47	14 21	13 44
7	16 50	16 44	16 38	16 31	16 23	16 15	16 06	15 55	15 44	15 30	15 14	14 55	14 30	13 56
11	16 54	16 48	16 42	16 36	16 28	16 20	16 11	16 01	15 50	15 37	15 22	15 04	14 41	14 10
15	16 59	16 53	16 47	16 41	16 33	16 26	16 17	16 08	15 57	15 45	15 31	15 13	14 52	14 25
19	17 03	16 58	16 52	16 46	16 39	16 32	16 24	16 15	16 05	15 53	15 40	15 24	15 05	14 40
23	17 08	17 03	16 57	16 51	16 45	16 38	16 31	16 22	16 13	16 02	15 50	15 35	15 17	14 55
27	17 12	17 08	17 03	16 57	16 51	16 45	16 38	16 30	16 21	16 11	16 00	15 46	15 30	15 11
31	17 17	17 13	17 08	17 03	16 58	16 52	16 45	16 38	16 30	16 21	16 10	15 58	15 44	15 26
Feb. 4	17 22	17 18	17 14	17 09	17 04	16 58	16 52	16 46	16 38	16 30	16 21	16 10	15 57	15 41
8	17 27	17 23	17 19	17 15	17 10	17 05	17 00	16 54	16 47	16 40	16 31	16 21	16 10	15 56
12	17 32	17 28	17 25	17 21	17 17	17 12	17 07	17 02	16 56	16 49	16 42	16 33	16 23	16 11
16	17 36	17 33	17 30	17 27	17 23	17 19	17 15	17 10	17 05	16 59	16 52	16 45	16 36	16 26
20	17 41	17 38	17 36	17 33	17 29	17 26	17 22	17 18	17 13	17 08	17 03	16 56	16 49	16 40
24	17 46	17 43	17 41	17 38	17 36	17 33	17 30	17 26	17 22	17 18	17 13	17 08	17 01	16 54
28	17 50	17 48	17 46	17 44	17 42	17 39	17 37	17 34	17 31	17 27	17 23	17 19	17 14	17 08
Mar. 3	17 54	17 53	17 51	17 50	17 48	17 46	17 44	17 42	17 39	17 37	17 33	17 30	17 26	17 21
7	17 59	17 58	17 57	17 55	17 54	17 53	17 51	17 50	17 48	17 46	17 44	17 41	17 38	17 35
11	18 03	18 02	18 02	18 01	18 00	17 59	17 58	17 57	17 56	17 55	17 53	17 52	17 50	17 48
15	18 07	18 07	18 07	18 06	18 06	18 06	18 05	18 05	18 04	18 04	18 03	18 03	18 02	18 01
19	18 11	18 11	18 12	18 12	18 12	18 12	18 12	18 12	18 13	18 13	18 13	18 13	18 14	18 14
23	18 15	18 16	18 16	18 17	18 18	18 18	18 19	18 20	18 21	18 22	18 23	18 24	18 26	18 27
27	18 20	18 20	18 21	18 22	18 23	18 25	18 26	18 27	18 29	18 31	18 33	18 35	18 37	18 40
31	18 24	18 25	18 26	18 28	18 29	18 31	18 33	18 35	18 37	18 40	18 42	18 46	18 49	18 54
Apr. 4	18 28	18 29	18 31	18 33	18 35	18 37	18 40	18 42	18 45	18 49	18 52	18 56	19 01	19 07

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	6 23	6 20	6 17	6 14	6 12	6 10	6 07	6 04	6 01	5 58	5 54	5 50	5 48	5 45
Apr. 4	6 31	6 26	6 22	6 18	6 15	6 13	6 08	6 04	6 00	5 55	5 51	5 45	5 42	5 39
8	6 39	6 32	6 27	6 22	6 19	6 15	6 09	6 04	5 58	5 53	5 47	5 41	5 37	5 32
12	6 46	6 38	6 32	6 26	6 22	6 17	6 10	6 04	5 57	5 51	5 44	5 36	5 32	5 26
16	6 54	6 44	6 37	6 30	6 25	6 20	6 11	6 04	5 56	5 49	5 41	5 32	5 26	5 20
20	7 02	6 51	6 42	6 34	6 28	6 22	6 13	6 04	5 55	5 47	5 38	5 27	5 21	5 14
24	7 09	6 57	6 47	6 38	6 31	6 25	6 14	6 04	5 55	5 45	5 35	5 23	5 17	5 09
28	7 17	7 03	6 52	6 42	6 34	6 27	6 15	6 04	5 54	5 44	5 33	5 20	5 12	5 03
May 2	7 24	7 09	6 56	6 46	6 38	6 30	6 17	6 05	5 54	5 42	5 30	5 16	5 08	4 58
6	7 31	7 15	7 01	6 50	6 41	6 32	6 18	6 05	5 53	5 41	5 28	5 13	5 04	4 54
10	7 39	7 20	7 06	6 54	6 44	6 35	6 19	6 06	5 53	5 40	5 26	5 10	5 00	4 49
14	7 45	7 26	7 10	6 58	6 47	6 37	6 21	6 06	5 53	5 39	5 24	5 07	4 57	4 45
18	7 52	7 31	7 15	7 01	6 50	6 40	6 23	6 07	5 53	5 38	5 23	5 05	4 54	4 42
22	7 59	7 36	7 19	7 05	6 53	6 42	6 24	6 08	5 53	5 38	5 22	5 03	4 52	4 39
26	8 04	7 41	7 23	7 08	6 56	6 45	6 26	6 09	5 54	5 38	5 21	5 01	4 49	4 36
30	8 10	7 45	7 27	7 11	6 58	6 47	6 27	6 10	5 54	5 38	5 20	5 00	4 48	4 34
June 3	8 15	7 49	7 30	7 14	7 01	6 49	6 29	6 11	5 55	5 38	5 20	4 59	4 47	4 32
7	8 19	7 53	7 33	7 17	7 03	6 51	6 30	6 12	5 55	5 38	5 20	4 58	4 46	4 31
11	8 22	7 56	7 35	7 19	7 05	6 52	6 32	6 13	5 56	5 39	5 20	4 58	4 45	4 31
15	8 25	7 58	7 37	7 20	7 06	6 54	6 33	6 14	5 57	5 39	5 21	4 59	4 46	4 31
19	8 26	7 59	7 38	7 22	7 07	6 55	6 34	6 15	5 58	5 40	5 21	4 59	4 46	4 31
23	8 27	8 00	7 39	7 22	7 08	6 56	6 35	6 16	5 59	5 41	5 22	5 00	4 47	4 32
27	8 27	8 00	7 40	7 23	7 09	6 56	6 35	6 17	6 00	5 42	5 23	5 01	4 48	4 33
July 1	8 26	7 59	7 39	7 23	7 09	6 57	6 36	6 17	6 00	5 43	5 24	5 03	4 50	4 35
5	8 24	7 58	7 38	7 22	7 08	6 56	6 36	6 18	6 01	5 44	5 26	5 04	4 52	4 37

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	17 44	17 47	17 50	17 53	17 55	17 57	18 01	18 04	18 07	18 11	18 14	18 18	18 21	18 24
Apr. 4	17 34	17 39	17 43	17 47	17 50	17 53	17 57	18 02	18 06	18 10	18 15	18 21	18 24	18 28
8	17 24	17 31	17 36	17 40	17 44	17 48	17 54	18 00	18 05	18 10	18 16	18 23	18 27	18 32
12	17 14	17 22	17 29	17 34	17 39	17 43	17 51	17 58	18 04	18 10	18 17	18 26	18 30	18 36
16	17 05	17 14	17 22	17 28	17 34	17 39	17 48	17 56	18 03	18 11	18 19	18 28	18 34	18 40
20	16 55	17 06	17 15	17 23	17 29	17 35	17 45	17 54	18 02	18 11	18 20	18 31	18 37	18 44
24	16 46	16 59	17 09	17 17	17 25	17 31	17 42	17 52	18 01	18 11	18 21	18 33	18 40	18 48
28	16 37	16 51	17 03	17 12	17 20	17 27	17 40	17 50	18 01	18 11	18 23	18 36	18 43	18 52
May 2	16 29	16 45	16 57	17 07	17 16	17 24	17 37	17 49	18 00	18 12	18 24	18 38	18 47	18 56
6	16 21	16 38	16 51	17 03	17 12	17 20	17 35	17 48	18 00	18 12	18 26	18 41	18 50	19 00
10	16 14	16 32	16 46	16 58	17 09	17 18	17 33	17 47	18 00	18 13	18 27	18 43	18 53	19 04
14	16 07	16 26	16 42	16 55	17 05	17 15	17 32	17 46	18 00	18 14	18 29	18 46	18 56	19 08
18	16 00	16 21	16 38	16 51	17 03	17 13	17 30	17 46	18 00	18 15	18 30	18 49	18 59	19 12
22	15 54	16 17	16 34	16 48	17 00	17 11	17 29	17 45	18 00	18 16	18 32	18 51	19 02	19 15
26	15 49	16 13	16 31	16 46	16 58	17 09	17 28	17 45	18 01	18 17	18 34	18 53	19 05	19 19
30	15 45	16 09	16 28	16 44	16 57	17 08	17 28	17 45	18 01	18 18	18 35	18 56	19 08	19 22
June 3	15 42	16 07	16 26	16 42	16 56	17 07	17 28	17 45	18 02	18 19	18 37	18 58	19 10	19 24
7	15 39	16 05	16 25	16 41	16 55	17 07	17 28	17 46	18 03	18 20	18 38	19 00	19 12	19 27
11	15 37	16 04	16 24	16 41	16 55	17 07	17 28	17 46	18 03	18 21	18 40	19 01	19 14	19 29
15	15 36	16 03	16 24	16 41	16 55	17 07	17 28	17 47	18 04	18 22	18 41	19 03	19 16	19 31
19	15 37	16 04	16 24	16 41	16 55	17 08	17 29	17 48	18 05	18 23	18 42	19 04	19 17	19 32
23	15 38	16 05	16 25	16 42	16 56	17 09	17 30	17 49	18 06	18 24	18 43	19 05	19 18	19 33
27	15 39	16 06	16 27	16 44	16 58	17 10	17 31	17 50	18 07	18 24	18 43	19 05	19 18	19 33
July 1	15 42	16 09	16 29	16 45	16 59	17 11	17 32	17 51	18 08	18 25	18 44	19 05	19 18	19 33
5	15 46	16 12	16 31	16 48	17 01	17 13	17 34	17 52	18 08	18 25	18 44	19 05	19 17	19 32

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	5 45	5 44	5 43	5 41	5 40	5 38	5 36	5 34	5 32	5 30	5 27	5 24	5 21	5 17
Apr. 4	5 39	5 37	5 35	5 34	5 32	5 30	5 27	5 25	5 22	5 19	5 15	5 11	5 06	5 01
8	5 32	5 30	5 28	5 26	5 24	5 21	5 18	5 15	5 11	5 07	5 03	4 58	4 52	4 46
12	5 26	5 24	5 21	5 19	5 16	5 13	5 09	5 05	5 01	4 56	4 51	4 45	4 38	4 30
16	5 20	5 18	5 15	5 11	5 08	5 04	5 00	4 56	4 51	4 46	4 39	4 32	4 24	4 14
20	5 14	5 11	5 08	5 04	5 01	4 56	4 52	4 47	4 41	4 35	4 28	4 20	4 10	3 59
24	5 09	5 05	5 02	4 58	4 53	4 49	4 43	4 38	4 31	4 24	4 16	4 07	3 56	3 43
28	5 03	5 00	4 56	4 51	4 46	4 41	4 35	4 29	4 22	4 14	4 05	3 55	3 42	3 28
May 2	4 58	4 54	4 50	4 45	4 40	4 34	4 28	4 21	4 13	4 04	3 54	3 43	3 29	3 12
6	4 54	4 49	4 44	4 39	4 33	4 27	4 20	4 13	4 04	3 55	3 44	3 31	3 15	2 56
10	4 49	4 45	4 39	4 34	4 28	4 21	4 14	4 05	3 56	3 46	3 33	3 19	3 02	2 40
14	4 45	4 40	4 35	4 29	4 22	4 15	4 07	3 58	3 48	3 37	3 24	3 08	2 49	2 24
18	4 42	4 36	4 31	4 24	4 17	4 10	4 01	3 52	3 41	3 29	3 15	2 58	2 36	2 08
22	4 39	4 33	4 27	4 20	4 13	4 05	3 56	3 46	3 35	3 22	3 06	2 48	2 24	1 52
26	4 36	4 30	4 24	4 17	4 09	4 01	3 51	3 41	3 29	3 15	2 59	2 38	2 13	1 36
30	4 34	4 28	4 21	4 14	4 06	3 57	3 47	3 36	3 24	3 09	2 52	2 30	2 02	1 19
June 3	4 32	4 26	4 19	4 12	4 03	3 54	3 44	3 33	3 20	3 04	2 46	2 23	1 52	1 02
7	4 31	4 25	4 18	4 10	4 01	3 52	3 42	3 30	3 16	3 01	2 41	2 17	1 44	0 43
11	4 31	4 24	4 17	4 09	4 00	3 51	3 40	3 28	3 14	2 58	2 38	2 13	1 37	0 18
15	4 31	4 24	4 17	4 09	4 00	3 50	3 39	3 27	3 13	2 56	2 36	2 10	1 33	▭
19	4 31	4 24	4 17	4 09	4 00	3 50	3 40	3 27	3 13	2 56	2 36	2 09	1 31	▭
23	4 32	4 25	4 18	4 10	4 01	3 51	3 40	3 28	3 14	2 57	2 37	2 10	1 32	▭
27	4 33	4 27	4 19	4 11	4 03	3 53	3 42	3 30	3 16	2 59	2 39	2 13	1 36	▭
July 1	4 35	4 28	4 21	4 13	4 05	3 55	3 45	3 33	3 19	3 02	2 43	2 17	1 42	0 24
5	4 37	4 31	4 24	4 16	4 08	3 58	3 48	3 36	3 23	3 07	2 48	2 23	1 50	0 50

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	18 24	18 25	18 26	18 28	18 29	18 31	18 33	18 35	18 37	18 40	18 42	18 46	18 49	18 54
Apr. 4	18 28	18 29	18 31	18 33	18 35	18 37	18 40	18 42	18 45	18 49	18 52	18 56	19 01	19 07
8	18 32	18 34	18 36	18 38	18 41	18 44	18 46	18 50	18 53	18 57	19 02	19 07	19 13	19 20
12	18 36	18 38	18 41	18 44	18 47	18 50	18 53	18 57	19 02	19 06	19 12	19 18	19 25	19 34
16	18 40	18 43	18 46	18 49	18 52	18 56	19 00	19 05	19 10	19 15	19 22	19 29	19 37	19 47
20	18 44	18 47	18 50	18 54	18 58	19 02	19 07	19 12	19 18	19 24	19 32	19 40	19 50	20 01
24	18 48	18 52	18 55	18 59	19 04	19 09	19 14	19 20	19 26	19 33	19 42	19 51	20 02	20 15
28	18 52	18 56	19 00	19 05	19 09	19 15	19 21	19 27	19 34	19 42	19 52	20 02	20 15	20 30
May 2	18 56	19 00	19 05	19 10	19 15	19 21	19 27	19 34	19 42	19 51	20 01	20 13	20 28	20 45
6	19 00	19 05	19 10	19 15	19 21	19 27	19 34	19 42	19 50	20 00	20 11	20 25	20 40	21 00
10	19 04	19 09	19 14	19 20	19 26	19 33	19 40	19 49	19 58	20 09	20 21	20 36	20 53	21 16
14	19 08	19 13	19 19	19 25	19 31	19 39	19 47	19 56	20 06	20 17	20 31	20 47	21 06	21 31
18	19 12	19 17	19 23	19 29	19 36	19 44	19 53	20 02	20 13	20 25	20 40	20 57	21 19	21 48
22	19 15	19 21	19 27	19 34	19 41	19 49	19 58	20 08	20 20	20 33	20 49	21 08	21 32	22 05
26	19 19	19 25	19 31	19 38	19 46	19 54	20 04	20 14	20 26	20 40	20 57	21 18	21 44	22 22
30	19 22	19 28	19 35	19 42	19 50	19 59	20 09	20 20	20 32	20 47	21 05	21 27	21 56	22 40
June 3	19 24	19 31	19 38	19 45	19 54	20 03	20 13	20 24	20 38	20 53	21 12	21 35	22 06	22 59
7	19 27	19 33	19 41	19 48	19 57	20 06	20 17	20 28	20 42	20 58	21 17	21 42	22 16	23 20
11	19 29	19 36	19 43	19 51	19 59	20 09	20 20	20 32	20 46	21 02	21 22	21 48	22 24	23 56
15	19 31	19 37	19 45	19 53	20 01	20 11	20 22	20 34	20 48	21 05	21 26	21 52	22 29	▭
19	19 32	19 39	19 46	19 54	20 03	20 13	20 23	20 36	20 50	21 07	21 27	21 54	22 32	▭
23	19 33	19 40	19 47	19 55	20 04	20 13	20 24	20 36	20 51	21 08	21 28	21 54	22 32	▭
27	19 33	19 40	19 47	19 55	20 04	20 13	20 24	20 36	20 50	21 07	21 27	21 53	22 30	▭
July 1	19 33	19 39	19 47	19 54	20 03	20 12	20 23	20 35	20 49	21 05	21 25	21 50	22 25	23 37
5	19 32	19 38	19 45	19 53	20 01	20 11	20 21	20 33	20 46	21 02	21 21	21 45	22 17	23 15

▭ indicates Sun continuously above horizon.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	8 26	7 59	7 39	7 23	7 09	6 57	6 36	6 17	6 00	5 43	5 24	5 03	4 50	4 35
5	8 24	7 58	7 38	7 22	7 08	6 56	6 36	6 18	6 01	5 44	5 26	5 04	4 52	4 37
9	8 21	7 56	7 37	7 21	7 07	6 56	6 36	6 18	6 02	5 45	5 27	5 06	4 54	4 40
13	8 17	7 53	7 34	7 19	7 06	6 55	6 35	6 18	6 02	5 46	5 29	5 08	4 56	4 43
17	8 13	7 49	7 32	7 17	7 04	6 53	6 35	6 18	6 03	5 47	5 30	5 10	4 59	4 46
21	8 07	7 45	7 28	7 14	7 02	6 52	6 34	6 18	6 03	5 48	5 32	5 13	5 02	4 49
25	8 01	7 41	7 24	7 11	7 00	6 50	6 32	6 17	6 03	5 49	5 33	5 15	5 04	4 52
29	7 54	7 35	7 20	7 07	6 57	6 47	6 31	6 17	6 03	5 49	5 35	5 17	5 07	4 56
Aug. 2	7 47	7 29	7 15	7 03	6 53	6 44	6 29	6 16	6 03	5 50	5 36	5 20	5 10	5 00
6	7 40	7 23	7 10	6 59	6 50	6 41	6 27	6 14	6 02	5 50	5 37	5 22	5 13	5 03
10	7 31	7 16	7 04	6 54	6 46	6 38	6 25	6 13	6 02	5 51	5 39	5 25	5 16	5 07
14	7 23	7 09	6 58	6 49	6 41	6 34	6 22	6 11	6 01	5 51	5 40	5 27	5 20	5 11
18	7 14	7 02	6 52	6 44	6 37	6 30	6 19	6 10	6 00	5 51	5 41	5 29	5 23	5 15
22	7 05	6 54	6 45	6 38	6 32	6 26	6 16	6 08	5 59	5 51	5 42	5 32	5 26	5 19
26	6 55	6 46	6 38	6 32	6 27	6 22	6 13	6 06	5 58	5 51	5 43	5 34	5 29	5 22
30	6 46	6 38	6 31	6 26	6 21	6 17	6 10	6 03	5 57	5 51	5 44	5 36	5 31	5 26
Sept. 3	6 36	6 29	6 24	6 20	6 16	6 12	6 06	6 01	5 56	5 51	5 45	5 38	5 34	5 30
7	6 26	6 21	6 17	6 13	6 10	6 08	6 03	5 59	5 55	5 50	5 46	5 40	5 37	5 34
11	6 16	6 12	6 09	6 07	6 05	6 03	5 59	5 56	5 53	5 50	5 47	5 43	5 40	5 37
15	6 06	6 03	6 02	6 00	5 59	5 58	5 56	5 54	5 52	5 50	5 47	5 45	5 43	5 41
19	5 55	5 55	5 54	5 54	5 53	5 53	5 52	5 51	5 50	5 49	5 48	5 47	5 46	5 45
23	5 45	5 46	5 47	5 47	5 47	5 48	5 48	5 49	5 49	5 49	5 49	5 49	5 49	5 49
27	5 35	5 37	5 39	5 40	5 42	5 43	5 45	5 46	5 48	5 49	5 50	5 51	5 52	5 53
Oct. 1	5 24	5 28	5 31	5 34	5 36	5 38	5 41	5 44	5 46	5 49	5 51	5 54	5 55	5 57
5	5 14	5 20	5 24	5 27	5 30	5 33	5 38	5 41	5 45	5 48	5 52	5 56	5 58	6 01

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	15 42	16 09	16 29	16 45	16 59	17 11	17 32	17 51	18 08	18 25	18 44	19 05	19 18	19 33
5	15 46	16 12	16 31	16 48	17 01	17 13	17 34	17 52	18 08	18 25	18 44	19 05	19 17	19 32
9	15 50	16 15	16 34	16 50	17 03	17 15	17 35	17 52	18 09	18 26	18 43	19 04	19 16	19 31
13	15 55	16 19	16 38	16 53	17 06	17 17	17 36	17 53	18 09	18 26	18 43	19 03	19 15	19 29
17	16 00	16 23	16 41	16 56	17 08	17 19	17 38	17 54	18 10	18 25	18 42	19 02	19 13	19 26
21	16 06	16 28	16 45	16 59	17 11	17 21	17 39	17 55	18 10	18 25	18 41	19 00	19 11	19 24
25	16 12	16 33	16 49	17 02	17 14	17 24	17 41	17 56	18 10	18 24	18 40	18 58	19 08	19 20
29	16 19	16 38	16 53	17 06	17 17	17 26	17 42	17 57	18 10	18 24	18 38	18 55	19 05	19 16
Aug. 2	16 26	16 44	16 58	17 10	17 20	17 28	17 44	17 57	18 10	18 23	18 36	18 52	19 02	19 12
6	16 33	16 49	17 02	17 13	17 22	17 31	17 45	17 57	18 09	18 21	18 34	18 49	18 58	19 08
10	16 40	16 55	17 07	17 17	17 25	17 33	17 46	17 58	18 09	18 20	18 32	18 46	18 54	19 03
14	16 47	17 01	17 12	17 21	17 28	17 35	17 47	17 58	18 08	18 18	18 29	18 42	18 49	18 58
18	16 54	17 06	17 16	17 24	17 31	17 38	17 48	17 58	18 07	18 16	18 26	18 38	18 44	18 52
22	17 02	17 12	17 21	17 28	17 34	17 40	17 49	17 58	18 06	18 14	18 23	18 33	18 39	18 46
26	17 09	17 18	17 26	17 32	17 37	17 42	17 50	17 58	18 05	18 12	18 20	18 29	18 34	18 40
30	17 16	17 24	17 30	17 36	17 40	17 44	17 51	17 58	18 04	18 10	18 17	18 24	18 29	18 34
Sept. 3	17 24	17 30	17 35	17 39	17 43	17 46	17 52	17 57	18 02	18 08	18 13	18 20	18 23	18 28
7	17 31	17 36	17 40	17 43	17 46	17 48	17 53	17 57	18 01	18 05	18 10	18 15	18 18	18 21
11	17 38	17 42	17 44	17 47	17 49	17 51	17 54	17 57	18 00	18 03	18 06	18 10	18 12	18 15
15	17 46	17 48	17 49	17 50	17 52	17 53	17 55	17 56	17 58	18 00	18 02	18 05	18 06	18 08
19	17 53	17 53	17 54	17 54	17 55	17 55	17 55	17 56	17 57	17 58	17 59	18 00	18 01	18 02
23	18 01	17 59	17 59	17 58	17 57	17 57	17 56	17 56	17 55	17 55	17 55	17 55	17 55	17 55
27	18 08	18 06	18 04	18 02	18 00	17 59	17 57	17 56	17 54	17 53	17 51	17 50	17 49	17 48
Oct. 1	18 16	18 12	18 08	18 06	18 04	18 02	17 58	17 55	17 53	17 50	17 48	17 45	17 43	17 42
5	18 23	18 18	18 13	18 10	18 07	18 04	17 59	17 55	17 52	17 48	17 44	17 40	17 38	17 35

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	4 35	4 28	4 21	4 13	4 05	3 55	3 45	3 33	3 19	3 02	2 43	2 17	1 42	0 24
5	4 37	4 31	4 24	4 16	4 08	3 58	3 48	3 36	3 23	3 07	2 48	2 23	1 50	0 50
9	4 40	4 33	4 26	4 19	4 11	4 02	3 52	3 40	3 27	3 12	2 54	2 31	2 00	1 10
13	4 43	4 36	4 30	4 22	4 15	4 06	3 56	3 45	3 33	3 18	3 01	2 39	2 11	1 28
17	4 46	4 40	4 33	4 26	4 19	4 10	4 01	3 50	3 39	3 25	3 08	2 48	2 23	1 46
21	4 49	4 43	4 37	4 30	4 23	4 15	4 06	3 56	3 45	3 32	3 17	2 58	2 35	2 03
25	4 52	4 47	4 41	4 35	4 28	4 20	4 12	4 02	3 52	3 40	3 25	3 08	2 47	2 19
29	4 56	4 51	4 45	4 39	4 33	4 26	4 18	4 09	3 59	3 48	3 35	3 19	3 00	2 35
Aug. 2	5 00	4 55	4 50	4 44	4 38	4 31	4 24	4 16	4 07	3 56	3 44	3 30	3 13	2 51
6	5 03	4 59	4 54	4 49	4 43	4 37	4 30	4 23	4 14	4 05	3 53	3 41	3 25	3 06
10	5 07	5 03	4 59	4 54	4 48	4 43	4 37	4 30	4 22	4 13	4 03	3 51	3 38	3 21
14	5 11	5 07	5 03	4 59	4 54	4 49	4 43	4 37	4 30	4 22	4 13	4 02	3 50	3 35
18	5 15	5 11	5 08	5 04	4 59	4 55	4 50	4 44	4 38	4 30	4 22	4 13	4 02	3 49
22	5 19	5 16	5 12	5 09	5 05	5 01	4 56	4 51	4 45	4 39	4 32	4 24	4 14	4 03
26	5 22	5 20	5 17	5 14	5 10	5 07	5 03	4 58	4 53	4 48	4 42	4 34	4 26	4 17
30	5 26	5 24	5 21	5 19	5 16	5 13	5 09	5 05	5 01	4 56	4 51	4 45	4 38	4 30
Sept. 3	5 30	5 28	5 26	5 24	5 21	5 18	5 16	5 12	5 09	5 05	5 01	4 55	4 50	4 43
7	5 34	5 32	5 30	5 29	5 27	5 24	5 22	5 20	5 17	5 13	5 10	5 06	5 01	4 56
11	5 37	5 36	5 35	5 34	5 32	5 30	5 29	5 27	5 24	5 22	5 19	5 16	5 13	5 09
15	5 41	5 40	5 39	5 39	5 37	5 36	5 35	5 34	5 32	5 31	5 29	5 27	5 24	5 21
19	5 45	5 45	5 44	5 44	5 43	5 42	5 42	5 41	5 40	5 39	5 38	5 37	5 35	5 34
23	5 49	5 49	5 49	5 49	5 48	5 48	5 48	5 48	5 48	5 48	5 47	5 47	5 47	5 46
27	5 53	5 53	5 53	5 54	5 54	5 54	5 55	5 55	5 56	5 56	5 57	5 58	5 58	5 59
Oct. 1	5 57	5 57	5 58	5 59	6 00	6 01	6 01	6 03	6 04	6 05	6 06	6 08	6 10	6 12
5	6 01	6 02	6 03	6 04	6 05	6 07	6 08	6 10	6 12	6 14	6 16	6 18	6 21	6 25

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	19 33	19 39	19 47	19 54	20 03	20 12	20 23	20 35	20 49	21 05	21 25	21 50	22 25	23 37
5	19 32	19 38	19 45	19 53	20 01	20 11	20 21	20 33	20 46	21 02	21 21	21 45	22 17	23 15
9	19 31	19 37	19 44	19 51	19 59	20 08	20 18	20 30	20 43	20 58	21 16	21 38	22 09	22 57
13	19 29	19 35	19 42	19 49	19 57	20 05	20 15	20 26	20 38	20 53	21 10	21 31	21 59	22 39
17	19 26	19 32	19 39	19 46	19 53	20 01	20 11	20 21	20 33	20 47	21 03	21 22	21 47	22 23
21	19 24	19 29	19 35	19 42	19 49	19 57	20 06	20 16	20 27	20 40	20 55	21 13	21 36	22 07
25	19 20	19 26	19 31	19 38	19 44	19 52	20 00	20 10	20 20	20 32	20 46	21 03	21 23	21 50
29	19 16	19 22	19 27	19 33	19 39	19 46	19 54	20 03	20 13	20 24	20 37	20 52	21 11	21 34
Aug. 2	19 12	19 17	19 22	19 28	19 34	19 40	19 48	19 56	20 05	20 15	20 27	20 41	20 58	21 19
6	19 08	19 12	19 17	19 22	19 28	19 34	19 40	19 48	19 56	20 06	20 16	20 29	20 44	21 03
10	19 03	19 07	19 11	19 16	19 21	19 27	19 33	19 40	19 47	19 56	20 06	20 17	20 31	20 47
14	18 58	19 01	19 05	19 10	19 14	19 19	19 25	19 31	19 38	19 46	19 55	20 05	20 17	20 31
18	18 52	18 55	18 59	19 03	19 07	19 12	19 17	19 22	19 29	19 36	19 43	19 52	20 03	20 16
22	18 46	18 49	18 53	18 56	19 00	19 04	19 08	19 13	19 19	19 25	19 32	19 40	19 49	20 00
26	18 40	18 43	18 46	18 49	18 52	18 56	19 00	19 04	19 09	19 14	19 20	19 27	19 35	19 44
30	18 34	18 36	18 39	18 41	18 44	18 47	18 51	18 54	18 59	19 03	19 08	19 14	19 21	19 29
Sept. 3	18 28	18 30	18 32	18 34	18 36	18 39	18 42	18 45	18 48	18 52	18 56	19 01	19 07	19 13
7	18 21	18 23	18 25	18 26	18 28	18 30	18 33	18 35	18 38	18 41	18 44	18 48	18 53	18 58
11	18 15	18 16	18 17	18 19	18 20	18 22	18 23	18 25	18 27	18 30	18 32	18 35	18 38	18 42
15	18 08	18 09	18 10	18 11	18 12	18 13	18 14	18 15	18 17	18 18	18 20	18 22	18 24	18 27
19	18 02	18 02	18 02	18 03	18 03	18 04	18 05	18 05	18 06	18 07	18 08	18 09	18 10	18 12
23	17 55	17 55	17 55	17 55	17 55	17 55	17 55	17 55	17 55	17 55	17 56	17 56	17 56	17 56
27	17 48	17 48	17 48	17 47	17 47	17 46	17 46	17 45	17 45	17 44	17 43	17 43	17 42	17 41
Oct. 1	17 42	17 41	17 40	17 39	17 39	17 38	17 37	17 35	17 34	17 33	17 31	17 30	17 28	17 26
5	17 35	17 34	17 33	17 32	17 30	17 29	17 27	17 26	17 24	17 22	17 19	17 17	17 14	17 10

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	5 24	5 28	5 31	5 34	5 36	5 38	5 41	5 44	5 46	5 49	5 51	5 54	5 55	5 57
5	5 14	5 20	5 24	5 27	5 30	5 33	5 38	5 41	5 45	5 48	5 52	5 56	5 58	6 01
9	5 04	5 11	5 17	5 21	5 25	5 28	5 34	5 39	5 44	5 48	5 53	5 58	6 01	6 05
13	4 54	5 03	5 09	5 15	5 20	5 24	5 31	5 37	5 43	5 48	5 54	6 01	6 05	6 09
17	4 44	4 54	5 02	5 09	5 14	5 19	5 28	5 35	5 42	5 49	5 56	6 03	6 08	6 13
21	4 35	4 46	4 55	5 03	5 10	5 15	5 25	5 33	5 41	5 49	5 57	6 06	6 11	6 17
25	4 26	4 39	4 49	4 58	5 05	5 11	5 22	5 32	5 41	5 49	5 59	6 09	6 15	6 22
29	4 17	4 31	4 43	4 52	5 00	5 08	5 20	5 30	5 40	5 50	6 00	6 12	6 19	6 26
Nov. 2	4 08	4 24	4 37	4 47	4 56	5 04	5 18	5 29	5 40	5 51	6 02	6 15	6 22	6 31
6	4 00	4 17	4 31	4 43	4 53	5 01	5 16	5 28	5 40	5 52	6 04	6 18	6 26	6 35
10	3 52	4 11	4 26	4 39	4 49	4 58	5 14	5 28	5 40	5 53	6 06	6 21	6 30	6 40
14	3 45	4 05	4 22	4 35	4 46	4 56	5 13	5 27	5 41	5 54	6 08	6 24	6 34	6 44
18	3 38	4 00	4 18	4 32	4 44	4 54	5 12	5 27	5 42	5 56	6 11	6 28	6 38	6 49
22	3 32	3 56	4 14	4 29	4 42	4 53	5 12	5 28	5 43	5 57	6 13	6 31	6 42	6 53
26	3 27	3 52	4 11	4 27	4 40	4 52	5 11	5 28	5 44	5 59	6 16	6 34	6 45	6 58
30	3 22	3 49	4 09	4 26	4 39	4 51	5 12	5 29	5 45	6 01	6 18	6 38	6 49	7 02
Dec. 4	3 19	3 47	4 08	4 25	4 39	4 51	5 12	5 30	5 47	6 03	6 21	6 41	6 52	7 06
8	3 17	3 45	4 07	4 24	4 39	4 52	5 13	5 31	5 48	6 05	6 23	6 44	6 56	7 09
12	3 16	3 45	4 07	4 25	4 40	4 52	5 14	5 33	5 50	6 07	6 26	6 47	6 59	7 13
16	3 15	3 45	4 08	4 26	4 41	4 54	5 16	5 35	5 52	6 09	6 28	6 49	7 01	7 16
20	3 16	3 47	4 09	4 27	4 42	4 55	5 17	5 36	5 54	6 12	6 30	6 51	7 04	7 18
24	3 19	3 49	4 11	4 29	4 44	4 57	5 19	5 38	5 56	6 13	6 32	6 53	7 06	7 20
28	3 22	3 52	4 14	4 32	4 47	5 00	5 22	5 41	5 58	6 15	6 34	6 55	7 07	7 21
32	3 26	3 55	4 17	4 35	4 50	5 03	5 24	5 43	6 00	6 17	6 35	6 56	7 08	7 22
36	3 32	4 00	4 21	4 39	4 53	5 05	5 27	5 45	6 02	6 19	6 36	6 57	7 09	7 22

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	18 16	18 12	18 08	18 06	18 04	18 02	17 58	17 55	17 53	17 50	17 48	17 45	17 43	17 42
5	18 23	18 18	18 13	18 10	18 07	18 04	17 59	17 55	17 52	17 48	17 44	17 40	17 38	17 35
9	18 31	18 24	18 19	18 14	18 10	18 06	18 00	17 55	17 50	17 46	17 41	17 36	17 32	17 29
13	18 39	18 31	18 24	18 18	18 13	18 09	18 02	17 55	17 49	17 44	17 38	17 31	17 27	17 23
17	18 47	18 37	18 29	18 22	18 17	18 12	18 03	17 55	17 49	17 42	17 35	17 27	17 22	17 17
21	18 56	18 44	18 34	18 27	18 20	18 14	18 04	17 56	17 48	17 40	17 32	17 23	17 17	17 11
25	19 04	18 51	18 40	18 31	18 24	18 17	18 06	17 56	17 47	17 39	17 29	17 19	17 13	17 06
29	19 12	18 57	18 45	18 36	18 27	18 20	18 08	17 57	17 47	17 37	17 27	17 15	17 08	17 01
Nov. 2	19 21	19 04	18 51	18 40	18 31	18 23	18 10	17 58	17 47	17 36	17 25	17 12	17 04	16 56
6	19 29	19 11	18 57	18 45	18 35	18 27	18 12	17 59	17 47	17 35	17 23	17 09	17 01	16 52
10	19 37	19 18	19 02	18 50	18 39	18 30	18 14	18 00	17 47	17 35	17 22	17 06	16 58	16 48
14	19 46	19 24	19 08	18 54	18 43	18 33	18 16	18 02	17 48	17 35	17 20	17 04	16 55	16 44
18	19 54	19 31	19 13	18 59	18 47	18 37	18 19	18 03	17 49	17 35	17 20	17 02	16 53	16 41
22	20 02	19 37	19 19	19 04	18 51	18 40	18 21	18 05	17 50	17 35	17 19	17 01	16 51	16 39
26	20 09	19 44	19 24	19 08	18 55	18 43	18 24	18 07	17 51	17 36	17 19	17 00	16 49	16 37
30	20 16	19 49	19 29	19 12	18 59	18 47	18 26	18 09	17 52	17 36	17 19	17 00	16 48	16 35
Dec. 4	20 22	19 54	19 33	19 16	19 02	18 50	18 29	18 11	17 54	17 37	17 20	17 00	16 48	16 35
8	20 28	19 59	19 37	19 20	19 05	18 53	18 31	18 13	17 56	17 39	17 21	17 00	16 48	16 35
12	20 33	20 03	19 41	19 23	19 08	18 56	18 34	18 15	17 58	17 40	17 22	17 01	16 49	16 35
16	20 36	20 07	19 44	19 26	19 11	18 58	18 36	18 17	18 00	17 42	17 24	17 03	16 50	16 36
20	20 39	20 09	19 46	19 28	19 13	19 00	18 38	18 19	18 02	17 44	17 26	17 04	16 52	16 38
24	20 41	20 11	19 48	19 30	19 15	19 02	18 40	18 21	18 04	17 46	17 28	17 06	16 54	16 40
28	20 41	20 12	19 49	19 31	19 17	19 04	18 42	18 23	18 06	17 48	17 30	17 09	16 57	16 42
32	20 40	20 11	19 50	19 32	19 17	19 05	18 43	18 25	18 07	17 50	17 32	17 12	16 59	16 46
36	20 39	20 11	19 49	19 32	19 18	19 05	18 44	18 26	18 09	17 53	17 35	17 14	17 03	16 49

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	5 57	5 57	5 58	5 59	6 00	6 01	6 01	6 03	6 04	6 05	6 06	6 08	6 10	6 12
5	6 01	6 02	6 03	6 04	6 05	6 07	6 08	6 10	6 12	6 14	6 16	6 18	6 21	6 25
9	6 05	6 06	6 08	6 09	6 11	6 13	6 15	6 17	6 20	6 22	6 26	6 29	6 33	6 38
13	6 09	6 11	6 12	6 15	6 17	6 19	6 22	6 25	6 28	6 31	6 35	6 40	6 45	6 51
17	6 13	6 15	6 17	6 20	6 23	6 26	6 29	6 32	6 36	6 40	6 45	6 51	6 57	7 04
21	6 17	6 20	6 23	6 26	6 29	6 32	6 36	6 40	6 45	6 50	6 55	7 02	7 09	7 18
25	6 22	6 25	6 28	6 31	6 35	6 39	6 43	6 48	6 53	6 59	7 05	7 13	7 21	7 32
29	6 26	6 29	6 33	6 37	6 41	6 45	6 50	6 55	7 01	7 08	7 16	7 24	7 34	7 46
Nov. 2	6 31	6 34	6 38	6 42	6 47	6 52	6 57	7 03	7 10	7 17	7 26	7 35	7 47	8 00
6	6 35	6 39	6 43	6 48	6 53	6 59	7 05	7 11	7 18	7 27	7 36	7 47	8 00	8 15
10	6 40	6 44	6 49	6 54	6 59	7 05	7 12	7 19	7 27	7 36	7 46	7 58	8 13	8 30
14	6 44	6 49	6 54	6 59	7 05	7 12	7 19	7 27	7 35	7 45	7 56	8 10	8 25	8 45
18	6 49	6 54	6 59	7 05	7 11	7 18	7 26	7 34	7 43	7 54	8 06	8 21	8 38	9 00
22	6 53	6 59	7 04	7 10	7 17	7 24	7 32	7 41	7 51	8 03	8 16	8 32	8 51	9 15
26	6 58	7 03	7 09	7 16	7 23	7 30	7 39	7 48	7 59	8 11	8 25	8 42	9 03	9 30
30	7 02	7 08	7 14	7 21	7 28	7 36	7 45	7 55	8 06	8 19	8 34	8 52	9 14	9 45
Dec. 4	7 06	7 12	7 18	7 25	7 33	7 41	7 50	8 00	8 12	8 26	8 41	9 01	9 25	9 59
8	7 09	7 16	7 22	7 29	7 37	7 46	7 55	8 06	8 18	8 32	8 48	9 08	9 34	10 11
12	7 13	7 19	7 26	7 33	7 41	7 50	7 59	8 10	8 23	8 37	8 54	9 15	9 42	10 22
16	7 16	7 22	7 29	7 36	7 44	7 53	8 03	8 14	8 26	8 41	8 59	9 20	9 48	10 30
20	7 18	7 24	7 31	7 39	7 47	7 56	8 05	8 17	8 29	8 44	9 02	9 23	9 52	10 34
24	7 20	7 26	7 33	7 40	7 48	7 57	8 07	8 18	8 31	8 46	9 03	9 25	9 53	10 35
28	7 21	7 27	7 34	7 42	7 50	7 58	8 08	8 19	8 32	8 46	9 03	9 25	9 52	10 33
32	7 22	7 28	7 35	7 42	7 50	7 58	8 08	8 19	8 31	8 45	9 02	9 23	9 49	10 27
36	7 22	7 28	7 35	7 42	7 49	7 58	8 07	8 18	8 29	8 43	8 59	9 19	9 44	10 19

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	17 42	17 41	17 40	17 39	17 39	17 38	17 37	17 35	17 34	17 33	17 31	17 30	17 28	17 26
5	17 35	17 34	17 33	17 32	17 30	17 29	17 27	17 26	17 24	17 22	17 19	17 17	17 14	17 10
9	17 29	17 28	17 26	17 24	17 22	17 20	17 18	17 16	17 13	17 11	17 07	17 04	17 00	16 55
13	17 23	17 21	17 19	17 17	17 15	17 12	17 09	17 07	17 03	17 00	16 56	16 51	16 46	16 40
17	17 17	17 15	17 12	17 10	17 07	17 04	17 01	16 57	16 53	16 49	16 44	16 39	16 32	16 25
21	17 11	17 09	17 06	17 03	17 00	16 56	16 52	16 48	16 44	16 39	16 33	16 26	16 19	16 10
25	17 06	17 03	17 00	16 56	16 53	16 49	16 44	16 40	16 34	16 28	16 22	16 14	16 05	15 55
29	17 01	16 57	16 54	16 50	16 46	16 41	16 36	16 31	16 25	16 18	16 11	16 02	15 52	15 40
Nov. 2	16 56	16 52	16 48	16 44	16 39	16 35	16 29	16 23	16 16	16 09	16 00	15 51	15 39	15 26
6	16 52	16 48	16 43	16 39	16 34	16 28	16 22	16 15	16 08	16 00	15 50	15 39	15 27	15 11
10	16 48	16 43	16 39	16 34	16 28	16 22	16 16	16 08	16 00	15 51	15 41	15 29	15 14	14 57
14	16 44	16 39	16 34	16 29	16 23	16 17	16 10	16 02	15 53	15 43	15 32	15 19	15 03	14 43
18	16 41	16 36	16 31	16 25	16 19	16 12	16 04	15 56	15 46	15 36	15 23	15 09	14 51	14 30
22	16 39	16 33	16 28	16 22	16 15	16 08	16 00	15 51	15 41	15 29	15 16	15 00	14 41	14 16
26	16 37	16 31	16 25	16 19	16 12	16 04	15 56	15 46	15 36	15 23	15 09	14 52	14 31	14 04
30	16 35	16 30	16 23	16 17	16 09	16 01	15 53	15 43	15 31	15 19	15 03	14 45	14 23	13 52
Dec. 4	16 35	16 29	16 22	16 15	16 08	15 59	15 50	15 40	15 28	15 15	14 59	14 40	14 15	13 42
8	16 35	16 28	16 22	16 15	16 07	15 58	15 49	15 38	15 26	15 12	14 56	14 35	14 09	13 33
12	16 35	16 29	16 22	16 15	16 07	15 58	15 48	15 37	15 25	15 11	14 54	14 33	14 05	13 26
16	16 36	16 30	16 23	16 16	16 07	15 59	15 49	15 38	15 25	15 10	14 53	14 32	14 04	13 22
20	16 38	16 31	16 24	16 17	16 09	16 00	15 50	15 39	15 26	15 12	14 54	14 32	14 04	13 21
24	16 40	16 33	16 27	16 19	16 11	16 02	15 52	15 41	15 29	15 14	14 56	14 35	14 07	13 24
28	16 42	16 36	16 29	16 22	16 14	16 05	15 56	15 45	15 32	15 18	15 00	14 39	14 11	13 31
32	16 46	16 39	16 33	16 26	16 18	16 09	15 59	15 49	15 36	15 22	15 05	14 45	14 18	13 40
36	16 49	16 43	16 37	16 30	16 22	16 13	16 04	15 54	15 42	15 28	15 12	14 52	14 27	13 52

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.		−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan.	0	8 56	9 10	9 20	9 29	9 36	9 43	9 54	10 04	10 13	10 22	10 32	10 43	10 49	10 56
	1	10 07	10 15	10 22	10 27	10 32	10 36	10 43	10 49	10 55	11 01	11 07	11 14	11 18	11 23
	2	11 16	11 20	11 22	11 25	11 27	11 28	11 31	11 34	11 36	11 39	11 41	11 44	11 46	11 48
	3	12 26	12 24	12 23	12 22	12 21	12 21	12 19	12 18	12 17	12 16	12 15	12 14	12 13	12 12
	4	13 36	13 30	13 25	13 20	13 17	13 13	13 08	13 03	12 58	12 54	12 49	12 44	12 41	12 37
	5	14 49	14 37	14 28	14 20	14 14	14 08	13 58	13 50	13 42	13 34	13 25	13 16	13 10	13 04
	6	16 03	15 46	15 33	15 22	15 13	15 05	14 51	14 39	14 27	14 16	14 04	13 51	13 43	13 34
	7	17 19	16 57	16 40	16 26	16 14	16 04	15 46	15 31	15 17	15 02	14 47	14 30	14 20	14 09
	8	18 34	18 08	17 47	17 31	17 17	17 05	16 44	16 26	16 10	15 53	15 36	15 16	15 04	14 50
	9	19 43	19 14	18 52	18 34	18 19	18 06	17 44	17 24	17 07	16 49	16 30	16 08	15 55	15 40
	10	20 42	20 13	19 51	19 33	19 18	19 05	18 43	18 24	18 06	17 48	17 29	17 07	16 54	16 39
	11	21 27	21 01	20 41	20 25	20 12	20 00	19 40	19 22	19 06	18 49	18 31	18 11	17 59	17 45
	12	22 00	21 40	21 24	21 11	21 00	20 50	20 33	20 18	20 04	19 50	19 35	19 18	19 08	18 56
	13	22 26	22 11	22 00	21 50	21 42	21 34	21 22	21 11	21 00	20 50	20 38	20 26	20 18	20 10
	14	22 46	22 37	22 30	22 25	22 19	22 15	22 07	22 00	21 54	21 47	21 40	21 32	21 28	21 22
	15	23 04	23 01	22 58	22 56	22 54	22 53	22 50	22 47	22 45	22 43	22 40	22 38	22 36	22 34
	16	23 20	23 23	23 25	23 26	23 28	23 29	23 31	23 33	23 35	23 37	23 39	23 42	23 43	23 45
	17	23 37	23 45	23 51	23 57	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
	18	23 56	.. ..	.. ..	.. ..	0 01	0 05	0 12	0 19	0 25	0 31	0 37	0 45	0 49	0 54
	19	.. ..	0 09	0 20	0 29	0 36	0 43	0 55	1 05	1 15	1 25	1 36	1 48	1 55	2 03
	20	0 19	0 37	0 52	1 04	1 15	1 24	1 40	1 54	2 07	2 20	2 34	2 51	3 00	3 11
	21	0 47	1 11	1 29	1 44	1 57	2 08	2 27	2 44	3 00	3 16	3 33	3 52	4 04	4 17
	22	1 24	1 52	2 13	2 30	2 44	2 57	3 18	3 37	3 54	4 12	4 30	4 52	5 05	5 20
	23	2 12	2 41	3 03	3 21	3 36	3 49	4 11	4 30	4 48	5 06	5 26	5 48	6 01	6 16
	24	3 11	3 39	4 00	4 17	4 32	4 44	5 06	5 24	5 42	5 59	6 18	6 39	6 51	7 06

MOONSET

		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan.	0	23 33	23 24	23 15	23 09	23 03	22 58	22 49	22 41	22 33	22 26	22 18	22 08	22 03	21 57
	1	23 48	23 42	23 38	23 34	23 31	23 28	23 24	23 19	23 15	23 11	23 06	23 01	22 58	22 55
	2	.. ..	.. ..	.. ..	23 59	23 58	23 58	23 57	23 57	23 56	23 55	23 54	23 53	23 53	23 52
	3	0 01	0 00	0 00	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
	4	0 14	0 18	0 21	0 23	0 26	0 28	0 31	0 34	0 37	0 40	0 43	0 46	0 48	0 50
	5	0 28	0 37	0 43	0 49	0 54	0 58	1 06	1 13	1 19	1 25	1 32	1 40	1 44	1 49
	6	0 45	0 58	1 08	1 17	1 25	1 32	1 43	1 54	2 03	2 13	2 23	2 35	2 42	2 50
	7	1 05	1 23	1 37	1 49	2 00	2 09	2 24	2 38	2 51	3 03	3 17	3 33	3 42	3 53
	8	1 31	1 54	2 12	2 27	2 40	2 51	3 10	3 26	3 42	3 57	4 14	4 33	4 44	4 57
	9	2 07	2 34	2 55	3 12	3 27	3 39	4 01	4 19	4 37	4 54	5 13	5 34	5 47	6 01
	10	2 57	3 26	3 49	4 07	4 22	4 35	4 57	5 17	5 35	5 53	6 12	6 34	6 47	7 02
	11	4 02	4 30	4 52	5 09	5 24	5 37	5 58	6 17	6 34	6 52	7 10	7 31	7 44	7 58
	12	5 20	5 44	6 03	6 18	6 31	6 42	7 02	7 18	7 34	7 49	8 05	8 24	8 35	8 47
	13	6 45	7 04	7 19	7 31	7 41	7 50	8 05	8 19	8 31	8 43	8 56	9 11	9 20	9 29
	14	8 14	8 26	8 36	8 44	8 51	8 58	9 08	9 17	9 26	9 34	9 43	9 54	9 59	10 06
	15	9 41	9 47	9 52	9 57	10 00	10 04	10 09	10 14	10 18	10 23	10 27	10 33	10 35	10 39
	16	11 07	11 07	11 08	11 08	11 08	11 08	11 08	11 09	11 09	11 09	11 09	11 09	11 09	11 10
	17	12 31	12 26	12 22	12 18	12 15	12 12	12 07	12 03	11 59	11 55	11 50	11 46	11 43	11 40
	18	13 55	13 44	13 35	13 27	13 21	13 15	13 05	12 57	12 49	12 41	12 32	12 23	12 17	12 11
	19	15 18	15 00	14 47	14 36	14 26	14 18	14 04	13 51	13 40	13 28	13 16	13 02	12 54	12 44
	20	16 37	16 15	15 57	15 43	15 31	15 20	15 02	14 47	14 32	14 17	14 02	13 44	13 34	13 22
	21	17 51	17 24	17 04	16 47	16 33	16 21	16 01	15 43	15 26	15 09	14 51	14 30	14 18	14 05
	22	18 56	18 27	18 05	17 47	17 32	17 19	16 57	16 38	16 20	16 02	15 43	15 21	15 08	14 53
	23	19 48	19 20	18 58	18 40	18 26	18 13	17 51	17 32	17 14	16 56	16 37	16 15	16 02	15 47
	24	20 28	20 02	19 43	19 27	19 13	19 01	18 41	18 23	18 07	17 50	17 32	17 11	16 59	16 45

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 0	10 56	10 59	11 03	11 06	11 10	11 14	11 19	11 24	11 30	11 36	11 43	11 51	12 00	12 11
1	11 23	11 25	11 27	11 29	11 32	11 34	11 37	11 40	11 44	11 48	11 52	11 57	12 03	12 09
2	11 48	11 49	11 49	11 50	11 51	11 53	11 54	11 55	11 57	11 58	12 00	12 02	12 04	12 07
3	12 12	12 12	12 11	12 11	12 11	12 10	12 10	12 09	12 09	12 08	12 07	12 06	12 06	12 04
4	12 37	12 36	12 34	12 32	12 30	12 28	12 26	12 24	12 21	12 18	12 15	12 11	12 07	12 02
5	13 04	13 01	12 58	12 55	12 52	12 48	12 44	12 40	12 35	12 30	12 24	12 17	12 09	12 00
6	13 34	13 30	13 26	13 21	13 16	13 11	13 05	12 59	12 52	12 44	12 35	12 25	12 13	11 59
7	14 09	14 04	13 58	13 53	13 46	13 39	13 32	13 23	13 14	13 03	12 51	12 37	12 20	11 59
8	14 50	14 44	14 38	14 31	14 23	14 15	14 06	13 56	13 44	13 31	13 15	12 56	12 33	12 02
9	15 40	15 34	15 26	15 19	15 10	15 01	14 51	14 39	14 26	14 10	13 52	13 30	13 00	12 15
10	16 39	16 32	16 25	16 17	16 08	15 59	15 49	15 37	15 23	15 07	14 48	14 25	13 53	13 03
11	17 45	17 39	17 32	17 25	17 17	17 09	16 59	16 48	16 36	16 22	16 05	15 44	15 18	14 41
12	18 56	18 51	18 46	18 40	18 33	18 26	18 18	18 10	18 00	17 48	17 35	17 20	17 01	16 37
13	20 10	20 06	20 02	19 57	19 53	19 47	19 42	19 35	19 28	19 21	19 12	19 01	18 49	18 34
14	21 22	21 20	21 18	21 15	21 12	21 09	21 06	21 02	20 58	20 53	20 48	20 42	20 35	20 27
15	22 34	22 33	22 33	22 32	22 31	22 30	22 28	22 27	22 26	22 24	22 22	22 20	22 18	22 16
16	23 45	23 45	23 46	23 47	23 48	23 49	23 50	23 51	23 52	23 54	23 55	23 57	23 59	.. ..
17	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 02
18	0 54	0 56	0 59	1 01	1 04	1 07	1 10	1 14	1 18	1 22	1 27	1 33	1 39	1 47
19	2 03	2 07	2 11	2 15	2 19	2 24	2 30	2 36	2 42	2 50	2 58	3 08	3 20	3 34
20	3 11	3 16	3 21	3 27	3 33	3 40	3 47	3 56	4 05	4 16	4 28	4 42	5 00	5 22
21	4 17	4 23	4 30	4 36	4 44	4 52	5 02	5 12	5 24	5 37	5 53	6 13	6 37	7 11
22	5 20	5 26	5 33	5 41	5 49	5 59	6 09	6 21	6 34	6 50	7 09	7 32	8 03	8 53
23	6 16	6 23	6 30	6 38	6 47	6 56	7 07	7 19	7 33	7 49	8 08	8 33	9 05	10 00
24	7 06	7 12	7 19	7 27	7 35	7 44	7 54	8 05	8 18	8 33	8 50	9 12	9 40	10 20

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 0	21 57	21 54	21 51	21 48	21 45	21 41	21 37	21 33	21 28	21 22	21 16	21 09	21 01	20 51
1	22 55	22 53	22 52	22 50	22 48	22 46	22 44	22 42	22 39	22 36	22 33	22 29	22 25	22 19
2	23 52	23 52	23 52	23 52	23 51	23 51	23 50	23 50	23 50	23 49	23 48	23 48	23 47	23 46
3	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
4	0 50	0 51	0 52	0 53	0 54	0 56	0 57	0 59	1 01	1 02	1 05	1 07	1 10	1 13
5	1 49	1 51	1 54	1 56	1 59	2 02	2 05	2 09	2 13	2 17	2 22	2 28	2 35	2 42
6	2 50	2 53	2 57	3 01	3 05	3 10	3 15	3 21	3 27	3 34	3 43	3 52	4 03	4 16
7	3 53	3 57	4 02	4 08	4 14	4 20	4 27	4 35	4 44	4 54	5 05	5 19	5 35	5 56
8	4 57	5 03	5 09	5 15	5 23	5 31	5 40	5 50	6 01	6 14	6 29	6 47	7 10	7 40
9	6 01	6 07	6 14	6 22	6 30	6 39	6 50	7 01	7 14	7 29	7 47	8 10	8 39	9 24
10	7 02	7 09	7 16	7 24	7 33	7 42	7 53	8 05	8 18	8 34	8 53	9 17	9 48	10 39
11	7 58	8 05	8 11	8 19	8 27	8 36	8 46	8 57	9 09	9 24	9 41	10 02	10 28	11 06
12	8 47	8 53	8 59	9 05	9 12	9 19	9 28	9 37	9 47	9 59	10 13	10 29	10 48	11 13
13	9 29	9 34	9 38	9 43	9 48	9 54	10 00	10 07	10 15	10 24	10 34	10 45	10 58	11 14
14	10 06	10 09	10 12	10 15	10 19	10 23	10 27	10 32	10 37	10 42	10 49	10 56	11 04	11 14
15	10 39	10 40	10 42	10 44	10 45	10 47	10 49	10 52	10 54	10 57	11 00	11 04	11 07	11 12
16	11 10	11 10	11 10	11 10	11 10	11 10	11 10	11 10	11 10	11 10	11 10	11 10	11 10	11 10
17	11 40	11 38	11 37	11 35	11 33	11 32	11 30	11 28	11 25	11 22	11 20	11 16	11 12	11 08
18	12 11	12 08	12 05	12 02	11 58	11 55	11 51	11 46	11 42	11 36	11 30	11 23	11 15	11 06
19	12 44	12 40	12 36	12 31	12 26	12 21	12 15	12 08	12 01	11 52	11 43	11 32	11 20	11 05
20	13 22	13 17	13 11	13 05	12 58	12 51	12 43	12 34	12 25	12 13	12 00	11 45	11 27	11 04
21	14 05	13 58	13 52	13 45	13 37	13 28	13 19	13 08	12 56	12 42	12 26	12 06	11 41	11 06
22	14 53	14 46	14 39	14 31	14 23	14 13	14 03	13 51	13 37	13 22	13 03	12 39	12 08	11 18
23	15 47	15 40	15 33	15 25	15 17	15 07	14 57	14 45	14 31	14 15	13 55	13 31	12 59	12 04
24	16 45	16 39	16 32	16 25	16 17	16 08	15 58	15 47	15 35	15 20	15 03	14 41	14 14	13 34

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	2 12	2 41	3 03	3 21	3 36	3 49	4 11	4 30	4 48	5 06	5 26	5 48	6 01	6 16
24	3 11	3 39	4 00	4 17	4 32	4 44	5 06	5 24	5 42	5 59	6 18	6 39	6 51	7 06
25	4 17	4 42	5 01	5 16	5 29	5 41	6 00	6 17	6 33	6 48	7 05	7 24	7 36	7 48
26	5 28	5 48	6 04	6 17	6 28	6 37	6 54	7 08	7 21	7 35	7 49	8 05	8 14	8 25
27	6 40	6 55	7 07	7 17	7 25	7 33	7 45	7 57	8 07	8 17	8 28	8 41	8 48	8 56
28	7 51	8 01	8 09	8 16	8 22	8 27	8 36	8 43	8 50	8 57	9 05	9 14	9 19	9 24
29	9 01	9 06	9 10	9 14	9 17	9 20	9 24	9 28	9 32	9 36	9 40	9 44	9 47	9 50
30	10 10	10 11	10 11	10 11	10 12	10 12	10 12	10 12	10 13	10 13	10 13	10 14	10 14	10 14
31	11 20	11 15	11 12	11 09	11 06	11 04	11 00	10 57	10 53	10 50	10 47	10 43	10 41	10 38
Feb. 1	12 30	12 21	12 13	12 07	12 02	11 57	11 49	11 42	11 35	11 28	11 21	11 14	11 09	11 04
2	13 43	13 28	13 16	13 07	12 59	12 52	12 39	12 29	12 19	12 09	11 58	11 46	11 40	11 32
3	14 56	14 37	14 21	14 08	13 58	13 48	13 32	13 18	13 05	12 52	12 39	12 23	12 14	12 04
4	16 11	15 46	15 27	15 11	14 58	14 47	14 28	14 11	13 55	13 40	13 23	13 04	12 53	12 41
5	17 22	16 54	16 32	16 15	16 00	15 47	15 26	15 07	14 49	14 32	14 14	13 52	13 40	13 26
6	18 25	17 56	17 33	17 15	17 00	16 47	16 25	16 05	15 47	15 29	15 10	14 47	14 34	14 19
7	19 17	18 50	18 28	18 11	17 57	17 44	17 23	17 04	16 47	16 29	16 11	15 49	15 36	15 22
8	19 56	19 33	19 16	19 01	18 48	18 37	18 19	18 02	17 47	17 31	17 15	16 56	16 45	16 32
9	20 26	20 09	19 55	19 44	19 34	19 26	19 11	18 58	18 46	18 33	18 20	18 05	17 57	17 46
10	20 49	20 38	20 29	20 21	20 15	20 09	19 59	19 50	19 42	19 34	19 25	19 15	19 09	19 02
11	21 08	21 03	20 59	20 55	20 52	20 49	20 45	20 40	20 36	20 32	20 28	20 23	20 21	20 17
12	21 26	21 26	21 26	21 27	21 27	21 27	21 28	21 28	21 29	21 29	21 30	21 30	21 31	21 31
13	21 43	21 49	21 54	21 58	22 02	22 05	22 10	22 15	22 20	22 25	22 30	22 36	22 40	22 43
14	22 01	22 13	22 22	22 30	22 37	22 43	22 54	23 03	23 12	23 20	23 30	23 41	23 47	23 54
15	22 23	22 40	22 54	23 05	23 15	23 23	23 38	23 51	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
16	22 49	23 12	23 29	23 44	23 56	.. ..	.. ..	.. ..	0 04	0 16	0 29	0 45	0 54	1 04

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	19 48	19 20	18 58	18 40	18 26	18 13	17 51	17 32	17 14	16 56	16 37	16 15	16 02	15 47
24	20 28	20 02	19 43	19 27	19 13	19 01	18 41	18 23	18 07	17 50	17 32	17 11	16 59	16 45
25	20 58	20 37	20 20	20 06	19 54	19 44	19 27	19 11	18 56	18 42	18 26	18 08	17 57	17 45
26	21 21	21 04	20 51	20 40	20 31	20 22	20 08	19 55	19 44	19 32	19 19	19 04	18 56	18 46
27	21 39	21 27	21 18	21 10	21 03	20 57	20 46	20 37	20 28	20 19	20 10	19 59	19 53	19 46
28	21 54	21 47	21 41	21 36	21 32	21 28	21 22	21 16	21 11	21 05	20 59	20 52	20 49	20 44
29	22 07	22 05	22 03	22 01	22 00	21 58	21 56	21 54	21 52	21 50	21 47	21 45	21 43	21 42
30	22 20	22 22	22 24	22 25	22 26	22 27	22 29	22 31	22 32	22 34	22 35	22 37	22 38	22 39
31	22 34	22 40	22 46	22 50	22 54	22 57	23 03	23 08	23 13	23 18	23 23	23 29	23 33	23 37
Feb. 1	22 49	23 00	23 09	23 16	23 23	23 29	23 39	23 47	23 56	.. ..	.. ..	.. ..	.. ..	.. ..
2	23 06	23 22	23 35	23 46	23 55	.. ..	.. ..	.. ..	.. ..	0 04	0 13	0 23	0 29	0 36
3	23 29	23 50	.. ..	.. ..	.. ..	0 03	0 17	0 29	0 41	0 52	1 04	1 19	1 27	1 36
4	23 59	.. ..	0 06	0 20	0 32	0 42	0 59	1 14	1 29	1 43	1 59	2 16	2 27	2 38
5	.. ..	0 25	0 45	1 01	1 14	1 26	1 46	2 04	2 21	2 37	2 55	3 16	3 28	3 42
6	0 41	1 10	1 32	1 50	2 04	2 17	2 40	2 59	3 17	3 35	3 54	4 16	4 29	4 44
7	1 38	2 07	2 30	2 48	3 03	3 16	3 38	3 57	4 15	4 33	4 52	5 14	5 27	5 42
8	2 50	3 17	3 38	3 54	4 08	4 20	4 41	4 59	5 15	5 32	5 50	6 10	6 21	6 35
9	4 15	4 36	4 53	5 07	5 19	5 29	5 46	6 01	6 15	6 29	6 44	7 00	7 10	7 21
10	5 45	6 00	6 12	6 22	6 31	6 38	6 51	7 02	7 13	7 23	7 34	7 46	7 53	8 01
11	7 16	7 25	7 32	7 38	7 43	7 48	7 55	8 02	8 08	8 14	8 21	8 28	8 32	8 37
12	8 46	8 49	8 51	8 53	8 54	8 55	8 58	9 00	9 01	9 03	9 05	9 07	9 08	9 09
13	10 15	10 11	10 08	10 06	10 04	10 02	9 59	9 56	9 53	9 51	9 48	9 45	9 43	9 41
14	11 41	11 32	11 24	11 17	11 12	11 07	10 59	10 51	10 45	10 38	10 30	10 22	10 18	10 12
15	13 06	12 50	12 38	12 28	12 19	12 11	11 58	11 47	11 36	11 26	11 14	11 01	10 54	10 46
16	14 27	14 06	13 50	13 36	13 25	13 15	12 58	12 43	12 29	12 15	12 00	11 43	11 33	11 22

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	6 16	6 23	6 30	6 38	6 47	6 56	7 07	7 19	7 33	7 49	8 08	8 33	9 05	10 00
24	7 06	7 12	7 19	7 27	7 35	7 44	7 54	8 05	8 18	8 33	8 50	9 12	9 40	10 20
25	7 48	7 54	8 00	8 07	8 14	8 22	8 31	8 40	8 51	9 04	9 18	9 36	9 57	10 25
26	8 25	8 30	8 35	8 40	8 46	8 52	9 00	9 07	9 16	9 26	9 37	9 50	10 06	10 25
27	8 56	9 00	9 04	9 08	9 12	9 17	9 23	9 29	9 35	9 42	9 50	10 00	10 11	10 24
28	9 24	9 27	9 29	9 32	9 35	9 38	9 42	9 46	9 50	9 55	10 00	10 06	10 13	10 22
29	9 50	9 51	9 52	9 54	9 55	9 57	9 59	10 01	10 03	10 06	10 08	10 12	10 15	10 19
30	10 14	10 14	10 14	10 14	10 15	10 15	10 15	10 15	10 15	10 16	10 16	10 16	10 16	10 17
31	10 38	10 37	10 36	10 35	10 34	10 32	10 31	10 29	10 27	10 25	10 23	10 21	10 18	10 14
Feb. 1	11 04	11 02	10 59	10 57	10 54	10 51	10 48	10 44	10 40	10 36	10 31	10 26	10 19	10 12
2	11 32	11 28	11 25	11 21	11 17	11 12	11 07	11 02	10 55	10 49	10 41	10 32	10 22	10 10
3	12 04	11 59	11 54	11 49	11 43	11 37	11 30	11 23	11 14	11 05	10 54	10 42	10 27	10 09
4	12 41	12 35	12 29	12 23	12 16	12 08	12 00	11 50	11 39	11 27	11 13	10 57	10 36	10 10
5	13 26	13 19	13 12	13 05	12 57	12 48	12 38	12 27	12 14	12 00	11 43	11 22	10 55	10 16
6	14 19	14 12	14 05	13 57	13 49	13 39	13 29	13 17	13 03	12 47	12 28	12 04	11 33	10 42
7	15 22	15 15	15 08	15 01	14 52	14 43	14 33	14 22	14 08	13 53	13 35	13 12	12 43	11 57
8	16 32	16 26	16 20	16 14	16 06	15 58	15 50	15 40	15 29	15 16	15 01	14 43	14 20	13 50
9	17 46	17 42	17 37	17 32	17 26	17 20	17 14	17 06	16 58	16 48	16 37	16 25	16 10	15 51
10	19 02	18 59	18 56	18 53	18 49	18 45	18 41	18 36	18 30	18 24	18 18	18 10	18 01	17 50
11	20 17	20 16	20 15	20 13	20 11	20 09	20 07	20 05	20 03	20 00	19 57	19 53	19 49	19 45
12	21 31	21 31	21 32	21 32	21 32	21 32	21 33	21 33	21 33	21 34	21 34	21 35	21 35	21 36
13	22 43	22 45	22 47	22 49	22 51	22 54	22 56	22 59	23 02	23 06	23 10	23 14	23 19	23 25
14	23 54	23 58	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
15	.. ..	.. ..	0 01	0 05	0 09	0 13	0 18	0 23	0 29	0 36	0 43	0 52	1 02	1 14
16	1 04	1 08	1 13	1 19	1 24	1 31	1 38	1 45	1 54	2 04	2 15	2 28	2 44	3 04

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	15 47	15 40	15 33	15 25	15 17	15 07	14 57	14 45	14 31	14 15	13 55	13 31	12 59	12 04
24	16 45	16 39	16 32	16 25	16 17	16 08	15 58	15 47	15 35	15 20	15 03	14 41	14 14	13 34
25	17 45	17 40	17 34	17 28	17 21	17 13	17 05	16 56	16 45	16 33	16 19	16 02	15 41	15 14
26	18 46	18 41	18 37	18 32	18 26	18 20	18 14	18 06	17 58	17 49	17 38	17 26	17 11	16 53
27	19 46	19 42	19 39	19 35	19 31	19 27	19 22	19 17	19 11	19 05	18 57	18 49	18 39	18 27
28	20 44	20 42	20 40	20 38	20 35	20 33	20 30	20 27	20 23	20 19	20 15	20 10	20 04	19 57
29	21 42	21 41	21 40	21 39	21 38	21 37	21 36	21 35	21 34	21 32	21 31	21 29	21 27	21 24
30	22 39	22 39	22 40	22 41	22 41	22 42	22 43	22 43	22 44	22 45	22 46	22 48	22 49	22 51
31	23 37	23 38	23 40	23 42	23 44	23 47	23 49	23 52	23 55	23 59	.. ..	.. ..	.. ..	.. ..
Feb. 1	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 02	0 07	0 12	0 18
2	0 36	0 39	0 42	0 45	0 49	0 53	0 57	1 02	1 07	1 13	1 20	1 28	1 37	1 48
3	1 36	1 40	1 45	1 50	1 55	2 01	2 07	2 14	2 22	2 30	2 40	2 52	3 06	3 23
4	2 38	2 44	2 49	2 56	3 02	3 10	3 18	3 27	3 37	3 49	4 02	4 18	4 38	5 03
5	3 42	3 48	3 54	4 02	4 10	4 18	4 28	4 39	4 51	5 05	5 22	5 43	6 09	6 47
6	4 44	4 50	4 58	5 05	5 14	5 23	5 34	5 46	5 59	6 15	6 34	6 58	7 30	8 20
7	5 42	5 49	5 56	6 04	6 12	6 21	6 32	6 43	6 57	7 12	7 31	7 54	8 23	9 09
8	6 35	6 41	6 47	6 54	7 02	7 10	7 19	7 30	7 41	7 54	8 10	8 29	8 52	9 22
9	7 21	7 26	7 31	7 37	7 43	7 50	7 57	8 05	8 14	8 24	8 36	8 49	9 06	9 25
10	8 01	8 05	8 09	8 13	8 17	8 22	8 27	8 32	8 39	8 46	8 54	9 03	9 13	9 25
11	8 37	8 39	8 41	8 43	8 46	8 49	8 52	8 55	8 58	9 02	9 07	9 12	9 17	9 24
12	9 09	9 10	9 11	9 11	9 12	9 13	9 13	9 14	9 15	9 16	9 17	9 19	9 20	9 22
13	9 41	9 40	9 39	9 38	9 37	9 35	9 34	9 33	9 31	9 29	9 27	9 25	9 23	9 20
14	10 12	10 10	10 07	10 05	10 02	9 59	9 55	9 51	9 47	9 43	9 38	9 32	9 25	9 18
15	10 46	10 42	10 38	10 33	10 29	10 24	10 18	10 12	10 06	9 58	9 50	9 40	9 29	9 16
16	11 22	11 17	11 12	11 06	11 00	10 53	10 46	10 37	10 28	10 18	10 06	9 52	9 35	9 14

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	22 23	22 40	22 54	23 05	23 15	23 23	23 38	23 51	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
16	22 49	23 12	23 29	23 44	23 56	.. ..	.. ..	.. ..	0 04	0 16	0 29	0 45	0 54	1 04
17	23 23	23 50	.. ..	.. ..	.. ..	0 07	0 25	0 41	0 56	1 12	1 28	1 47	1 58	2 11
18	.. ..	.. ..	0 11	0 27	0 41	0 54	1 15	1 33	1 50	2 07	2 26	2 47	3 00	3 14
19	0 08	0 37	0 59	1 16	1 31	1 44	2 07	2 26	2 44	3 02	3 21	3 44	3 57	4 12
20	1 02	1 31	1 53	2 10	2 25	2 38	3 00	3 19	3 37	3 55	4 14	4 35	4 48	5 03
21	2 06	2 32	2 52	3 08	3 22	3 34	3 54	4 12	4 28	4 44	5 02	5 22	5 34	5 47
22	3 15	3 37	3 54	4 08	4 20	4 30	4 47	5 03	5 17	5 31	5 46	6 03	6 14	6 25
23	4 27	4 43	4 57	5 08	5 17	5 25	5 39	5 52	6 03	6 15	6 27	6 41	6 49	6 58
24	5 38	5 50	5 59	6 07	6 14	6 20	6 30	6 39	6 47	6 55	7 04	7 14	7 20	7 26
25	6 49	6 55	7 01	7 05	7 09	7 13	7 19	7 24	7 29	7 34	7 39	7 45	7 49	7 52
26	7 58	8 00	8 02	8 03	8 04	8 05	8 07	8 09	8 10	8 12	8 13	8 15	8 16	8 17
27	9 08	9 05	9 02	9 00	8 59	8 57	8 55	8 53	8 51	8 49	8 46	8 44	8 43	8 41
28	10 17	10 10	10 03	9 58	9 54	9 50	9 43	9 37	9 32	9 26	9 20	9 14	9 10	9 06
29	11 28	11 16	11 05	10 57	10 50	10 43	10 32	10 23	10 14	10 05	9 56	9 45	9 39	9 32
Mar. 1	12 41	12 23	12 08	11 57	11 47	11 38	11 23	11 10	10 58	10 47	10 34	10 19	10 11	10 02
2	13 53	13 30	13 12	12 58	12 46	12 35	12 17	12 01	11 46	11 31	11 16	10 58	10 47	10 36
3	15 04	14 37	14 16	13 59	13 45	13 33	13 12	12 54	12 37	12 20	12 02	11 41	11 29	11 16
4	16 10	15 40	15 18	14 59	14 44	14 31	14 09	13 49	13 31	13 13	12 54	12 32	12 19	12 04
5	17 06	16 36	16 14	15 56	15 41	15 28	15 06	14 46	14 28	14 10	13 51	13 29	13 16	13 01
6	17 50	17 24	17 04	16 48	16 34	16 22	16 02	15 44	15 27	15 10	14 52	14 32	14 20	14 06
7	18 23	18 03	17 47	17 33	17 22	17 12	16 55	16 40	16 26	16 12	15 57	15 39	15 29	15 18
8	18 49	18 35	18 23	18 14	18 05	17 58	17 45	17 34	17 24	17 13	17 02	16 49	16 42	16 33
9	19 10	19 02	18 55	18 49	18 45	18 40	18 33	18 26	18 20	18 14	18 07	17 59	17 55	17 50
10	19 28	19 26	19 24	19 23	19 21	19 20	19 18	19 16	19 15	19 13	19 11	19 09	19 08	19 07

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	13 06	12 50	12 38	12 28	12 19	12 11	11 58	11 47	11 36	11 26	11 14	11 01	10 54	10 46
16	14 27	14 06	13 50	13 36	13 25	13 15	12 58	12 43	12 29	12 15	12 00	11 43	11 33	11 22
17	15 44	15 18	14 58	14 42	14 28	14 16	13 56	13 38	13 22	13 06	12 48	12 28	12 17	12 03
18	16 51	16 22	16 00	15 42	15 28	15 15	14 53	14 34	14 16	13 58	13 39	13 17	13 04	12 50
19	17 46	17 17	16 55	16 37	16 22	16 09	15 47	15 27	15 09	14 51	14 32	14 10	13 57	13 41
20	18 29	18 02	17 41	17 25	17 11	16 58	16 37	16 19	16 02	15 44	15 26	15 05	14 52	14 38
21	19 01	18 38	18 20	18 06	17 53	17 42	17 24	17 07	16 52	16 36	16 20	16 01	15 50	15 37
22	19 25	19 07	18 53	18 41	18 31	18 22	18 06	17 52	17 39	17 27	17 13	16 57	16 47	16 37
23	19 45	19 31	19 20	19 11	19 04	18 57	18 45	18 34	18 25	18 15	18 04	17 52	17 45	17 36
24	20 00	19 52	19 45	19 39	19 34	19 29	19 21	19 14	19 08	19 01	18 54	18 46	18 41	18 35
25	20 14	20 10	20 07	20 04	20 01	19 59	19 56	19 52	19 49	19 46	19 42	19 38	19 36	19 33
26	20 27	20 28	20 28	20 28	20 28	20 29	20 29	20 29	20 30	20 30	20 30	20 30	20 31	20 31
27	20 40	20 45	20 49	20 52	20 55	20 58	21 02	21 06	21 10	21 14	21 18	21 23	21 25	21 28
28	20 54	21 03	21 11	21 18	21 23	21 28	21 37	21 45	21 52	21 59	22 07	22 15	22 21	22 26
29	21 10	21 24	21 36	21 45	21 54	22 01	22 14	22 25	22 35	22 46	22 57	23 10	23 17	23 25
Mar. 1	21 30	21 49	22 04	22 17	22 27	22 37	22 53	23 07	23 21	23 34	23 49	.. ..	.. ..	.. ..
2	21 55	22 19	22 38	22 53	23 06	23 18	23 37	23 54	.. ..	.. ..	.. ..	0 05	0 15	0 26
3	22 30	22 58	23 20	23 37	23 52	.. ..	.. ..	.. ..	0 10	0 26	0 43	1 03	1 14	1 27
4	23 18	23 48	.. ..	.. ..	.. ..	0 04	0 26	0 45	1 02	1 20	1 39	2 01	2 13	2 28
5	.. ..	.. ..	0 11	0 29	0 45	0 58	1 20	1 40	1 58	2 16	2 36	2 58	3 12	3 27
6	0 22	0 51	1 13	1 30	1 45	1 58	2 20	2 39	2 56	3 14	3 33	3 54	4 07	4 21
7	1 40	2 05	2 24	2 39	2 52	3 04	3 23	3 40	3 55	4 11	4 27	4 46	4 57	5 09
8	3 07	3 26	3 41	3 53	4 03	4 12	4 28	4 41	4 54	5 06	5 19	5 34	5 42	5 52
9	4 39	4 52	5 01	5 10	5 17	5 23	5 33	5 42	5 51	5 59	6 08	6 18	6 23	6 30
10	6 12	6 18	6 23	6 27	6 30	6 33	6 38	6 42	6 46	6 50	6 54	6 59	7 01	7 04

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	.. ..	.. ..	0 01	0 05	0 09	0 13	0 18	0 23	0 29	0 36	0 43	0 52	1 02	1 14
16	1 04	1 08	1 13	1 19	1 24	1 31	1 38	1 45	1 54	2 04	2 15	2 28	2 44	3 04
17	2 11	2 17	2 23	2 29	2 37	2 45	2 54	3 03	3 15	3 28	3 43	4 01	4 24	4 54
18	3 14	3 21	3 28	3 35	3 44	3 53	4 03	4 14	4 28	4 43	5 01	5 24	5 54	6 40
19	4 12	4 19	4 26	4 34	4 43	4 52	5 03	5 15	5 29	5 45	6 05	6 30	7 03	8 02
20	5 03	5 10	5 17	5 24	5 33	5 42	5 53	6 04	6 18	6 33	6 52	7 15	7 45	8 31
21	5 47	5 53	6 00	6 07	6 14	6 23	6 32	6 42	6 54	7 07	7 23	7 42	8 05	8 37
22	6 25	6 30	6 36	6 41	6 48	6 55	7 02	7 11	7 21	7 31	7 44	7 58	8 16	8 37
23	6 58	7 02	7 06	7 11	7 16	7 21	7 27	7 33	7 41	7 49	7 58	8 09	8 21	8 36
24	7 26	7 29	7 32	7 36	7 39	7 43	7 47	7 52	7 57	8 02	8 09	8 16	8 24	8 34
25	7 52	7 54	7 56	7 58	8 00	8 02	8 05	8 07	8 10	8 13	8 17	8 21	8 26	8 31
26	8 17	8 18	8 18	8 19	8 19	8 20	8 21	8 21	8 22	8 23	8 24	8 26	8 27	8 29
27	8 41	8 40	8 40	8 39	8 38	8 37	8 36	8 35	8 34	8 33	8 31	8 30	8 28	8 26
28	9 06	9 04	9 02	9 00	8 58	8 55	8 52	8 50	8 46	8 43	8 39	8 34	8 29	8 23
29	9 32	9 29	9 26	9 22	9 19	9 15	9 10	9 05	9 00	8 54	8 47	8 40	8 31	8 21
Mar. 1	10 02	9 57	9 53	9 48	9 43	9 37	9 31	9 24	9 17	9 08	8 59	8 48	8 35	8 19
2	10 36	10 30	10 25	10 19	10 12	10 05	9 57	9 48	9 38	9 27	9 14	8 59	8 41	8 18
3	11 16	11 10	11 03	10 56	10 48	10 40	10 30	10 19	10 07	9 54	9 37	9 18	8 53	8 20
4	12 04	11 57	11 50	11 42	11 33	11 24	11 13	11 02	10 48	10 32	10 14	9 50	9 19	8 31
5	13 01	12 54	12 46	12 39	12 30	12 20	12 10	11 58	11 44	11 28	11 09	10 44	10 12	9 17
6	14 06	14 00	13 53	13 46	13 38	13 29	13 19	13 08	12 56	12 41	12 24	12 03	11 36	10 58
7	15 18	15 12	15 07	15 01	14 54	14 47	14 39	14 30	14 20	14 09	13 56	13 40	13 21	12 57
8	16 33	16 29	16 25	16 21	16 16	16 11	16 05	15 59	15 52	15 44	15 35	15 25	15 13	14 58
9	17 50	17 48	17 45	17 43	17 40	17 37	17 34	17 30	17 26	17 22	17 17	17 11	17 05	16 57
10	19 07	19 06	19 06	19 05	19 04	19 03	19 03	19 02	19 01	19 00	18 58	18 57	18 55	18 54

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	10 46	10 42	10 38	10 33	10 29	10 24	10 18	10 12	10 06	9 58	9 50	9 40	9 29	9 16
16	11 22	11 17	11 12	11 06	11 00	10 53	10 46	10 37	10 28	10 18	10 06	9 52	9 35	9 14
17	12 03	11 57	11 51	11 44	11 36	11 28	11 19	11 09	10 57	10 44	10 28	10 09	9 46	9 15
18	12 50	12 43	12 36	12 28	12 20	12 10	12 00	11 48	11 35	11 19	11 01	10 38	10 08	9 21
19	13 41	13 35	13 27	13 19	13 11	13 01	12 50	12 38	12 24	12 08	11 48	11 24	10 50	9 52
20	14 38	14 31	14 24	14 17	14 08	13 59	13 49	13 37	13 24	13 09	12 51	12 28	11 58	11 12
21	15 37	15 31	15 25	15 18	15 11	15 03	14 54	14 44	14 32	14 19	14 04	13 46	13 22	12 51
22	16 37	16 32	16 27	16 21	16 15	16 09	16 01	15 53	15 44	15 34	15 22	15 08	14 52	14 31
23	17 36	17 33	17 29	17 25	17 20	17 15	17 10	17 04	16 57	16 50	16 41	16 32	16 20	16 06
24	18 35	18 33	18 30	18 28	18 25	18 22	18 18	18 14	18 10	18 05	18 00	17 53	17 46	17 38
25	19 33	19 32	19 31	19 30	19 28	19 27	19 25	19 23	19 21	19 19	19 16	19 13	19 10	19 06
26	20 31	20 31	20 31	20 31	20 31	20 31	20 31	20 32	20 32	20 32	20 32	20 32	20 33	20 33
27	21 28	21 30	21 31	21 33	21 34	21 36	21 38	21 40	21 42	21 45	21 48	21 51	21 55	22 00
28	22 26	22 29	22 32	22 35	22 38	22 41	22 45	22 49	22 54	22 59	23 05	23 11	23 19	23 28
29	23 25	23 29	23 33	23 38	23 42	23 47	23 53	23 59	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
Mar. 1	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 06	0 14	0 23	0 33	0 46	1 00
2	0 26	0 31	0 36	0 42	0 48	0 55	1 02	1 11	1 20	1 31	1 43	1 57	2 15	2 37
3	1 27	1 33	1 39	1 46	1 54	2 02	2 11	2 22	2 33	2 47	3 02	3 22	3 46	4 19
4	2 28	2 35	2 42	2 50	2 58	3 07	3 18	3 29	3 43	3 58	4 17	4 40	5 11	5 59
5	3 27	3 34	3 41	3 49	3 58	4 07	4 18	4 30	4 44	5 00	5 19	5 44	6 16	7 11
6	4 21	4 27	4 34	4 42	4 50	4 59	5 09	5 20	5 33	5 48	6 05	6 26	6 54	7 33
7	5 09	5 15	5 21	5 27	5 34	5 42	5 50	6 00	6 10	6 22	6 36	6 52	7 12	7 37
8	5 52	5 56	6 01	6 06	6 11	6 17	6 23	6 30	6 38	6 47	6 57	7 08	7 22	7 37
9	6 30	6 33	6 36	6 39	6 43	6 46	6 50	6 55	7 00	7 05	7 12	7 19	7 27	7 36
10	7 04	7 06	7 07	7 08	7 10	7 12	7 14	7 16	7 18	7 20	7 23	7 26	7 30	7 34

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	19 10	19 02	18 55	18 49	18 45	18 40	18 33	18 26	18 20	18 14	18 07	17 59	17 55	17 50
10	19 28	19 26	19 24	19 23	19 21	19 20	19 18	19 16	19 15	19 13	19 11	19 09	19 08	19 07
11	19 46	19 49	19 52	19 55	19 57	19 59	20 02	20 05	20 08	20 11	20 14	20 18	20 20	20 23
12	20 04	20 13	20 21	20 27	20 33	20 38	20 47	20 54	21 02	21 09	21 17	21 26	21 31	21 37
13	20 24	20 40	20 52	21 02	21 11	21 19	21 32	21 44	21 55	22 07	22 19	22 33	22 41	22 50
14	20 50	21 11	21 27	21 41	21 52	22 02	22 20	22 35	22 50	23 05	23 20	23 38	23 49	.. ..
15	21 22	21 48	22 07	22 24	22 37	22 49	23 10	23 28	23 45	.. ..	.. ..	.. ..	.. ..	0 01
16	22 03	22 32	22 54	23 12	23 27	23 40	.. ..	.. ..	.. ..	0 02	0 20	0 41	0 53	1 08
17	22 55	23 25	23 47	.. ..	.. ..	.. ..	0 02	0 22	0 40	0 58	1 17	1 40	1 53	2 08
18	23 57	.. ..	.. ..	0 05	0 20	0 34	0 56	1 15	1 33	1 52	2 11	2 34	2 47	3 02
19	.. ..	0 24	0 45	1 02	1 16	1 29	1 50	2 08	2 25	2 42	3 01	3 22	3 34	3 48
20	1 05	1 28	1 47	2 01	2 14	2 25	2 43	3 00	3 15	3 30	3 46	4 04	4 15	4 27
21	2 16	2 34	2 49	3 01	3 11	3 20	3 35	3 49	4 01	4 14	4 27	4 42	4 51	5 01
22	3 27	3 41	3 51	4 00	4 08	4 15	4 26	4 36	4 46	4 55	5 05	5 16	5 23	5 30
23	4 38	4 46	4 53	4 59	5 04	5 08	5 15	5 22	5 28	5 34	5 40	5 48	5 52	5 57
24	5 48	5 51	5 54	5 57	5 59	6 01	6 04	6 06	6 09	6 12	6 14	6 17	6 19	6 21
25	6 58	6 56	6 55	6 54	6 53	6 53	6 51	6 50	6 49	6 49	6 48	6 46	6 46	6 45
26	8 08	8 01	7 56	7 52	7 48	7 45	7 40	7 35	7 30	7 26	7 21	7 16	7 13	7 09
27	9 18	9 07	8 58	8 50	8 44	8 38	8 28	8 20	8 12	8 04	7 56	7 46	7 41	7 35
28	10 30	10 14	10 01	9 50	9 41	9 33	9 19	9 07	8 56	8 45	8 33	8 19	8 12	8 03
29	11 43	11 21	11 04	10 50	10 38	10 28	10 11	9 56	9 42	9 28	9 13	8 56	8 46	8 35
30	12 54	12 27	12 07	11 51	11 37	11 25	11 05	10 47	10 31	10 14	9 57	9 37	9 25	9 12
31	14 01	13 31	13 08	12 50	12 35	12 22	12 00	11 41	11 23	11 05	10 45	10 23	10 11	9 56
Apr. 1	14 59	14 28	14 05	13 47	13 32	13 18	12 55	12 36	12 17	11 59	11 39	11 16	11 03	10 48
2	15 46	15 18	14 56	14 39	14 24	14 12	13 50	13 31	13 13	12 56	12 37	12 15	12 02	11 47

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	4 39	4 52	5 01	5 10	5 17	5 23	5 33	5 42	5 51	5 59	6 08	6 18	6 23	6 30
10	6 12	6 18	6 23	6 27	6 30	6 33	6 38	6 42	6 46	6 50	6 54	6 59	7 01	7 04
11	7 45	7 44	7 43	7 43	7 42	7 42	7 41	7 41	7 40	7 39	7 39	7 38	7 37	7 37
12	9 16	9 09	9 03	8 58	8 54	8 50	8 44	8 39	8 33	8 28	8 23	8 17	8 13	8 09
13	10 45	10 32	10 21	10 12	10 05	9 58	9 46	9 36	9 27	9 18	9 08	8 57	8 50	8 43
14	12 12	11 52	11 37	11 24	11 14	11 04	10 48	10 34	10 21	10 08	9 55	9 39	9 30	9 19
15	13 33	13 08	12 49	12 33	12 20	12 09	11 49	11 32	11 16	11 00	10 43	10 24	10 13	10 00
16	14 45	14 16	13 55	13 37	13 22	13 10	12 48	12 29	12 11	11 54	11 35	11 13	11 00	10 46
17	15 45	15 15	14 53	14 35	14 19	14 06	13 44	13 24	13 06	12 47	12 28	12 05	11 52	11 37
18	16 31	16 03	15 42	15 24	15 10	14 57	14 35	14 16	13 59	13 41	13 22	13 00	12 47	12 32
19	17 06	16 41	16 23	16 07	15 54	15 42	15 23	15 06	14 49	14 33	14 16	13 56	13 44	13 30
20	17 32	17 12	16 56	16 43	16 32	16 23	16 06	15 51	15 37	15 24	15 09	14 52	14 42	14 30
21	17 52	17 37	17 25	17 15	17 06	16 59	16 45	16 34	16 23	16 12	16 00	15 47	15 39	15 30
22	18 08	17 58	17 50	17 43	17 37	17 31	17 22	17 14	17 06	16 58	16 50	16 41	16 35	16 29
23	18 22	18 17	18 12	18 08	18 05	18 02	17 57	17 52	17 48	17 43	17 39	17 33	17 30	17 27
24	18 35	18 34	18 33	18 32	18 32	18 31	18 30	18 29	18 29	18 28	18 27	18 26	18 25	18 24
25	18 47	18 51	18 54	18 56	18 58	19 00	19 04	19 06	19 09	19 12	19 15	19 18	19 20	19 22
26	19 00	19 09	19 15	19 21	19 26	19 30	19 38	19 44	19 50	19 56	20 03	20 11	20 15	20 20
27	19 15	19 28	19 39	19 48	19 55	20 02	20 13	20 23	20 33	20 42	20 53	21 04	21 11	21 19
28	19 33	19 51	20 05	20 17	20 27	20 36	20 51	21 05	21 18	21 30	21 44	21 59	22 08	22 19
29	19 56	20 19	20 37	20 51	21 04	21 15	21 33	21 50	22 05	22 20	22 37	22 56	23 07	23 19
30	20 27	20 54	21 15	21 31	21 46	21 58	22 19	22 38	22 55	23 13	23 31	23 52	.. ..	.. ..
31	21 08	21 38	22 01	22 19	22 34	22 48	23 10	23 30	23 48	.. ..	.. ..	.. ..	0 05	0 19
Apr. 1	22 03	22 34	22 56	23 15	23 30	23 43	.. ..	.. ..	.. ..	0 07	0 26	0 49	1 02	1 18
2	23 13	23 41	.. ..	.. ..	.. ..	.. ..	0 06	0 26	0 44	1 02	1 21	1 44	1 57	2 12

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	17 50	17 48	17 45	17 43	17 40	17 37	17 34	17 30	17 26	17 22	17 17	17 11	17 05	16 57
10	19 07	19 06	19 06	19 05	19 04	19 03	19 03	19 02	19 01	19 00	18 58	18 57	18 55	18 54
11	20 23	20 24	20 25	20 26	20 27	20 29	20 30	20 32	20 34	20 36	20 39	20 41	20 44	20 48
12	21 37	21 40	21 43	21 46	21 49	21 53	21 57	22 01	22 06	22 11	22 17	22 24	22 33	22 42
13	22 50	22 55	22 59	23 04	23 09	23 15	23 21	23 28	23 36	23 44	23 55	.. ..	.. ..	.. ..
14	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 06	0 20	0 37
15	0 01	0 06	0 12	0 19	0 26	0 33	0 41	0 51	1 01	1 14	1 28	1 45	2 05	2 33
16	1 08	1 14	1 21	1 28	1 36	1 45	1 55	2 07	2 20	2 35	2 52	3 15	3 43	4 27
17	2 08	2 15	2 23	2 31	2 39	2 49	3 00	3 12	3 26	3 43	4 03	4 28	5 03	6 06
18	3 02	3 09	3 16	3 24	3 33	3 42	3 53	4 05	4 19	4 35	4 55	5 19	5 52	6 48
19	3 48	3 54	4 01	4 08	4 16	4 25	4 35	4 46	4 58	5 12	5 29	5 50	6 16	6 53
20	4 27	4 33	4 38	4 45	4 52	4 59	5 07	5 16	5 27	5 39	5 52	6 08	6 28	6 52
21	5 01	5 05	5 10	5 15	5 20	5 26	5 33	5 40	5 48	5 57	6 07	6 19	6 33	6 50
22	5 30	5 33	5 37	5 41	5 45	5 49	5 54	5 59	6 05	6 11	6 18	6 27	6 36	6 48
23	5 57	5 59	6 01	6 03	6 06	6 09	6 12	6 15	6 18	6 22	6 27	6 32	6 38	6 45
24	6 21	6 22	6 23	6 24	6 25	6 26	6 28	6 29	6 31	6 32	6 34	6 36	6 39	6 41
25	6 45	6 45	6 45	6 44	6 44	6 43	6 43	6 42	6 42	6 41	6 41	6 40	6 39	6 38
26	7 09	7 08	7 06	7 05	7 03	7 01	6 59	6 56	6 54	6 51	6 48	6 44	6 40	6 35
27	7 35	7 32	7 29	7 26	7 23	7 19	7 15	7 11	7 06	7 01	6 55	6 49	6 41	6 32
28	8 03	7 59	7 55	7 50	7 46	7 40	7 35	7 29	7 22	7 14	7 05	6 55	6 43	6 29
29	8 35	8 30	8 24	8 19	8 12	8 06	7 58	7 50	7 41	7 30	7 18	7 04	6 48	6 27
30	9 12	9 06	8 59	8 53	8 45	8 37	8 28	8 18	8 06	7 53	7 38	7 19	6 56	6 26
31	9 56	9 49	9 42	9 34	9 26	9 16	9 06	8 54	8 41	8 26	8 07	7 44	7 14	6 28
Apr. 1	10 48	10 41	10 33	10 25	10 16	10 06	9 56	9 43	9 29	9 13	8 53	8 27	7 53	6 50
2	11 47	11 41	11 34	11 26	11 17	11 08	10 58	10 46	10 32	10 17	9 58	9 34	9 03	8 13

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	6 30	6 33	6 36	6 39	6 43	6 46	6 50	6 55	7 00	7 05	7 12	7 19	7 27	7 36
10	7 04	7 06	7 07	7 08	7 10	7 12	7 14	7 16	7 18	7 20	7 23	7 26	7 30	7 34
11	7 37	7 37	7 36	7 36	7 36	7 35	7 35	7 35	7 34	7 34	7 33	7 33	7 32	7 31
12	8 09	8 07	8 05	8 03	8 01	7 59	7 56	7 54	7 51	7 47	7 43	7 39	7 34	7 29
13	8 43	8 39	8 36	8 32	8 28	8 24	8 19	8 14	8 08	8 02	7 55	7 47	7 37	7 26
14	9 19	9 15	9 10	9 04	8 59	8 52	8 46	8 38	8 30	8 20	8 09	7 57	7 42	7 24
15	10 00	9 54	9 48	9 41	9 34	9 26	9 17	9 07	8 56	8 44	8 29	8 12	7 50	7 22
16	10 46	10 39	10 32	10 24	10 16	10 07	9 57	9 45	9 32	9 17	8 58	8 36	8 07	7 23
17	11 37	11 30	11 22	11 14	11 05	10 56	10 45	10 32	10 18	10 02	9 42	9 16	8 42	7 38
18	12 32	12 25	12 18	12 10	12 02	11 52	11 42	11 30	11 16	11 00	10 40	10 16	9 43	8 48
19	13 30	13 24	13 18	13 11	13 03	12 54	12 45	12 34	12 22	12 08	11 52	11 31	11 06	10 29
20	14 30	14 25	14 19	14 13	14 07	14 00	13 52	13 43	13 33	13 22	13 09	12 54	12 35	12 11
21	15 30	15 26	15 21	15 17	15 12	15 06	15 00	14 54	14 46	14 38	14 28	14 17	14 04	13 48
22	16 29	16 26	16 23	16 20	16 16	16 12	16 08	16 04	15 59	15 53	15 46	15 39	15 31	15 20
23	17 27	17 25	17 24	17 22	17 20	17 18	17 16	17 13	17 10	17 07	17 04	17 00	16 55	16 50
24	18 24	18 24	18 24	18 23	18 23	18 23	18 22	18 22	18 21	18 21	18 20	18 19	18 18	18 17
25	19 22	19 23	19 24	19 25	19 26	19 27	19 29	19 30	19 32	19 34	19 36	19 38	19 41	19 44
26	20 20	20 22	20 25	20 27	20 30	20 33	20 36	20 40	20 43	20 48	20 53	20 58	21 05	21 13
27	21 19	21 22	21 26	21 30	21 34	21 39	21 44	21 50	21 56	22 03	22 11	22 20	22 31	22 44
28	22 19	22 23	22 28	22 34	22 39	22 46	22 53	23 01	23 09	23 19	23 31	23 44	.. ..	.. ..
29	23 19	23 25	23 31	23 38	23 45	23 53	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 00	0 20
30	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 02	0 11	0 22	0 35	0 50	1 08	1 31	2 00
31	0 19	0 26	0 33	0 41	0 49	0 58	1 08	1 20	1 33	1 48	2 06	2 29	2 58	3 44
Apr. 1	1 18	1 25	1 32	1 40	1 49	1 59	2 09	2 22	2 36	2 52	3 12	3 37	4 12	5 15
2	2 12	2 19	2 26	2 34	2 43	2 52	3 03	3 15	3 28	3 44	4 03	4 27	4 58	5 48

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 1	14 59	14 28	14 05	13 47	13 32	13 18	12 55	12 36	12 17	11 59	11 39	11 16	11 03	10 48
2	15 46	15 18	14 56	14 39	14 24	14 12	13 50	13 31	13 13	12 56	12 37	12 15	12 02	11 47
3	16 22	15 59	15 40	15 25	15 13	15 02	14 43	14 26	14 10	13 55	13 38	13 19	13 07	12 54
4	16 50	16 32	16 18	16 06	15 56	15 48	15 33	15 19	15 07	14 54	14 41	14 25	14 16	14 06
5	17 12	17 00	16 51	16 43	16 36	16 30	16 20	16 11	16 02	15 54	15 44	15 34	15 28	15 21
6	17 30	17 25	17 20	17 17	17 13	17 10	17 05	17 01	16 57	16 53	16 48	16 43	16 40	16 37
7	17 48	17 48	17 49	17 49	17 49	17 49	17 50	17 50	17 51	17 51	17 52	17 53	17 53	17 53
8	18 05	18 12	18 17	18 21	18 25	18 29	18 35	18 40	18 45	18 50	18 56	19 02	19 06	19 10
9	18 24	18 37	18 47	18 56	19 03	19 09	19 21	19 31	19 40	19 50	20 00	20 12	20 18	20 26
10	18 48	19 06	19 21	19 33	19 44	19 53	20 09	20 23	20 36	20 50	21 04	21 20	21 30	21 41
11	19 17	19 41	20 00	20 16	20 29	20 40	21 00	21 17	21 33	21 50	22 07	22 27	22 39	22 53
12	19 55	20 24	20 46	21 03	21 18	21 31	21 53	22 12	22 30	22 48	23 08	23 30	23 43	23 59
13	20 45	21 15	21 38	21 57	22 12	22 25	22 48	23 08	23 27	23 45	.. ..	.. ..	.. ..	.. ..
14	21 45	22 14	22 36	22 54	23 09	23 22	23 44	.. ..	.. ..	.. ..	0 05	0 28	0 41	0 57
15	22 53	23 18	23 38	23 54	.. ..	.. ..	.. ..	0 03	0 20	0 38	0 57	1 19	1 32	1 47
16	.. ..	.. ..	.. ..	.. ..	0 07	0 18	0 38	0 55	1 11	1 27	1 45	2 04	2 16	2 29
17	0 04	0 25	0 41	0 54	1 05	1 15	1 31	1 46	1 59	2 13	2 27	2 44	2 53	3 04
18	1 16	1 31	1 43	1 54	2 02	2 10	2 23	2 34	2 44	2 55	3 06	3 19	3 26	3 34
19	2 27	2 37	2 46	2 52	2 58	3 03	3 12	3 20	3 27	3 34	3 42	3 51	3 56	4 01
20	3 37	3 43	3 47	3 50	3 53	3 56	4 01	4 05	4 08	4 12	4 16	4 21	4 23	4 26
21	4 47	4 47	4 48	4 48	4 48	4 48	4 48	4 49	4 49	4 49	4 49	4 50	4 50	4 50
22	5 57	5 53	5 49	5 46	5 43	5 41	5 36	5 33	5 29	5 26	5 23	5 19	5 16	5 14
23	7 08	6 58	6 51	6 44	6 39	6 34	6 25	6 18	6 11	6 04	5 57	5 49	5 44	5 39
24	8 21	8 05	7 54	7 44	7 35	7 28	7 15	7 04	6 54	6 44	6 33	6 21	6 14	6 06
25	9 34	9 13	8 57	8 44	8 33	8 24	8 07	7 53	7 40	7 26	7 12	6 56	6 47	6 36

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 1	22 03	22 34	22 56	23 15	23 30	23 43	.. ..	.. ..	.. ..	0 07	0 26	0 49	1 02	1 18
2	23 13	23 41	.. ..	.. ..	.. ..	.. ..	0 06	0 26	0 44	1 02	1 21	1 44	1 57	2 12
3	.. ..	.. ..	0 01	0 18	0 32	0 45	1 06	1 24	1 41	1 57	2 15	2 36	2 47	3 01
4	0 34	0 57	1 14	1 28	1 40	1 50	2 08	2 23	2 37	2 51	3 06	3 24	3 33	3 45
5	2 02	2 18	2 31	2 41	2 50	2 58	3 11	3 23	3 33	3 44	3 55	4 08	4 15	4 23
6	3 34	3 43	3 51	3 57	4 02	4 07	4 15	4 22	4 28	4 35	4 41	4 49	4 53	4 58
7	5 06	5 09	5 11	5 13	5 15	5 16	5 18	5 21	5 22	5 24	5 26	5 28	5 30	5 31
8	6 39	6 35	6 32	6 30	6 28	6 26	6 22	6 19	6 16	6 14	6 11	6 07	6 05	6 03
9	8 12	8 02	7 53	7 46	7 40	7 35	7 26	7 18	7 11	7 04	6 56	6 47	6 42	6 36
10	9 44	9 27	9 13	9 02	8 53	8 45	8 30	8 18	8 07	7 55	7 43	7 29	7 21	7 12
11	11 11	10 48	10 30	10 16	10 03	9 53	9 34	9 18	9 03	8 48	8 33	8 14	8 04	7 52
12	12 31	12 03	11 42	11 25	11 10	10 58	10 36	10 18	10 01	9 43	9 25	9 04	8 51	8 37
13	13 39	13 08	12 46	12 27	12 12	11 58	11 36	11 16	10 58	10 39	10 19	9 56	9 43	9 28
14	14 31	14 02	13 39	13 21	13 06	12 53	12 31	12 11	11 53	11 34	11 15	10 52	10 39	10 23
15	15 10	14 44	14 24	14 07	13 53	13 41	13 20	13 02	12 45	12 28	12 10	11 49	11 36	11 22
16	15 39	15 17	15 00	14 46	14 34	14 24	14 06	13 50	13 35	13 20	13 04	12 46	12 35	12 22
17	16 00	15 43	15 30	15 19	15 09	15 01	14 46	14 33	14 21	14 09	13 56	13 41	13 33	13 23
18	16 17	16 05	15 55	15 47	15 40	15 34	15 24	15 14	15 05	14 56	14 47	14 36	14 29	14 22
19	16 31	16 24	16 18	16 13	16 09	16 05	15 59	15 53	15 47	15 42	15 36	15 29	15 25	15 20
20	16 44	16 41	16 39	16 37	16 36	16 34	16 32	16 30	16 28	16 26	16 24	16 21	16 20	16 18
21	16 56	16 58	17 00	17 01	17 02	17 03	17 05	17 07	17 08	17 10	17 12	17 13	17 15	17 16
22	17 08	17 15	17 21	17 25	17 29	17 33	17 39	17 44	17 49	17 54	18 00	18 06	18 10	18 14
23	17 22	17 34	17 43	17 51	17 58	18 04	18 14	18 23	18 31	18 40	18 49	19 00	19 06	19 13
24	17 39	17 55	18 08	18 19	18 29	18 37	18 51	19 04	19 16	19 27	19 40	19 55	20 03	20 13
25	18 00	18 21	18 38	18 52	19 04	19 14	19 32	19 48	20 02	20 17	20 33	20 51	21 02	21 14

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 1	10 48	10 41	10 33	10 25	10 16	10 06	9 56	9 43	9 29	9 13	8 53	8 27	7 53	6 50
2	11 47	11 41	11 34	11 26	11 17	11 08	10 58	10 46	10 32	10 17	9 58	9 34	9 03	8 13
3	12 54	12 48	12 42	12 35	12 28	12 20	12 11	12 01	11 50	11 36	11 21	11 02	10 39	10 08
4	14 06	14 02	13 57	13 51	13 46	13 39	13 32	13 25	13 16	13 06	12 55	12 42	12 26	12 07
5	15 21	15 18	15 14	15 11	15 07	15 03	14 58	14 53	14 48	14 41	14 34	14 26	14 17	14 05
6	16 37	16 35	16 34	16 32	16 30	16 28	16 26	16 24	16 21	16 18	16 15	16 11	16 07	16 02
7	17 53	17 54	17 54	17 54	17 54	17 55	17 55	17 55	17 56	17 56	17 56	17 57	17 58	17 58
8	19 10	19 12	19 14	19 16	19 18	19 21	19 24	19 27	19 30	19 34	19 38	19 43	19 48	19 55
9	20 26	20 30	20 34	20 38	20 42	20 47	20 52	20 58	21 04	21 11	21 19	21 29	21 40	21 53
10	21 41	21 46	21 51	21 57	22 03	22 10	22 18	22 26	22 36	22 47	22 59	23 14	23 32	23 55
11	22 53	22 59	23 06	23 13	23 21	23 29	23 39	23 49	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
12	23 59	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 02	0 16	0 33	0 53	1 20	1 57
13	.. ..	0 06	0 13	0 21	0 30	0 39	0 50	1 03	1 17	1 33	1 53	2 19	2 53	3 58
14	0 57	1 04	1 11	1 20	1 29	1 39	1 50	2 02	2 17	2 34	2 54	3 20	3 57	5 12
15	1 47	1 53	2 00	2 08	2 17	2 26	2 36	2 48	3 01	3 17	3 35	3 58	4 28	5 13
16	2 29	2 34	2 41	2 48	2 55	3 03	3 12	3 22	3 33	3 46	4 01	4 19	4 41	5 10
17	3 04	3 09	3 14	3 20	3 26	3 32	3 39	3 47	3 56	4 06	4 18	4 31	4 47	5 07
18	3 34	3 38	3 42	3 46	3 51	3 56	4 01	4 07	4 14	4 21	4 29	4 39	4 50	5 03
19	4 01	4 04	4 07	4 09	4 13	4 16	4 19	4 23	4 28	4 33	4 38	4 44	4 51	5 00
20	4 26	4 28	4 29	4 30	4 32	4 34	4 36	4 38	4 40	4 42	4 45	4 48	4 52	4 56
21	4 50	4 50	4 50	4 50	4 50	4 51	4 51	4 51	4 51	4 51	4 51	4 52	4 52	4 52
22	5 14	5 13	5 12	5 10	5 09	5 07	5 06	5 04	5 02	5 00	4 58	4 55	4 52	4 49
23	5 39	5 36	5 34	5 31	5 28	5 25	5 22	5 18	5 14	5 10	5 05	4 59	4 53	4 45
24	6 06	6 02	5 58	5 54	5 50	5 45	5 40	5 35	5 28	5 21	5 13	5 04	4 54	4 41
25	6 36	6 32	6 27	6 21	6 15	6 09	6 02	5 54	5 46	5 36	5 25	5 12	4 57	4 38

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 1	1 18	1 25	1 32	1 40	1 49	1 59	2 09	2 22	2 36	2 52	3 12	3 37	4 12	5 15
2	2 12	2 19	2 26	2 34	2 43	2 52	3 03	3 15	3 28	3 44	4 03	4 27	4 58	5 48
3	3 01	3 07	3 14	3 21	3 29	3 37	3 46	3 57	4 09	4 22	4 38	4 57	5 21	5 53
4	3 45	3 50	3 55	4 01	4 07	4 14	4 21	4 30	4 39	4 49	5 01	5 15	5 32	5 52
5	4 23	4 27	4 31	4 35	4 40	4 44	4 50	4 56	5 02	5 09	5 17	5 27	5 38	5 50
6	4 58	5 00	5 03	5 05	5 08	5 11	5 14	5 17	5 21	5 25	5 29	5 35	5 41	5 47
7	5 31	5 32	5 32	5 33	5 34	5 34	5 35	5 36	5 37	5 38	5 39	5 41	5 42	5 44
8	6 03	6 02	6 01	6 00	5 59	5 57	5 56	5 55	5 53	5 51	5 49	5 47	5 44	5 41
9	6 36	6 34	6 31	6 28	6 25	6 22	6 18	6 14	6 10	6 05	5 59	5 53	5 46	5 38
10	7 12	7 08	7 04	6 59	6 54	6 49	6 43	6 36	6 29	6 21	6 12	6 01	5 49	5 34
11	7 52	7 46	7 41	7 35	7 28	7 20	7 12	7 03	6 53	6 42	6 29	6 13	5 54	5 31
12	8 37	8 31	8 24	8 16	8 08	7 59	7 49	7 38	7 26	7 11	6 54	6 33	6 06	5 28
13	9 28	9 21	9 13	9 05	8 56	8 46	8 35	8 23	8 09	7 52	7 32	7 06	6 31	5 27
14	10 23	10 16	10 09	10 01	9 52	9 42	9 31	9 18	9 04	8 47	8 27	8 01	7 24	6 10
15	11 22	11 16	11 09	11 01	10 53	10 44	10 34	10 23	10 09	9 54	9 36	9 14	8 44	7 59
16	12 22	12 17	12 11	12 04	11 57	11 50	11 41	11 32	11 21	11 08	10 54	10 36	10 15	9 46
17	13 23	13 18	13 13	13 08	13 03	12 57	12 50	12 42	12 34	12 25	12 14	12 01	11 46	11 27
18	14 22	14 19	14 15	14 12	14 08	14 03	13 58	13 53	13 47	13 41	13 33	13 24	13 14	13 02
19	15 20	15 18	15 16	15 14	15 12	15 09	15 06	15 03	14 59	14 55	14 51	14 46	14 40	14 33
20	16 18	16 17	16 17	16 16	16 15	16 14	16 13	16 12	16 10	16 09	16 07	16 05	16 03	16 01
21	17 16	17 16	17 17	17 17	17 18	17 19	17 20	17 20	17 21	17 22	17 24	17 25	17 26	17 28
22	18 14	18 16	18 17	18 20	18 22	18 24	18 27	18 30	18 33	18 37	18 41	18 45	18 50	18 57
23	19 13	19 16	19 19	19 23	19 26	19 31	19 35	19 40	19 46	19 52	19 59	20 07	20 17	20 28
24	20 13	20 17	20 22	20 27	20 32	20 38	20 44	20 52	21 00	21 09	21 19	21 31	21 46	22 03
25	21 14	21 19	21 25	21 31	21 38	21 46	21 54	22 03	22 14	22 26	22 40	22 57	23 17	23 44

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	8 21	8 05	7 54	7 44	7 35	7 28	7 15	7 04	6 54	6 44	6 33	6 21	6 14	6 06
25	9 34	9 13	8 57	8 44	8 33	8 24	8 07	7 53	7 40	7 26	7 12	6 56	6 47	6 36
26	10 46	10 21	10 01	9 45	9 32	9 21	9 01	8 44	8 28	8 12	7 55	7 36	7 24	7 11
27	11 55	11 26	11 03	10 46	10 31	10 18	9 56	9 36	9 19	9 01	8 42	8 20	8 07	7 53
28	12 56	12 25	12 02	11 43	11 27	11 14	10 51	10 31	10 12	9 53	9 33	9 11	8 57	8 42
29	13 46	13 16	12 54	12 36	12 20	12 07	11 45	11 25	11 07	10 49	10 29	10 06	9 53	9 38
30	14 24	13 59	13 39	13 23	13 09	12 57	12 37	12 19	12 02	11 45	11 28	11 07	10 55	10 41
May 1	14 54	14 33	14 17	14 04	13 53	13 43	13 26	13 11	12 57	12 43	12 28	12 11	12 01	11 49
2	15 16	15 02	14 50	14 41	14 32	14 25	14 12	14 01	13 51	13 40	13 29	13 16	13 09	13 00
3	15 35	15 27	15 20	15 14	15 09	15 05	14 57	14 50	14 44	14 37	14 31	14 23	14 18	14 13
4	15 52	15 49	15 47	15 45	15 44	15 42	15 40	15 38	15 36	15 34	15 32	15 30	15 29	15 27
5	16 08	16 11	16 14	16 16	16 18	16 20	16 23	16 26	16 29	16 32	16 34	16 38	16 40	16 42
6	16 26	16 35	16 43	16 49	16 54	16 59	17 08	17 16	17 23	17 30	17 38	17 47	17 52	17 58
7	16 46	17 02	17 14	17 24	17 33	17 41	17 55	18 07	18 18	18 30	18 42	18 56	19 05	19 14
8	17 12	17 33	17 50	18 04	18 16	18 27	18 45	19 01	19 16	19 31	19 47	20 06	20 17	20 29
9	17 46	18 13	18 34	18 50	19 05	19 17	19 38	19 57	20 14	20 32	20 51	21 13	21 25	21 40
10	18 31	19 01	19 24	19 43	19 58	20 12	20 35	20 54	21 13	21 32	21 52	22 15	22 29	22 44
11	19 29	19 59	20 22	20 40	20 56	21 09	21 32	21 52	22 10	22 28	22 48	23 11	23 24	23 40
12	20 36	21 03	21 24	21 41	21 55	22 08	22 29	22 47	23 04	23 21	23 39	.. ..	.. ..	.. ..
13	21 48	22 11	22 28	22 43	22 55	23 06	23 24	23 40	23 54	.. ..	.. ..	0 00	0 12	0 26
14	23 01	23 19	23 33	23 44	23 54	.. ..	.. ..	.. ..	.. ..	0 09	0 25	0 43	0 53	1 05
15	.. ..	.. ..	.. ..	.. ..	.. ..	0 02	0 17	0 29	0 41	0 53	1 05	1 20	1 28	1 37
16	0 14	0 26	0 36	0 44	0 51	0 57	1 07	1 16	1 25	1 34	1 43	1 53	1 59	2 06
17	1 25	1 32	1 38	1 42	1 46	1 50	1 56	2 02	2 07	2 12	2 17	2 23	2 27	2 31
18	2 35	2 37	2 39	2 40	2 41	2 42	2 44	2 46	2 47	2 49	2 51	2 53	2 54	2 55

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	17 39	17 55	18 08	18 19	18 29	18 37	18 51	19 04	19 16	19 27	19 40	19 55	20 03	20 13
25	18 00	18 21	18 38	18 52	19 04	19 14	19 32	19 48	20 02	20 17	20 33	20 51	21 02	21 14
26	18 27	18 53	19 14	19 30	19 44	19 56	20 17	20 35	20 52	21 09	21 27	21 48	22 00	22 14
27	19 04	19 34	19 57	20 15	20 30	20 43	21 06	21 26	21 44	22 02	22 22	22 45	22 58	23 13
28	19 54	20 25	20 49	21 07	21 23	21 36	22 00	22 20	22 38	22 57	23 17	23 39	23 53	.. ..
29	20 58	21 27	21 49	22 07	22 22	22 35	22 57	23 16	23 33	23 51	.. ..	.. ..	.. ..	0 08
30	22 14	22 38	22 57	23 13	23 26	23 37	23 56	.. ..	.. ..	.. ..	0 10	0 31	0 44	0 58
May 1	23 37	23 56	.. ..	.. ..	.. ..	.. ..	.. ..	0 13	0 28	0 44	1 00	1 19	1 30	1 42
2	.. ..	.. ..	0 10	0 23	0 33	0 42	0 57	1 10	1 23	1 35	1 48	2 03	2 11	2 21
3	1 04	1 17	1 26	1 35	1 42	1 48	1 58	2 08	2 16	2 24	2 33	2 43	2 49	2 56
4	2 33	2 39	2 44	2 48	2 52	2 55	3 00	3 04	3 09	3 13	3 17	3 22	3 25	3 28
5	4 04	4 03	4 03	4 03	4 02	4 02	4 02	4 01	4 01	4 01	4 00	4 00	3 59	3 59
6	5 35	5 28	5 23	5 18	5 14	5 11	5 04	4 59	4 54	4 49	4 44	4 38	4 34	4 31
7	7 07	6 54	6 43	6 34	6 26	6 20	6 08	5 58	5 49	5 39	5 29	5 18	5 12	5 04
8	8 39	8 19	8 03	7 50	7 39	7 29	7 13	6 59	6 45	6 32	6 18	6 02	5 52	5 42
9	10 06	9 40	9 20	9 03	8 50	8 38	8 18	8 00	7 44	7 27	7 10	6 50	6 38	6 25
10	11 22	10 52	10 30	10 11	9 56	9 43	9 20	9 01	8 43	8 24	8 05	7 42	7 29	7 14
11	12 24	11 53	11 30	11 11	10 56	10 42	10 19	9 59	9 41	9 22	9 02	8 39	8 25	8 09
12	13 10	12 41	12 20	12 03	11 48	11 35	11 13	10 54	10 36	10 18	9 59	9 37	9 24	9 09
13	13 43	13 19	13 00	12 45	12 32	12 21	12 01	11 44	11 29	11 13	10 55	10 36	10 24	10 11
14	14 07	13 48	13 33	13 21	13 10	13 01	12 45	12 30	12 17	12 04	11 50	11 33	11 23	11 12
15	14 25	14 11	14 00	13 51	13 43	13 36	13 24	13 13	13 03	12 52	12 41	12 29	12 21	12 13
16	14 40	14 31	14 24	14 18	14 12	14 08	13 59	13 52	13 45	13 38	13 31	13 23	13 18	13 12
17	14 53	14 49	14 45	14 42	14 40	14 37	14 33	14 30	14 26	14 23	14 20	14 15	14 13	14 10
18	15 05	15 05	15 05	15 06	15 06	15 06	15 06	15 07	15 07	15 07	15 07	15 08	15 08	15 08

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	6 06	6 02	5 58	5 54	5 50	5 45	5 40	5 35	5 28	5 21	5 13	5 04	4 54	4 41
25	6 36	6 32	6 27	6 21	6 15	6 09	6 02	5 54	5 46	5 36	5 25	5 12	4 57	4 38
26	7 11	7 06	7 00	6 53	6 46	6 38	6 29	6 19	6 08	5 56	5 41	5 24	5 03	4 35
27	7 53	7 46	7 39	7 32	7 23	7 14	7 04	6 53	6 40	6 24	6 06	5 44	5 16	4 33
28	8 42	8 35	8 27	8 19	8 10	8 00	7 49	7 37	7 23	7 06	6 46	6 20	5 45	4 38
29	9 38	9 31	9 24	9 16	9 07	8 57	8 46	8 34	8 20	8 03	7 43	7 18	6 43	5 39
30	10 41	10 35	10 28	10 21	10 13	10 04	9 54	9 43	9 31	9 16	8 59	8 38	8 11	7 32
May 1	11 49	11 44	11 38	11 32	11 26	11 19	11 11	11 02	10 52	10 41	10 28	10 12	9 53	9 29
2	13 00	12 56	12 52	12 48	12 43	12 38	12 32	12 26	12 19	12 11	12 02	11 52	11 39	11 25
3	14 13	14 11	14 08	14 06	14 03	14 00	13 57	13 53	13 49	13 44	13 39	13 33	13 27	13 19
4	15 27	15 26	15 26	15 25	15 24	15 23	15 22	15 21	15 20	15 19	15 17	15 16	15 14	15 12
5	16 42	16 43	16 44	16 45	16 46	16 48	16 49	16 51	16 53	16 55	16 57	16 59	17 02	17 06
6	17 58	18 01	18 03	18 06	18 10	18 13	18 17	18 22	18 26	18 32	18 38	18 45	18 53	19 02
7	19 14	19 18	19 23	19 28	19 33	19 39	19 45	19 52	20 00	20 09	20 20	20 32	20 46	21 03
8	20 29	20 35	20 41	20 47	20 54	21 02	21 11	21 21	21 32	21 44	21 59	22 17	22 40	23 09
9	21 40	21 47	21 54	22 02	22 10	22 20	22 30	22 42	22 55	23 11	23 30	23 54	.. ..	.. ..
10	22 44	22 51	22 59	23 07	23 16	23 27	23 38	23 51	.. ..	.. ..	.. ..	.. ..	0 26	1 19
11	23 40	23 47	23 54	.. ..	.. ..	.. ..	.. ..	.. ..	0 05	0 23	0 44	1 11	1 50	▬
12	.. ..	.. ..	.. ..	0 02	0 11	0 21	0 32	0 44	0 58	1 15	1 35	2 00	2 34	3 36
13	0 26	0 32	0 39	0 46	0 54	1 03	1 13	1 24	1 36	1 50	2 07	2 27	2 53	3 29
14	1 05	1 10	1 16	1 22	1 28	1 36	1 44	1 53	2 03	2 14	2 27	2 42	3 01	3 24
15	1 37	1 42	1 46	1 51	1 56	2 01	2 08	2 14	2 22	2 30	2 40	2 51	3 04	3 19
16	2 06	2 09	2 12	2 15	2 19	2 23	2 27	2 32	2 37	2 43	2 49	2 57	3 05	3 15
17	2 31	2 33	2 35	2 37	2 39	2 41	2 44	2 46	2 49	2 53	2 57	3 01	3 06	3 11
18	2 55	2 55	2 56	2 57	2 57	2 58	2 59	3 00	3 01	3 02	3 03	3 04	3 06	3 07

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	20 13	20 17	20 22	20 27	20 32	20 38	20 44	20 52	21 00	21 09	21 19	21 31	21 46	22 03
25	21 14	21 19	21 25	21 31	21 38	21 46	21 54	22 03	22 14	22 26	22 40	22 57	23 17	23 44
26	22 14	22 21	22 28	22 35	22 43	22 52	23 02	23 13	23 26	23 41	23 58	.. ..	.. ..	.. ..
27	23 13	23 20	23 28	23 36	23 44	23 54	.. ..	.. ..	.. ..	.. ..	.. ..	0 20	0 48	1 30
28	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 05	0 18	0 32	0 48	1 08	1 34	2 09	3 16
29	0 08	0 15	0 23	0 31	0 40	0 50	1 01	1 13	1 27	1 44	2 04	2 29	3 04	4 08
30	0 58	1 05	1 12	1 19	1 27	1 36	1 46	1 58	2 10	2 25	2 43	3 04	3 32	4 11
May 1	1 42	1 48	1 54	2 00	2 07	2 15	2 23	2 32	2 43	2 55	3 08	3 25	3 44	4 09
2	2 21	2 25	2 30	2 35	2 40	2 46	2 52	2 59	3 07	3 16	3 26	3 37	3 50	4 06
3	2 56	2 59	3 02	3 05	3 09	3 12	3 17	3 21	3 26	3 32	3 38	3 45	3 53	4 03
4	3 28	3 29	3 31	3 32	3 34	3 36	3 38	3 40	3 42	3 45	3 48	3 51	3 55	3 59
5	3 59	3 59	3 59	3 58	3 58	3 58	3 58	3 58	3 57	3 57	3 57	3 56	3 56	3 55
6	4 31	4 29	4 27	4 25	4 23	4 21	4 18	4 16	4 13	4 09	4 06	4 01	3 57	3 51
7	5 04	5 01	4 58	4 54	4 50	4 45	4 41	4 35	4 30	4 23	4 16	4 08	3 58	3 47
8	5 42	5 37	5 32	5 27	5 21	5 14	5 07	5 00	4 51	4 41	4 30	4 17	4 02	3 43
9	6 25	6 19	6 12	6 05	5 58	5 50	5 41	5 30	5 19	5 06	4 50	4 32	4 09	3 38
10	7 14	7 07	7 00	6 52	6 43	6 34	6 23	6 11	5 57	5 41	5 21	4 57	4 25	3 32
11	8 09	8 02	7 54	7 46	7 37	7 27	7 16	7 03	6 48	6 31	6 09	5 42	5 04	▬
12	9 09	9 02	8 55	8 47	8 38	8 28	8 18	8 05	7 52	7 35	7 15	6 50	6 16	5 15
13	10 11	10 05	9 58	9 51	9 43	9 35	9 26	9 15	9 03	8 49	8 33	8 13	7 48	7 13
14	11 12	11 07	11 02	10 56	10 50	10 43	10 36	10 27	10 18	10 07	9 55	9 40	9 22	9 00
15	12 13	12 09	12 05	12 01	11 56	11 51	11 46	11 39	11 33	11 25	11 16	11 06	10 54	10 39
16	13 12	13 10	13 07	13 04	13 01	12 58	12 54	12 50	12 46	12 41	12 35	12 29	12 21	12 12
17	14 10	14 09	14 08	14 06	14 05	14 03	14 02	14 00	13 57	13 55	13 52	13 49	13 46	13 42
18	15 08	15 08	15 08	15 08	15 08	15 08	15 08	15 08	15 09	15 09	15 09	15 09	15 09	15 09

▬ indicates Moon continuously below horizon.
.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	1 25	1 32	1 38	1 42	1 46	1 50	1 56	2 02	2 07	2 12	2 17	2 23	2 27	2 31
18	2 35	2 37	2 39	2 40	2 41	2 42	2 44	2 46	2 47	2 49	2 51	2 53	2 54	2 55
19	3 45	3 42	3 40	3 38	3 36	3 35	3 32	3 30	3 28	3 26	3 24	3 21	3 20	3 18
20	4 56	4 48	4 41	4 36	4 31	4 27	4 21	4 14	4 09	4 03	3 57	3 51	3 47	3 43
21	6 08	5 55	5 44	5 35	5 28	5 22	5 10	5 01	4 51	4 42	4 33	4 22	4 16	4 09
22	7 22	7 03	6 48	6 36	6 26	6 17	6 02	5 49	5 36	5 24	5 11	4 56	4 48	4 38
23	8 36	8 12	7 53	7 38	7 25	7 14	6 56	6 39	6 24	6 09	5 53	5 34	5 24	5 12
24	9 47	9 19	8 57	8 40	8 25	8 12	7 51	7 32	7 15	6 57	6 39	6 18	6 05	5 51
25	10 52	10 21	9 58	9 39	9 23	9 10	8 47	8 27	8 08	7 49	7 30	7 07	6 53	6 38
26	11 46	11 15	10 52	10 34	10 18	10 04	9 41	9 22	9 03	8 44	8 24	8 01	7 48	7 32
27	12 28	12 00	11 39	11 22	11 08	10 56	10 34	10 16	9 58	9 41	9 22	9 01	8 48	8 33
28	12 59	12 37	12 19	12 05	11 53	11 42	11 24	11 08	10 53	10 38	10 22	10 03	9 52	9 40
29	13 23	13 06	12 53	12 42	12 33	12 25	12 10	11 58	11 46	11 34	11 22	11 07	10 59	10 49
30	13 42	13 31	13 23	13 15	13 09	13 04	12 54	12 46	12 38	12 30	12 21	12 11	12 06	11 59
31	13 59	13 54	13 50	13 46	13 43	13 41	13 36	13 32	13 28	13 25	13 21	13 16	13 14	13 11
June 1	14 14	14 15	14 15	14 16	14 16	14 17	14 18	14 18	14 19	14 20	14 21	14 21	14 22	14 23
2	14 30	14 37	14 42	14 46	14 50	14 54	15 00	15 05	15 10	15 16	15 21	15 28	15 31	15 36
3	14 48	15 01	15 11	15 19	15 26	15 33	15 44	15 54	16 04	16 13	16 23	16 35	16 42	16 50
4	15 10	15 29	15 44	15 56	16 07	16 16	16 32	16 46	16 59	17 13	17 27	17 43	17 53	18 04
5	15 39	16 04	16 23	16 38	16 52	17 03	17 23	17 41	17 57	18 13	18 31	18 51	19 03	19 17
6	16 19	16 48	17 10	17 28	17 43	17 56	18 18	18 38	18 56	19 14	19 34	19 57	20 10	20 26
7	17 11	17 41	18 05	18 23	18 39	18 53	19 16	19 36	19 55	20 14	20 34	20 57	21 11	21 26
8	18 15	18 44	19 06	19 24	19 39	19 52	20 14	20 34	20 51	21 09	21 28	21 51	22 03	22 18
9	19 27	19 52	20 12	20 27	20 40	20 52	21 12	21 29	21 45	22 01	22 18	22 37	22 48	23 01
10	20 42	21 02	21 17	21 30	21 41	21 51	22 07	22 21	22 34	22 47	23 01	23 17	23 26	23 37

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	14 53	14 49	14 45	14 42	14 40	14 37	14 33	14 30	14 26	14 23	14 20	14 15	14 13	14 10
18	15 05	15 05	15 05	15 06	15 06	15 06	15 06	15 07	15 07	15 07	15 07	15 08	15 08	15 08
19	15 17	15 22	15 26	15 29	15 32	15 35	15 40	15 44	15 47	15 51	15 55	16 00	16 03	16 06
20	15 30	15 40	15 48	15 54	16 00	16 05	16 14	16 22	16 29	16 37	16 44	16 53	16 59	17 05
21	15 45	16 00	16 12	16 22	16 30	16 38	16 51	17 02	17 13	17 24	17 35	17 48	17 56	18 05
22	16 04	16 24	16 40	16 53	17 04	17 14	17 30	17 45	17 59	18 13	18 28	18 45	18 55	19 06
23	16 29	16 54	17 13	17 29	17 43	17 54	18 14	18 32	18 48	19 04	19 22	19 42	19 54	20 08
24	17 03	17 32	17 54	18 12	18 27	18 40	19 03	19 22	19 40	19 58	20 18	20 40	20 53	21 08
25	17 49	18 20	18 44	19 03	19 18	19 32	19 55	20 15	20 34	20 53	21 13	21 36	21 50	22 05
26	18 49	19 19	19 42	20 00	20 16	20 29	20 52	21 11	21 29	21 48	22 07	22 29	22 42	22 57
27	20 01	20 28	20 48	21 04	21 18	21 30	21 50	22 08	22 24	22 41	22 58	23 18	23 30	23 43
28	21 22	21 43	21 59	22 12	22 24	22 33	22 50	23 05	23 18	23 32	23 46	.. ..	.. ..	.. ..
29	22 46	23 01	23 13	23 22	23 31	23 38	23 50	.. ..	.. ..	.. ..	.. ..	0 02	0 12	0 23
30	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 01	0 11	0 21	0 31	0 43	0 50	0 58
31	0 12	0 21	0 28	0 33	0 38	0 42	0 50	0 56	1 02	1 08	1 14	1 21	1 25	1 29
June 1	1 39	1 41	1 43	1 45	1 46	1 47	1 49	1 51	1 52	1 54	1 55	1 57	1 58	1 59
2	3 07	3 03	3 00	2 57	2 55	2 53	2 49	2 46	2 43	2 40	2 37	2 34	2 32	2 29
3	4 36	4 26	4 18	4 11	4 05	4 00	3 51	3 43	3 35	3 28	3 20	3 11	3 06	3 01
4	6 07	5 50	5 36	5 25	5 16	5 08	4 53	4 41	4 30	4 18	4 06	3 52	3 44	3 35
5	7 35	7 12	6 54	6 39	6 27	6 16	5 57	5 41	5 26	5 11	4 56	4 37	4 27	4 15
6	8 58	8 29	8 08	7 50	7 36	7 23	7 01	6 43	6 25	6 08	5 49	5 27	5 15	5 00
7	10 08	9 37	9 14	8 55	8 40	8 26	8 03	7 43	7 24	7 06	6 46	6 22	6 09	5 53
8	11 02	10 33	10 10	9 52	9 37	9 23	9 01	8 41	8 22	8 04	7 44	7 21	7 07	6 52
9	11 42	11 16	10 56	10 39	10 25	10 13	9 53	9 34	9 17	9 00	8 42	8 21	8 08	7 54
10	12 10	11 49	11 32	11 19	11 07	10 57	10 39	10 23	10 09	9 54	9 38	9 20	9 10	8 58

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	2 31	2 33	2 35	2 37	2 39	2 41	2 44	2 46	2 49	2 53	2 57	3 01	3 06	3 11
18	2 55	2 55	2 56	2 57	2 57	2 58	2 59	3 00	3 01	3 02	3 03	3 04	3 06	3 07
19	3 18	3 18	3 17	3 16	3 15	3 15	3 14	3 13	3 11	3 10	3 09	3 07	3 05	3 03
20	3 43	3 41	3 39	3 37	3 34	3 32	3 29	3 26	3 23	3 19	3 15	3 11	3 05	2 59
21	4 09	4 06	4 02	3 59	3 55	3 51	3 46	3 41	3 36	3 30	3 23	3 15	3 06	2 55
22	4 38	4 34	4 29	4 24	4 19	4 13	4 06	3 59	3 52	3 43	3 33	3 21	3 08	2 52
23	5 12	5 06	5 00	4 54	4 47	4 40	4 32	4 23	4 12	4 01	3 47	3 31	3 12	2 48
24	5 51	5 45	5 38	5 31	5 23	5 14	5 04	4 53	4 40	4 26	4 09	3 48	3 22	2 44
25	6 38	6 31	6 24	6 15	6 07	5 57	5 46	5 34	5 19	5 03	4 43	4 18	3 44	2 42
26	7 32	7 25	7 18	7 10	7 01	6 51	6 39	6 27	6 12	5 55	5 35	5 09	4 32	3 12
27	8 33	8 27	8 20	8 12	8 04	7 55	7 44	7 33	7 20	7 04	6 46	6 23	5 52	5 05
28	9 40	9 34	9 28	9 22	9 15	9 07	8 58	8 49	8 38	8 25	8 11	7 53	7 31	7 03
29	10 49	10 45	10 40	10 35	10 30	10 24	10 17	10 10	10 02	9 53	9 42	9 30	9 16	8 58
30	11 59	11 57	11 53	11 50	11 47	11 43	11 39	11 34	11 29	11 23	11 16	11 09	11 00	10 50
31	13 11	13 09	13 08	13 06	13 05	13 03	13 01	12 59	12 57	12 54	12 51	12 48	12 44	12 40
June 1	14 23	14 23	14 23	14 23	14 24	14 24	14 25	14 25	14 26	14 26	14 27	14 27	14 28	14 29
2	15 36	15 37	15 39	15 42	15 44	15 47	15 49	15 52	15 56	16 00	16 04	16 09	16 14	16 21
3	16 50	16 53	16 57	17 01	17 05	17 10	17 15	17 21	17 27	17 35	17 43	17 52	18 03	18 17
4	18 04	18 09	18 15	18 20	18 27	18 34	18 41	18 50	18 59	19 10	19 23	19 37	19 55	20 18
5	19 17	19 23	19 30	19 37	19 45	19 54	20 04	20 15	20 27	20 42	20 59	21 20	21 47	22 26
6	20 26	20 33	20 40	20 48	20 57	21 07	21 18	21 31	21 45	22 02	22 23	22 49	23 26	.. ..
7	21 26	21 34	21 41	21 50	21 59	22 09	22 20	22 33	22 48	23 05	23 26	23 53	.. ..	0 47
8	22 18	22 25	22 32	22 40	22 48	22 58	23 08	23 20	23 33	23 49	.. ..	.. ..	0 32	▬
9	23 01	23 07	23 13	23 20	23 27	23 35	23 44	23 54	.. ..	.. ..	0 07	0 30	1 00	1 47
10	23 37	23 42	23 47	23 52	23 58	.. ..	.. ..	.. ..	0 05	0 18	0 32	0 50	1 12	1 40

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	14 10	14 09	14 08	14 06	14 05	14 03	14 02	14 00	13 57	13 55	13 52	13 49	13 46	13 42
18	15 08	15 08	15 08	15 08	15 08	15 08	15 08	15 08	15 09	15 09	15 09	15 09	15 09	15 09
19	16 06	16 07	16 09	16 10	16 12	16 14	16 15	16 18	16 20	16 23	16 26	16 29	16 33	16 37
20	17 05	17 07	17 10	17 13	17 16	17 20	17 24	17 28	17 33	17 38	17 44	17 51	17 59	18 08
21	18 05	18 08	18 13	18 17	18 22	18 27	18 33	18 40	18 47	18 55	19 04	19 15	19 27	19 43
22	19 06	19 11	19 16	19 22	19 29	19 36	19 44	19 52	20 02	20 13	20 26	20 41	21 00	21 23
23	20 08	20 14	20 20	20 27	20 35	20 44	20 53	21 04	21 16	21 30	21 47	22 07	22 33	23 10
24	21 08	21 15	21 22	21 30	21 39	21 49	21 59	22 12	22 26	22 42	23 02	23 27	.. ..	.. ..
25	22 05	22 12	22 20	22 28	22 37	22 47	22 58	23 11	23 25	23 43	.. ..	.. ..	0 01	1 02
26	22 57	23 04	23 11	23 19	23 28	23 37	23 47	23 59	.. ..	.. ..	0 03	0 30	1 06	2 26
27	23 43	23 49	23 55	.. ..	.. ..	.. ..	.. ..	.. ..	0 13	0 28	0 47	1 10	1 41	2 29
28	.. ..	.. ..	.. ..	0 02	0 09	0 18	0 27	0 37	0 48	1 01	1 16	1 34	1 56	2 26
29	0 23	0 27	0 32	0 38	0 44	0 50	0 57	1 05	1 14	1 24	1 35	1 48	2 03	2 22
30	0 58	1 01	1 05	1 09	1 13	1 17	1 22	1 28	1 34	1 40	1 48	1 57	2 07	2 18
31	1 29	1 31	1 33	1 36	1 38	1 41	1 44	1 47	1 50	1 54	1 58	2 03	2 08	2 14
June 1	1 59	2 00	2 00	2 01	2 02	2 02	2 03	2 04	2 04	2 05	2 06	2 08	2 09	2 10
2	2 29	2 28	2 27	2 26	2 25	2 23	2 22	2 20	2 19	2 17	2 15	2 12	2 09	2 06
3	3 01	2 58	2 55	2 52	2 49	2 46	2 42	2 38	2 34	2 29	2 24	2 17	2 10	2 02
4	3 35	3 31	3 27	3 22	3 17	3 12	3 06	2 59	2 52	2 44	2 35	2 24	2 12	1 57
5	4 15	4 09	4 03	3 57	3 50	3 43	3 35	3 26	3 16	3 04	2 51	2 35	2 16	1 53
6	5 00	4 54	4 47	4 39	4 31	4 22	4 12	4 01	3 48	3 33	3 15	2 54	2 26	1 47
7	5 53	5 46	5 38	5 30	5 21	5 11	5 00	4 47	4 32	4 15	3 55	3 28	2 51	1 30
8	6 52	6 45	6 37	6 29	6 20	6 10	5 58	5 46	5 31	5 14	4 53	4 26	3 48	▬
9	7 54	7 48	7 41	7 33	7 25	7 16	7 06	6 54	6 41	6 26	6 08	5 45	5 15	4 30
10	8 58	8 52	8 46	8 40	8 33	8 25	8 17	8 08	7 57	7 45	7 30	7 13	6 52	6 25

▬ indicates Moon continuously below horizon.
.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	18 15	18 44	19 06	19 24	19 39	19 52	20 14	20 34	20 51	21 09	21 28	21 51	22 03	22 18
9	19 27	19 52	20 12	20 27	20 40	20 52	21 12	21 29	21 45	22 01	22 18	22 37	22 48	23 01
10	20 42	21 02	21 17	21 30	21 41	21 51	22 07	22 21	22 34	22 47	23 01	23 17	23 26	23 37
11	21 56	22 11	22 22	22 32	22 40	22 47	22 59	23 10	23 20	23 30	23 41	23 53	23 59	.. ..
12	23 09	23 18	23 26	23 32	23 37	23 42	23 50	23 57	.. ..	.. ..	.. ..	.. ..	.. ..	0 07
13	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 03	0 10	0 17	0 24	0 29	0 34
14	0 20	0 24	0 27	0 30	0 32	0 35	0 38	0 41	0 44	0 47	0 51	0 54	0 56	0 59
15	1 30	1 29	1 28	1 28	1 27	1 27	1 26	1 25	1 25	1 24	1 24	1 23	1 23	1 22
16	2 40	2 35	2 30	2 26	2 22	2 19	2 14	2 10	2 05	2 01	1 57	1 52	1 49	1 46
17	3 52	3 41	3 32	3 25	3 18	3 13	3 03	2 55	2 47	2 40	2 31	2 22	2 17	2 11
18	5 05	4 49	4 36	4 25	4 16	4 08	3 54	3 42	3 31	3 20	3 08	2 55	2 47	2 39
19	6 20	5 58	5 41	5 27	5 15	5 05	4 47	4 32	4 18	4 04	3 49	3 32	3 22	3 11
20	7 33	7 06	6 46	6 29	6 15	6 03	5 42	5 24	5 08	4 51	4 34	4 13	4 01	3 48
21	8 42	8 12	7 49	7 30	7 15	7 02	6 39	6 19	6 01	5 43	5 23	5 01	4 48	4 33
22	9 41	9 10	8 47	8 28	8 12	7 58	7 35	7 15	6 56	6 38	6 17	5 54	5 41	5 25
23	10 28	9 59	9 38	9 20	9 05	8 52	8 30	8 11	7 53	7 35	7 15	6 53	6 40	6 25
24	11 03	10 39	10 20	10 05	9 52	9 41	9 21	9 04	8 49	8 33	8 16	7 56	7 44	7 31
25	11 29	11 11	10 56	10 44	10 34	10 25	10 09	9 56	9 43	9 30	9 16	9 00	8 51	8 40
26	11 50	11 37	11 27	11 19	11 11	11 05	10 54	10 44	10 35	10 26	10 16	10 05	9 58	9 51
27	12 06	12 00	11 54	11 50	11 46	11 42	11 36	11 31	11 26	11 21	11 15	11 09	11 05	11 01
28	12 22	12 21	12 20	12 19	12 18	12 18	12 17	12 16	12 15	12 15	12 14	12 13	12 12	12 12
29	12 37	12 41	12 45	12 48	12 51	12 53	12 58	13 02	13 05	13 09	13 13	13 17	13 20	13 23
30	12 53	13 04	13 12	13 19	13 25	13 30	13 40	13 48	13 56	14 04	14 12	14 22	14 28	14 34
July 1	13 13	13 29	13 42	13 53	14 02	14 10	14 25	14 37	14 49	15 01	15 14	15 28	15 37	15 47
2	13 38	14 00	14 18	14 32	14 44	14 55	15 13	15 29	15 44	15 59	16 16	16 35	16 46	16 59

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	11 02	10 33	10 10	9 52	9 37	9 23	9 01	8 41	8 22	8 04	7 44	7 21	7 07	6 52
9	11 42	11 16	10 56	10 39	10 25	10 13	9 53	9 34	9 17	9 00	8 42	8 21	8 08	7 54
10	12 10	11 49	11 32	11 19	11 07	10 57	10 39	10 23	10 09	9 54	9 38	9 20	9 10	8 58
11	12 31	12 15	12 02	11 52	11 42	11 34	11 20	11 08	10 57	10 45	10 32	10 18	10 10	10 00
12	12 47	12 36	12 27	12 20	12 14	12 08	11 58	11 49	11 41	11 33	11 24	11 14	11 08	11 01
13	13 01	12 55	12 50	12 45	12 42	12 39	12 33	12 28	12 23	12 18	12 13	12 07	12 04	12 00
14	13 13	13 12	13 10	13 09	13 08	13 08	13 06	13 05	13 04	13 03	13 01	13 00	12 59	12 58
15	13 25	13 28	13 31	13 33	13 35	13 36	13 39	13 42	13 44	13 47	13 49	13 52	13 54	13 56
16	13 37	13 45	13 52	13 57	14 02	14 06	14 13	14 19	14 25	14 31	14 38	14 45	14 49	14 54
17	13 52	14 04	14 15	14 23	14 31	14 37	14 49	14 59	15 08	15 18	15 28	15 39	15 46	15 54
18	14 09	14 27	14 41	14 53	15 03	15 12	15 27	15 41	15 53	16 06	16 19	16 35	16 44	16 55
19	14 31	14 54	15 12	15 27	15 40	15 51	16 10	16 26	16 41	16 57	17 14	17 33	17 44	17 57
20	15 02	15 29	15 51	16 08	16 22	16 35	16 57	17 15	17 33	17 51	18 09	18 31	18 44	18 59
21	15 44	16 14	16 38	16 56	17 12	17 25	17 49	18 09	18 27	18 46	19 06	19 29	19 43	19 58
22	16 40	17 11	17 34	17 53	18 08	18 22	18 45	19 05	19 23	19 42	20 02	20 24	20 38	20 53
23	17 49	18 17	18 39	18 56	19 10	19 23	19 44	20 02	20 20	20 37	20 55	21 16	21 28	21 42
24	19 09	19 32	19 49	20 04	20 16	20 26	20 45	21 00	21 15	21 29	21 45	22 02	22 12	22 24
25	20 33	20 50	21 03	21 14	21 23	21 31	21 45	21 57	22 08	22 19	22 31	22 44	22 52	23 00
26	21 59	22 09	22 18	22 24	22 30	22 36	22 44	22 52	22 59	23 06	23 14	23 22	23 27	23 33
27	23 25	23 29	23 32	23 35	23 37	23 40	23 43	23 46	23 49	23 52	23 55	23 59	.. ..	.. ..
28	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 01	0 03
29	0 50	0 48	0 47	0 46	0 44	0 44	0 42	0 40	0 39	0 37	0 36	0 34	0 33	0 32
30	2 17	2 09	2 02	1 57	1 52	1 48	1 41	1 35	1 29	1 23	1 17	1 10	1 06	1 02
July 1	3 44	3 30	3 18	3 09	3 01	2 54	2 41	2 31	2 21	2 11	2 00	1 48	1 42	1 34
2	5 11	4 50	4 34	4 21	4 10	4 00	3 43	3 29	3 15	3 01	2 47	2 30	2 21	2 10

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	22 18	22 25	22 32	22 40	22 48	22 58	23 08	23 20	23 33	23 49	.. ..	.. ..	0 32	▬
9	23 01	23 07	23 13	23 20	23 27	23 35	23 44	23 54	.. ..	.. ..	0 07	0 30	1 00	1 47
10	23 37	23 42	23 47	23 52	23 58	.. ..	.. ..	.. ..	0 05	0 18	0 32	0 50	1 12	1 40
11	.. ..	.. ..	.. ..	.. ..	.. ..	0 04	0 11	0 19	0 28	0 37	0 48	1 01	1 16	1 35
12	0 07	0 11	0 15	0 19	0 23	0 27	0 33	0 38	0 44	0 51	0 59	1 08	1 18	1 30
13	0 34	0 36	0 39	0 41	0 44	0 47	0 50	0 54	0 58	1 02	1 07	1 12	1 19	1 26
14	0 59	1 00	1 01	1 02	1 03	1 04	1 06	1 08	1 09	1 11	1 13	1 16	1 19	1 22
15	1 22	1 22	1 22	1 21	1 21	1 21	1 21	1 20	1 20	1 20	1 19	1 19	1 18	1 18
16	1 46	1 44	1 43	1 41	1 40	1 38	1 36	1 34	1 31	1 28	1 25	1 22	1 18	1 14
17	2 11	2 08	2 06	2 03	1 59	1 56	1 52	1 48	1 43	1 38	1 32	1 26	1 18	1 10
18	2 39	2 35	2 31	2 26	2 22	2 16	2 11	2 05	1 58	1 50	1 41	1 31	1 20	1 06
19	3 11	3 06	3 00	2 54	2 48	2 41	2 34	2 26	2 16	2 06	1 54	1 40	1 23	1 02
20	3 48	3 42	3 35	3 28	3 21	3 13	3 03	2 53	2 41	2 28	2 12	1 53	1 30	0 58
21	4 33	4 26	4 18	4 11	4 02	3 52	3 42	3 30	3 16	3 00	2 41	2 17	1 46	0 55
22	5 25	5 18	5 10	5 02	4 53	4 43	4 32	4 19	4 05	3 48	3 27	3 00	2 23	1 00
23	6 25	6 18	6 11	6 03	5 55	5 45	5 34	5 22	5 08	4 52	4 33	4 08	3 35	2 38
24	7 31	7 25	7 19	7 12	7 04	6 56	6 47	6 37	6 25	6 11	5 55	5 36	5 12	4 38
25	8 40	8 36	8 31	8 25	8 19	8 13	8 05	7 58	7 49	7 38	7 27	7 13	6 56	6 36
26	9 51	9 48	9 44	9 40	9 36	9 32	9 27	9 21	9 15	9 08	9 01	8 52	8 42	8 29
27	11 01	11 00	10 58	10 56	10 53	10 51	10 48	10 46	10 42	10 39	10 35	10 30	10 25	10 19
28	12 12	12 12	12 11	12 11	12 11	12 11	12 10	12 10	12 09	12 09	12 08	12 08	12 07	12 06
29	13 23	13 24	13 26	13 27	13 29	13 30	13 32	13 35	13 37	13 40	13 42	13 46	13 50	13 54
30	14 34	14 37	14 40	14 44	14 47	14 51	14 55	15 00	15 05	15 11	15 18	15 26	15 34	15 45
July 1	15 47	15 51	15 56	16 01	16 06	16 12	16 19	16 26	16 35	16 44	16 55	17 07	17 22	17 41
2	16 59	17 04	17 10	17 17	17 24	17 32	17 41	17 51	18 02	18 15	18 30	18 49	19 12	19 42

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	6 52	6 45	6 37	6 29	6 20	6 10	5 58	5 46	5 31	5 14	4 53	4 26	3 48	▬
9	7 54	7 48	7 41	7 33	7 25	7 16	7 06	6 54	6 41	6 26	6 08	5 45	5 15	4 30
10	8 58	8 52	8 46	8 40	8 33	8 25	8 17	8 08	7 57	7 45	7 30	7 13	6 52	6 25
11	10 00	9 56	9 51	9 46	9 41	9 35	9 29	9 21	9 13	9 04	8 54	8 42	8 28	8 10
12	11 01	10 58	10 55	10 51	10 47	10 43	10 39	10 34	10 29	10 22	10 16	10 08	9 58	9 47
13	12 00	11 58	11 56	11 54	11 52	11 50	11 48	11 45	11 42	11 38	11 34	11 30	11 25	11 19
14	12 58	12 58	12 57	12 57	12 56	12 55	12 55	12 54	12 53	12 52	12 51	12 50	12 49	12 48
15	13 56	13 57	13 57	13 58	13 59	14 01	14 02	14 03	14 05	14 06	14 08	14 10	14 13	14 15
16	14 54	14 56	14 58	15 01	15 03	15 06	15 09	15 13	15 17	15 21	15 26	15 31	15 37	15 45
17	15 54	15 57	16 01	16 04	16 09	16 13	16 18	16 24	16 30	16 37	16 45	16 54	17 05	17 17
18	16 55	16 59	17 04	17 09	17 15	17 22	17 29	17 36	17 45	17 55	18 06	18 20	18 36	18 56
19	17 57	18 02	18 09	18 15	18 23	18 31	18 39	18 49	19 01	19 14	19 29	19 47	20 10	20 41
20	18 59	19 05	19 12	19 20	19 28	19 38	19 48	20 00	20 13	20 29	20 48	21 11	21 43	22 33
21	19 58	20 05	20 13	20 21	20 30	20 40	20 51	21 04	21 18	21 35	21 56	22 22	23 00	.. ..
22	20 53	21 00	21 07	21 15	21 24	21 34	21 45	21 57	22 11	22 27	22 47	23 12	23 45	0 23
23	21 42	21 48	21 55	22 02	22 10	22 18	22 28	22 39	22 51	23 05	23 21	23 41	.. ..	0 43
24	22 24	22 29	22 34	22 40	22 47	22 54	23 01	23 10	23 20	23 30	23 43	23 57	0 06	0 40
25	23 00	23 04	23 08	23 13	23 17	23 23	23 28	23 34	23 41	23 49	23 57	.. ..	0 15	0 36
26	23 33	23 35	23 38	23 41	23 44	23 47	23 50	23 54	23 58	.. ..	.. ..	0 07	0 19	0 32
27	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 03	0 08	0 14	0 21	0 28
28	0 03	0 04	0 05	0 06	0 07	0 08	0 10	0 11	0 13	0 15	0 17	0 19	0 22	0 24
29	0 32	0 31	0 31	0 30	0 30	0 29	0 28	0 27	0 27	0 26	0 25	0 23	0 22	0 20
30	1 02	1 00	0 58	0 55	0 53	0 50	0 47	0 44	0 41	0 37	0 33	0 28	0 22	0 16
July 1	1 34	1 30	1 27	1 23	1 18	1 14	1 09	1 03	0 57	0 50	0 43	0 34	0 24	0 12
2	2 10	2 05	2 00	1 54	1 48	1 42	1 34	1 26	1 18	1 07	0 56	0 43	0 27	0 07

▬ indicates Moon continuously below horizon.
.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	13 13	13 29	13 42	13 53	14 02	14 10	14 25	14 37	14 49	15 01	15 14	15 28	15 37	15 47
2	13 38	14 00	14 18	14 32	14 44	14 55	15 13	15 29	15 44	15 59	16 16	16 35	16 46	16 59
3	14 12	14 39	15 00	15 17	15 31	15 44	16 05	16 24	16 42	16 59	17 18	17 40	17 53	18 08
4	14 57	15 28	15 51	16 09	16 25	16 38	17 01	17 21	17 40	17 59	18 19	18 42	18 56	19 12
5	15 56	16 26	16 49	17 08	17 23	17 37	17 59	18 19	18 38	18 56	19 16	19 39	19 52	20 07
6	17 05	17 33	17 54	18 10	18 24	18 37	18 58	19 16	19 33	19 50	20 08	20 29	20 41	20 55
7	18 20	18 43	19 00	19 14	19 26	19 37	19 55	20 10	20 25	20 39	20 54	21 12	21 22	21 34
8	19 36	19 53	20 06	20 17	20 27	20 35	20 49	21 01	21 13	21 24	21 36	21 50	21 58	22 07
9	20 51	21 02	21 11	21 19	21 25	21 31	21 41	21 49	21 57	22 05	22 14	22 23	22 29	22 35
10	22 03	22 09	22 14	22 18	22 22	22 25	22 31	22 35	22 40	22 44	22 49	22 54	22 57	23 01
11	23 14	23 15	23 16	23 17	23 17	23 18	23 19	23 20	23 21	23 21	23 22	23 23	23 24	23 25
12	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 58	23 55	23 52	23 50	23 48
13	0 24	0 20	0 17	0 15	0 12	0 10	0 07	0 04	0 01	.. ..	.. ..	.. ..	.. ..	.. ..
14	1 35	1 26	1 19	1 13	1 08	1 03	0 55	0 48	0 42	0 36	0 29	0 22	0 17	0 13
15	2 47	2 33	2 21	2 12	2 04	1 57	1 45	1 35	1 25	1 15	1 05	0 53	0 46	0 39
16	4 01	3 41	3 26	3 13	3 02	2 53	2 37	2 23	2 10	1 57	1 43	1 28	1 19	1 09
17	5 15	4 50	4 31	4 15	4 02	3 50	3 31	3 14	2 58	2 43	2 26	2 07	1 56	1 43
18	6 26	5 57	5 35	5 17	5 02	4 49	4 27	4 08	3 50	3 32	3 14	2 52	2 39	2 25
19	7 30	6 59	6 35	6 17	6 01	5 47	5 24	5 04	4 45	4 26	4 06	3 43	3 30	3 14
20	8 23	7 53	7 30	7 12	6 56	6 43	6 20	6 00	5 42	5 24	5 04	4 41	4 28	4 12
21	9 03	8 37	8 17	8 01	7 47	7 35	7 14	6 56	6 39	6 23	6 04	5 44	5 31	5 17
22	9 33	9 12	8 56	8 43	8 32	8 22	8 05	7 50	7 36	7 22	7 06	6 49	6 39	6 27
23	9 55	9 41	9 29	9 20	9 11	9 04	8 51	8 40	8 30	8 19	8 08	7 55	7 48	7 39
24	10 13	10 05	9 58	9 52	9 47	9 43	9 35	9 28	9 22	9 16	9 09	9 01	8 57	8 52
25	10 29	10 26	10 24	10 22	10 21	10 19	10 17	10 15	10 13	10 11	10 09	10 06	10 05	10 03

MOONSET

	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	3 44	3 30	3 18	3 09	3 01	2 54	2 41	2 31	2 21	2 11	2 00	1 48	1 42	1 34
2	5 11	4 50	4 34	4 21	4 10	4 00	3 43	3 29	3 15	3 01	2 47	2 30	2 21	2 10
3	6 35	6 09	5 48	5 32	5 18	5 06	4 46	4 28	4 11	3 55	3 37	3 17	3 05	2 52
4	7 50	7 20	6 57	6 39	6 24	6 10	5 48	5 28	5 10	4 51	4 32	4 09	3 56	3 40
5	8 51	8 21	7 58	7 39	7 23	7 10	6 47	6 27	6 08	5 49	5 29	5 06	4 52	4 36
6	9 37	9 09	8 48	8 31	8 16	8 03	7 41	7 22	7 04	6 47	6 27	6 05	5 52	5 37
7	10 10	9 47	9 29	9 14	9 01	8 50	8 31	8 14	7 58	7 42	7 25	7 06	6 54	6 41
8	10 34	10 16	10 02	9 50	9 39	9 30	9 15	9 01	8 48	8 35	8 21	8 05	7 55	7 45
9	10 53	10 40	10 29	10 20	10 13	10 06	9 54	9 44	9 34	9 25	9 14	9 02	8 55	8 47
10	11 07	10 59	10 53	10 47	10 42	10 38	10 31	10 24	10 18	10 12	10 05	9 57	9 53	9 48
11	11 20	11 17	11 14	11 12	11 10	11 08	11 05	11 02	10 59	10 57	10 54	10 51	10 49	10 47
12	11 32	11 33	11 34	11 35	11 36	11 37	11 38	11 39	11 40	11 41	11 42	11 43	11 44	11 45
13	11 44	11 50	11 55	11 59	12 03	12 06	12 11	12 16	12 21	12 25	12 30	12 36	12 39	12 43
14	11 57	12 08	12 17	12 24	12 31	12 36	12 46	12 54	13 02	13 10	13 19	13 29	13 35	13 41
15	12 13	12 29	12 42	12 52	13 01	13 09	13 23	13 35	13 46	13 58	14 10	14 24	14 32	14 41
16	12 33	12 54	13 10	13 24	13 36	13 46	14 03	14 18	14 33	14 47	15 03	15 20	15 31	15 43
17	12 59	13 25	13 45	14 02	14 15	14 28	14 48	15 06	15 23	15 40	15 58	16 18	16 31	16 45
18	13 36	14 06	14 29	14 47	15 02	15 15	15 38	15 58	16 16	16 35	16 54	17 17	17 30	17 46
19	14 27	14 58	15 22	15 40	15 56	16 10	16 33	16 53	17 12	17 31	17 51	18 14	18 28	18 43
20	15 32	16 02	16 24	16 42	16 57	17 10	17 32	17 52	18 09	18 27	18 46	19 08	19 21	19 35
21	16 50	17 15	17 35	17 50	18 03	18 15	18 34	18 51	19 06	19 22	19 38	19 57	20 08	20 21
22	18 16	18 35	18 49	19 01	19 12	19 21	19 36	19 49	20 02	20 14	20 27	20 42	20 50	21 00
23	19 43	19 56	20 06	20 14	20 21	20 27	20 37	20 47	20 55	21 03	21 12	21 22	21 28	21 35
24	21 11	21 17	21 22	21 26	21 29	21 32	21 38	21 42	21 46	21 51	21 55	22 00	22 03	22 06
25	22 38	22 37	22 37	22 37	22 37	22 37	22 37	22 37	22 36	22 36	22 36	22 36	22 36	22 35

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	15 47	15 51	15 56	16 01	16 06	16 12	16 19	16 26	16 35	16 44	16 55	17 07	17 22	17 41
2	16 59	17 04	17 10	17 17	17 24	17 32	17 41	17 51	18 02	18 15	18 30	18 49	19 12	19 42
3	18 08	18 15	18 22	18 30	18 38	18 48	18 58	19 10	19 24	19 40	19 59	20 23	20 56	21 51
4	19 12	19 19	19 26	19 35	19 44	19 54	20 05	20 18	20 33	20 51	21 12	21 39	22 19	▬
5	20 07	20 14	20 22	20 30	20 39	20 49	21 00	21 12	21 26	21 43	22 03	22 28	23 02	▬
6	20 55	21 01	21 08	21 15	21 23	21 31	21 41	21 52	22 04	22 18	22 34	22 54	23 20	{00 04 / 23 54}
7	21 34	21 39	21 45	21 51	21 57	22 04	22 12	22 21	22 30	22 41	22 54	23 09	23 27	23 49
8	22 07	22 11	22 15	22 20	22 25	22 30	22 36	22 42	22 50	22 58	23 07	23 17	23 30	23 44
9	22 35	22 38	22 41	22 44	22 47	22 51	22 55	23 00	23 04	23 10	23 16	23 23	23 31	23 40
10	23 01	23 02	23 04	23 06	23 07	23 09	23 12	23 14	23 17	23 20	23 23	23 27	23 31	23 36
11	23 25	23 25	23 25	23 26	23 26	23 26	23 27	23 27	23 28	23 28	23 29	23 30	23 30	23 31
12	23 48	23 47	23 46	23 45	23 44	23 43	23 42	23 40	23 39	23 37	23 35	23 33	23 30	23 27
13	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 57	23 54	23 50	23 46	23 41	23 36	23 30	23 23
14	0 13	0 10	0 08	0 06	0 03	0 00	.. ..	.. ..	.. ..	23 57	23 49	23 41	23 31	23 19
15	0 39	0 35	0 32	0 28	0 24	0 19	0 15	0 09	0 03	.. ..	.. ..	23 47	23 33	23 15
16	1 09	1 04	0 59	0 54	0 48	0 42	0 35	0 28	0 20	0 10	0 00	23 58	23 38	23 12
17	1 43	1 38	1 32	1 25	1 18	1 10	1 02	0 52	0 42	0 29	0 15	.. ..	23 49	23 08
18	2 25	2 18	2 11	2 04	1 55	1 46	1 36	1 25	1 12	0 57	0 39	0 17	.. ..	23 07
19	3 14	3 07	3 00	2 51	2 43	2 33	2 22	2 09	1 55	1 38	1 17	0 52	0 16	.. ..
20	4 12	4 05	3 58	3 50	3 41	3 31	3 20	3 07	2 53	2 36	2 16	1 50	1 14	0 03
21	5 17	5 11	5 04	4 57	4 49	4 40	4 30	4 19	4 06	3 52	3 34	3 13	2 45	2 04
22	6 27	6 22	6 17	6 11	6 04	5 57	5 49	5 40	5 30	5 19	5 05	4 50	4 31	4 06
23	7 39	7 36	7 32	7 27	7 22	7 17	7 12	7 05	6 58	6 50	6 41	6 31	6 19	6 04
24	8 52	8 49	8 47	8 44	8 42	8 38	8 35	8 32	8 27	8 23	8 18	8 12	8 05	7 57
25	10 03	10 03	10 02	10 01	10 00	9 59	9 58	9 57	9 56	9 55	9 53	9 51	9 49	9 47

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	1 34	1 30	1 27	1 23	1 18	1 14	1 09	1 03	0 57	0 50	0 43	0 34	0 24	0 12
2	2 10	2 05	2 00	1 54	1 48	1 42	1 34	1 26	1 18	1 07	0 56	0 43	0 27	0 07
3	2 52	2 46	2 39	2 32	2 25	2 16	2 07	1 57	1 45	1 31	1 16	0 57	0 33	{00 02 / 23 54}
4	3 40	3 34	3 26	3 18	3 09	3 00	2 49	2 37	2 23	2 06	1 47	1 22	0 49	▬
5	4 36	4 29	4 21	4 13	4 04	3 54	3 42	3 29	3 15	2 57	2 36	2 08	1 29	▬
6	5 37	5 30	5 23	5 15	5 06	4 57	4 46	4 34	4 20	4 04	3 44	3 19	2 45	1 44
7	6 41	6 35	6 28	6 22	6 14	6 06	5 56	5 46	5 34	5 21	5 05	4 45	4 20	3 46
8	7 45	7 40	7 35	7 29	7 23	7 16	7 09	7 01	6 52	6 41	6 29	6 15	5 58	5 37
9	8 47	8 44	8 40	8 36	8 31	8 27	8 21	8 15	8 09	8 02	7 53	7 44	7 32	7 19
10	9 48	9 46	9 43	9 41	9 38	9 35	9 31	9 28	9 24	9 19	9 14	9 08	9 02	8 54
11	10 47	10 46	10 45	10 44	10 42	10 41	10 40	10 38	10 37	10 35	10 32	10 30	10 27	10 24
12	11 45	11 45	11 45	11 46	11 46	11 47	11 47	11 48	11 48	11 49	11 49	11 50	11 51	11 52
13	12 43	12 44	12 46	12 48	12 50	12 52	12 54	12 57	13 00	13 03	13 06	13 10	13 15	13 21
14	13 41	13 44	13 47	13 50	13 54	13 58	14 02	14 07	14 12	14 18	14 24	14 32	14 41	14 51
15	14 41	14 45	14 50	14 54	15 00	15 05	15 11	15 18	15 26	15 35	15 45	15 56	16 10	16 26
16	15 43	15 48	15 54	16 00	16 06	16 14	16 22	16 31	16 41	16 53	17 06	17 23	17 43	18 08
17	16 45	16 51	16 58	17 05	17 13	17 22	17 32	17 43	17 55	18 10	18 27	18 49	19 17	19 57
18	17 46	17 53	18 00	18 08	18 17	18 27	18 38	18 50	19 04	19 21	19 41	20 07	20 42	21 51
19	18 43	18 50	18 58	19 06	19 15	19 25	19 36	19 49	20 03	20 20	20 40	21 06	21 42	22 53
20	19 35	19 42	19 49	19 56	20 05	20 14	20 24	20 35	20 48	21 03	21 21	21 43	22 11	22 53
21	20 21	20 26	20 32	20 39	20 46	20 53	21 02	21 11	21 22	21 34	21 48	22 04	22 24	22 49
22	21 00	21 04	21 09	21 14	21 19	21 25	21 31	21 38	21 46	21 55	22 05	22 16	22 29	22 45
23	21 35	21 38	21 41	21 44	21 47	21 51	21 55	22 00	22 05	22 11	22 17	22 24	22 32	22 41
24	22 06	22 07	22 09	22 10	22 12	22 14	22 16	22 18	22 20	22 23	22 26	22 29	22 33	22 37
25	22 35	22 35	22 35	22 35	22 35	22 35	22 35	22 35	22 34	22 34	22 34	22 34	22 34	22 33

▬ indicates Moon continuously below horizon.
.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	10 13	10 05	9 58	9 52	9 47	9 43	9 35	9 28	9 22	9 16	9 09	9 01	8 57	8 52
25	10 29	10 26	10 24	10 22	10 21	10 19	10 17	10 15	10 13	10 11	10 09	10 06	10 05	10 03
26	10 44	10 47	10 50	10 52	10 53	10 55	10 58	11 00	11 03	11 05	11 08	11 11	11 12	11 14
27	11 00	11 09	11 16	11 22	11 27	11 31	11 39	11 46	11 53	12 00	12 07	12 15	12 20	12 25
28	11 18	11 33	11 44	11 54	12 02	12 10	12 23	12 34	12 45	12 55	13 07	13 20	13 28	13 37
29	11 41	12 01	12 17	12 30	12 42	12 52	13 09	13 24	13 38	13 52	14 08	14 25	14 36	14 48
30	12 11	12 36	12 56	13 12	13 26	13 38	13 59	14 17	14 34	14 50	15 09	15 30	15 42	15 56
31	12 51	13 20	13 43	14 01	14 16	14 30	14 52	15 12	15 30	15 49	16 09	16 32	16 45	17 01
Aug. 1	13 43	14 14	14 38	14 56	15 12	15 25	15 49	16 09	16 27	16 46	17 06	17 29	17 43	17 59
2	14 48	15 17	15 39	15 57	16 11	16 24	16 46	17 05	17 23	17 40	17 59	18 21	18 34	18 48
3	16 01	16 26	16 45	17 00	17 13	17 24	17 43	18 00	18 16	18 31	18 48	19 07	19 18	19 30
4	17 17	17 36	17 51	18 03	18 14	18 23	18 39	18 52	19 05	19 18	19 31	19 46	19 55	20 05
5	18 33	18 46	18 57	19 06	19 13	19 20	19 32	19 42	19 51	20 00	20 10	20 22	20 28	20 36
6	19 46	19 55	20 01	20 07	20 11	20 15	20 22	20 29	20 35	20 40	20 47	20 54	20 58	21 02
7	20 58	21 01	21 04	21 06	21 07	21 09	21 12	21 14	21 16	21 18	21 21	21 23	21 25	21 27
8	22 09	22 07	22 05	22 04	22 03	22 02	22 00	21 58	21 57	21 55	21 54	21 52	21 51	21 50
9	23 19	23 12	23 06	23 02	22 58	22 54	22 48	22 42	22 37	22 32	22 27	22 21	22 18	22 14
10	.. ..	.. ..	.. ..	.. ..	23 53	23 47	23 37	23 28	23 19	23 11	23 02	22 52	22 46	22 39
11	0 30	0 18	0 08	0 00	.. ..	.. ..	.. ..	.. ..	.. ..	23 51	23 39	23 24	23 16	23 07
12	1 43	1 25	1 11	1 00	0 50	0 42	0 27	0 14	0 03	.. ..	.. ..	.. ..	23 51	23 39
13	2 56	2 33	2 15	2 01	1 48	1 38	1 19	1 04	0 49	0 34	0 19	0 01	.. ..	.. ..
14	4 08	3 40	3 19	3 02	2 48	2 35	2 14	1 56	1 39	1 22	1 03	0 43	0 31	0 17
15	5 15	4 44	4 21	4 02	3 46	3 33	3 10	2 50	2 32	2 13	1 53	1 31	1 17	1 02
16	6 13	5 41	5 18	4 59	4 43	4 30	4 06	3 46	3 27	3 09	2 48	2 25	2 12	1 56
17	6 58	6 30	6 08	5 51	5 36	5 23	5 02	4 43	4 25	4 07	3 48	3 26	3 13	2 58

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	21 11	21 17	21 22	21 26	21 29	21 32	21 38	21 42	21 46	21 51	21 55	22 00	22 03	22 06
25	22 38	22 37	22 37	22 37	22 37	22 37	22 37	22 37	22 36	22 36	22 36	22 36	22 36	22 35
26	.. ..	23 58	23 52	23 48	23 45	23 41	23 36	23 31	23 26	23 22	23 17	23 12	23 08	23 05
27	0 04	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 59	23 49	23 43	23 36
28	1 30	1 18	1 08	0 59	0 52	0 46	0 35	0 26	0 17	0 09	.. ..	.. ..	.. ..	.. ..
29	2 56	2 37	2 23	2 11	2 00	1 51	1 36	1 22	1 10	0 57	0 44	0 29	0 20	0 10
30	4 20	3 55	3 36	3 21	3 08	2 56	2 37	2 20	2 04	1 49	1 32	1 13	1 02	0 49
31	5 37	5 08	4 45	4 28	4 13	4 00	3 38	3 19	3 01	2 43	2 24	2 02	1 49	1 34
Aug. 1	6 42	6 11	5 48	5 29	5 13	5 00	4 37	4 17	3 58	3 39	3 19	2 56	2 42	2 26
2	7 33	7 03	6 41	6 23	6 08	5 55	5 32	5 13	4 54	4 36	4 16	3 53	3 40	3 24
3	8 10	7 45	7 25	7 09	6 55	6 43	6 23	6 05	5 49	5 32	5 14	4 53	4 41	4 27
4	8 37	8 17	8 01	7 47	7 36	7 26	7 09	6 54	6 40	6 25	6 10	5 53	5 42	5 30
5	8 57	8 42	8 30	8 20	8 11	8 03	7 50	7 39	7 27	7 16	7 04	6 51	6 43	6 34
6	9 13	9 03	8 55	8 48	8 42	8 37	8 28	8 20	8 12	8 05	7 56	7 47	7 42	7 35
7	9 27	9 21	9 17	9 14	9 10	9 08	9 03	8 59	8 55	8 51	8 46	8 41	8 38	8 35
8	9 39	9 38	9 38	9 38	9 37	9 37	9 37	9 36	9 36	9 35	9 35	9 34	9 34	9 34
9	9 50	9 55	9 58	10 01	10 04	10 06	10 10	10 13	10 16	10 20	10 23	10 27	10 29	10 32
10	10 03	10 12	10 19	10 25	10 31	10 35	10 43	10 51	10 57	11 04	11 11	11 20	11 24	11 30
11	10 17	10 31	10 42	10 52	11 00	11 07	11 19	11 30	11 40	11 50	12 01	12 13	12 20	12 29
12	10 35	10 54	11 09	11 21	11 32	11 41	11 57	12 11	12 25	12 38	12 52	13 08	13 18	13 29
13	10 58	11 22	11 40	11 56	12 09	12 20	12 40	12 56	13 12	13 28	13 45	14 05	14 17	14 30
14	11 29	11 58	12 19	12 37	12 52	13 05	13 27	13 46	14 04	14 22	14 41	15 03	15 16	15 31
15	12 13	12 44	13 07	13 26	13 42	13 56	14 19	14 39	14 58	15 17	15 37	16 00	16 14	16 30
16	13 11	13 42	14 06	14 24	14 40	14 53	15 16	15 36	15 55	16 13	16 33	16 56	17 09	17 24
17	14 25	14 52	15 13	15 30	15 44	15 56	16 17	16 35	16 52	17 09	17 27	17 47	17 59	18 13

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	8 52	8 49	8 47	8 44	8 42	8 38	8 35	8 32	8 27	8 23	8 18	8 12	8 05	7 57
25	10 03	10 03	10 02	10 01	10 00	9 59	9 58	9 57	9 56	9 55	9 53	9 51	9 49	9 47
26	11 14	11 15	11 16	11 17	11 18	11 20	11 21	11 22	11 24	11 26	11 28	11 30	11 32	11 35
27	12 25	12 28	12 31	12 33	12 36	12 40	12 43	12 47	12 52	12 57	13 02	13 08	13 16	13 25
28	13 37	13 41	13 45	13 49	13 54	14 00	14 06	14 12	14 20	14 28	14 37	14 48	15 01	15 17
29	14 48	14 53	14 59	15 05	15 11	15 19	15 27	15 36	15 46	15 58	16 12	16 28	16 48	17 14
30	15 56	16 03	16 10	16 17	16 25	16 34	16 45	16 56	17 09	17 24	17 42	18 04	18 34	19 18
31	17 01	17 08	17 16	17 24	17 33	17 43	17 54	18 07	18 21	18 39	19 00	19 26	20 05	▬
Aug. 1	17 59	18 06	18 13	18 22	18 31	18 41	18 52	19 05	19 19	19 37	19 57	20 24	21 02	22 33
2	18 48	18 55	19 02	19 10	19 18	19 27	19 37	19 49	20 02	20 17	20 35	20 57	21 26	22 09
3	19 30	19 36	19 42	19 48	19 56	20 03	20 12	20 21	20 32	20 44	20 59	21 15	21 36	22 02
4	20 05	20 10	20 15	20 20	20 25	20 32	20 38	20 46	20 54	21 03	21 14	21 26	21 40	21 57
5	20 36	20 39	20 42	20 46	20 50	20 54	20 59	21 04	21 10	21 17	21 24	21 32	21 42	21 53
6	21 02	21 04	21 06	21 09	21 11	21 14	21 17	21 20	21 23	21 27	21 31	21 36	21 42	21 48
7	21 27	21 27	21 28	21 29	21 30	21 31	21 32	21 33	21 35	21 36	21 38	21 40	21 42	21 44
8	21 50	21 50	21 49	21 49	21 48	21 48	21 47	21 46	21 45	21 45	21 44	21 42	21 41	21 40
9	22 14	22 12	22 11	22 09	22 07	22 04	22 02	21 59	21 56	21 53	21 50	21 46	21 41	21 36
10	22 39	22 36	22 33	22 30	22 26	22 22	22 18	22 14	22 09	22 03	21 57	21 49	21 41	21 31
11	23 07	23 03	22 59	22 54	22 49	22 43	22 37	22 31	22 23	22 15	22 06	21 55	21 42	21 27
12	23 39	23 34	23 28	23 22	23 16	23 09	23 01	22 52	22 42	22 31	22 18	22 03	21 45	21 23
13	.. ..	.. ..	.. ..	23 57	23 49	23 40	23 31	23 20	23 08	22 54	22 38	22 18	21 53	21 19
14	0 17	0 11	0 04	.. ..	.. ..	.. ..	.. ..	23 58	23 44	23 28	23 08	22 44	22 10	21 14
15	1 02	0 55	0 48	0 40	0 31	0 21	0 10	.. ..	.. ..	.. ..	23 57	23 30	22 52	▭
16	1 56	1 49	1 41	1 33	1 24	1 14	1 02	0 50	0 35	0 18	.. ..	.. ..	.. ..	23 17
17	2 58	2 51	2 44	2 36	2 28	2 18	2 08	1 56	1 42	1 26	1 07	0 43	0 11	.. ..

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	22 06	22 07	22 09	22 10	22 12	22 14	22 16	22 18	22 20	22 23	22 26	22 29	22 33	22 37
25	22 35	22 35	22 35	22 35	22 35	22 35	22 35	22 35	22 34	22 34	22 34	22 34	22 34	22 33
26	23 05	23 03	23 02	23 00	22 58	22 56	22 54	22 51	22 48	22 45	22 42	22 38	22 34	22 29
27	23 36	23 33	23 30	23 26	23 22	23 18	23 14	23 09	23 04	22 58	22 51	22 44	22 35	22 25
28	.. ..	.. ..	.. ..	23 56	23 50	23 44	23 38	23 30	23 22	23 13	23 03	22 51	22 37	22 20
29	0 10	0 06	0 01	.. ..	.. ..	.. ..	.. ..	23 57	23 46	23 34	23 20	23 03	22 42	22 15
30	0 49	0 43	0 37	0 31	0 23	0 16	0 07	.. ..	.. ..	.. ..	23 46	23 23	22 53	22 08
31	1 34	1 27	1 20	1 13	1 04	0 55	0 44	0 33	0 20	0 04	.. ..	.. ..	23 21	▬
Aug. 1	2 26	2 19	2 11	2 03	1 54	1 44	1 33	1 20	1 05	0 48	0 27	0 00	.. ..	22 52
2	3 24	3 17	3 10	3 02	2 53	2 43	2 32	2 19	2 04	1 47	1 27	1 00	0 23	.. ..
3	4 27	4 20	4 13	4 06	3 58	3 49	3 39	3 28	3 15	3 00	2 43	2 21	1 53	1 10
4	5 30	5 25	5 19	5 13	5 07	4 59	4 51	4 42	4 32	4 20	4 06	3 50	3 30	3 05
5	6 34	6 30	6 25	6 21	6 15	6 10	6 04	5 57	5 49	5 41	5 31	5 20	5 06	4 50
6	7 35	7 33	7 30	7 26	7 23	7 19	7 15	7 11	7 06	7 00	6 54	6 46	6 38	6 28
7	8 35	8 34	8 32	8 31	8 29	8 27	8 25	8 22	8 20	8 17	8 14	8 10	8 06	8 01
8	9 34	9 34	9 33	9 33	9 33	9 33	9 33	9 32	9 32	9 32	9 31	9 31	9 31	9 30
9	10 32	10 33	10 34	10 35	10 37	10 38	10 40	10 42	10 44	10 46	10 48	10 51	10 54	10 58
10	11 30	11 32	11 35	11 38	11 41	11 44	11 47	11 51	11 55	12 00	12 06	12 12	12 19	12 28
11	12 29	12 32	12 36	12 41	12 45	12 50	12 56	13 02	13 08	13 16	13 24	13 34	13 46	14 00
12	13 29	13 34	13 39	13 45	13 51	13 57	14 05	14 13	14 22	14 33	14 45	14 59	15 17	15 38
13	14 30	14 36	14 42	14 49	14 57	15 05	15 14	15 24	15 36	15 50	16 06	16 25	16 50	17 23
14	15 31	15 37	15 45	15 53	16 01	16 11	16 21	16 33	16 47	17 03	17 23	17 47	18 20	19 16
15	16 30	16 37	16 44	16 53	17 02	17 12	17 23	17 36	17 50	18 07	18 28	18 55	19 33	▭
16	17 24	17 31	17 38	17 46	17 55	18 05	18 15	18 28	18 41	18 58	19 17	19 41	20 14	21 08
17	18 13	18 19	18 25	18 32	18 40	18 48	18 58	19 08	19 20	19 33	19 49	20 08	20 32	21 03

▭ indicates Moon continuously above horizon.
▬ indicates Moon continuously below horizon.
.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	6 13	5 41	5 18	4 59	4 43	4 30	4 06	3 46	3 27	3 09	2 48	2 25	2 12	1 56
17	6 58	6 30	6 08	5 51	5 36	5 23	5 02	4 43	4 25	4 07	3 48	3 26	3 13	2 58
18	7 32	7 09	6 51	6 36	6 24	6 13	5 54	5 38	5 22	5 07	4 50	4 31	4 20	4 07
19	7 58	7 41	7 27	7 16	7 06	6 58	6 43	6 31	6 18	6 06	5 53	5 39	5 30	5 20
20	8 18	8 07	7 58	7 51	7 45	7 39	7 29	7 21	7 13	7 05	6 56	6 46	6 41	6 34
21	8 35	8 30	8 26	8 23	8 20	8 17	8 13	8 09	8 06	8 02	7 58	7 54	7 51	7 48
22	8 50	8 51	8 52	8 53	8 54	8 54	8 55	8 56	8 57	8 58	8 59	9 01	9 01	9 02
23	9 06	9 13	9 19	9 23	9 28	9 31	9 38	9 43	9 49	9 54	10 00	10 07	10 11	10 15
24	9 24	9 36	9 47	9 55	10 03	10 10	10 21	10 31	10 41	10 50	11 01	11 13	11 20	11 28
25	9 45	10 03	10 18	10 31	10 41	10 51	11 07	11 21	11 34	11 48	12 02	12 19	12 29	12 40
26	10 12	10 36	10 55	11 11	11 24	11 36	11 56	12 13	12 29	12 46	13 03	13 24	13 36	13 49
27	10 48	11 17	11 39	11 57	12 12	12 25	12 48	13 07	13 25	13 44	14 03	14 26	14 40	14 55
28	11 36	12 08	12 31	12 50	13 06	13 19	13 43	14 03	14 22	14 41	15 01	15 24	15 38	15 54
29	12 37	13 07	13 30	13 48	14 03	14 17	14 39	14 59	15 17	15 35	15 55	16 17	16 30	16 46
30	13 47	14 13	14 33	14 50	15 03	15 15	15 36	15 53	16 10	16 26	16 44	17 04	17 16	17 29
31	15 02	15 23	15 39	15 53	16 04	16 14	16 31	16 46	17 00	17 13	17 28	17 45	17 55	18 06
Sept. 1	16 17	16 33	16 45	16 55	17 04	17 11	17 24	17 36	17 46	17 57	18 08	18 21	18 29	18 37
2	17 31	17 42	17 50	17 56	18 02	18 07	18 16	18 23	18 31	18 38	18 45	18 54	18 59	19 04
3	18 44	18 49	18 53	18 56	18 59	19 01	19 05	19 09	19 13	19 16	19 20	19 24	19 27	19 29
4	19 55	19 55	19 55	19 54	19 54	19 54	19 54	19 54	19 54	19 53	19 53	19 53	19 53	19 53
5	21 06	21 00	20 56	20 53	20 49	20 47	20 42	20 38	20 34	20 30	20 26	20 22	20 19	20 16
6	22 17	22 06	21 58	21 51	21 45	21 39	21 30	21 23	21 15	21 08	21 00	20 51	20 46	20 41
7	23 28	23 12	23 00	22 41	22 33	22 20	22 08	21 58	21 47	21 36	21 23	21 16	21 07	
8	.. ..	.. ..	.. ..	23 49	23 38	23 28	23 11	22 56	22 42	22 29	22 14	21 57	21 48	21 37
9	0 41	0 19	0 03	.. ..	.. ..	.. ..	.. ..	23 46	23 30	23 13	22 56	22 36	22 25	22 11

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	13 11	13 42	14 06	14 24	14 40	14 53	15 16	15 36	15 55	16 13	16 33	16 56	17 09	17 24
17	14 25	14 52	15 13	15 30	15 44	15 56	16 17	16 35	16 52	17 09	17 27	17 47	17 59	18 13
18	15 49	16 11	16 28	16 41	16 53	17 03	17 20	17 35	17 49	18 03	18 18	18 34	18 44	18 55
19	17 18	17 33	17 45	17 55	18 04	18 11	18 23	18 34	18 45	18 55	19 05	19 17	19 24	19 32
20	18 49	18 57	19 04	19 10	19 14	19 19	19 26	19 32	19 38	19 44	19 50	19 57	20 01	20 05
21	20 19	20 21	20 22	20 24	20 25	20 26	20 27	20 29	20 30	20 32	20 33	20 34	20 35	20 36
22	21 48	21 43	21 40	21 37	21 34	21 32	21 28	21 25	21 22	21 18	21 15	21 11	21 09	21 06
23	23 16	23 06	22 57	22 50	22 44	22 38	22 29	22 21	22 13	22 06	21 58	21 49	21 43	21 37
24	.. ..	.. ..	.. ..	.. ..	23 53	23 44	23 30	23 18	23 06	22 54	22 42	22 28	22 20	22 11
25	0 44	0 27	0 13	0 02	.. ..	.. ..	.. ..	.. ..	.. ..	23 45	23 29	23 11	23 01	22 48
26	2 09	1 46	1 28	1 13	1 01	0 50	0 31	0 15	0 00	.. ..	.. ..	23 58	23 46	23 32
27	3 29	3 00	2 39	2 21	2 07	1 54	1 32	1 14	0 56	0 39	0 20	.. ..	.. ..	.. ..
28	4 37	4 06	3 43	3 24	3 08	2 55	2 31	2 11	1 53	1 34	1 14	0 50	0 37	0 21
29	5 31	5 01	4 38	4 19	4 04	3 50	3 27	3 07	2 48	2 30	2 10	1 46	1 33	1 17
30	6 12	5 45	5 24	5 07	4 53	4 40	4 19	4 00	3 43	3 25	3 06	2 45	2 32	2 17
31	6 41	6 19	6 01	5 47	5 35	5 24	5 05	4 49	4 34	4 19	4 03	3 44	3 33	3 20
Sept. 1	7 03	6 46	6 32	6 21	6 11	6 03	5 48	5 35	5 23	5 10	4 57	4 42	4 33	4 23
2	7 19	7 08	6 58	6 50	6 43	6 37	6 26	6 17	6 08	5 59	5 50	5 39	5 32	5 25
3	7 33	7 26	7 21	7 16	7 12	7 08	7 02	6 56	6 51	6 46	6 40	6 33	6 30	6 25
4	7 46	7 43	7 42	7 40	7 39	7 38	7 36	7 34	7 32	7 31	7 29	7 27	7 26	7 24
5	7 57	8 00	8 02	8 04	8 05	8 07	8 09	8 11	8 13	8 15	8 17	8 20	8 21	8 23
6	8 09	8 16	8 22	8 27	8 32	8 36	8 42	8 48	8 54	8 59	9 05	9 12	9 16	9 21
7	8 22	8 35	8 44	8 53	9 00	9 06	9 17	9 26	9 35	9 45	9 54	10 05	10 12	10 19
8	8 38	8 55	9 09	9 20	9 30	9 39	9 54	10 07	10 19	10 31	10 44	10 59	11 08	11 18
9	8 58	9 20	9 38	9 52	10 05	10 15	10 34	10 50	11 05	11 20	11 36	11 55	12 06	12 18

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	1 56	1 49	1 41	1 33	1 24	1 14	1 02	0 50	0 35	0 18	.. ..	.. ..	.. ..	23 17
17	2 58	2 51	2 44	2 36	2 28	2 18	2 08	1 56	1 42	1 26	1 07	0 43	0 11	.. ..
18	4 07	4 01	3 55	3 48	3 41	3 33	3 24	3 14	3 03	2 50	2 35	2 16	1 53	1 23
19	5 20	5 16	5 11	5 06	5 00	4 54	4 47	4 40	4 32	4 22	4 12	3 59	3 44	3 25
20	6 34	6 31	6 28	6 25	6 21	6 17	6 13	6 09	6 03	5 57	5 51	5 43	5 34	5 24
21	7 48	7 47	7 46	7 44	7 43	7 41	7 39	7 37	7 35	7 33	7 30	7 27	7 23	7 19
22	9 02	9 02	9 03	9 03	9 04	9 04	9 05	9 05	9 06	9 07	9 08	9 08	9 10	9 11
23	10 15	10 17	10 19	10 22	10 24	10 27	10 30	10 33	10 36	10 40	10 45	10 50	10 56	11 03
24	11 28	11 31	11 35	11 39	11 44	11 49	11 54	12 00	12 06	12 14	12 22	12 32	12 43	12 57
25	12 40	12 45	12 50	12 56	13 02	13 09	13 17	13 25	13 35	13 46	13 58	14 13	14 31	14 54
26	13 49	13 56	14 02	14 10	14 17	14 26	14 36	14 47	14 59	15 13	15 31	15 51	16 19	16 57
27	14 55	15 02	15 09	15 18	15 27	15 36	15 48	16 00	16 15	16 32	16 52	17 19	17 56	19 20
28	15 54	16 01	16 09	16 17	16 27	16 37	16 48	17 01	17 16	17 34	17 56	18 23	19 03	▬
29	16 46	16 52	17 00	17 08	17 16	17 26	17 37	17 49	18 03	18 19	18 38	19 02	19 35	20 28
30	17 29	17 35	17 42	17 48	17 56	18 04	18 14	18 24	18 36	18 49	19 04	19 23	19 47	20 18
31	18 06	18 11	18 16	18 22	18 28	18 34	18 42	18 50	18 59	19 09	19 21	19 35	19 51	20 12
Sept. 1	18 37	18 41	18 45	18 49	18 53	18 58	19 04	19 10	19 17	19 24	19 32	19 42	19 53	20 06
2	19 04	19 07	19 09	19 12	19 15	19 19	19 22	19 26	19 30	19 35	19 40	19 46	19 53	20 01
3	19 29	19 31	19 32	19 33	19 35	19 36	19 38	19 40	19 42	19 44	19 47	19 50	19 53	19 57
4	19 53	19 53	19 53	19 53	19 53	19 53	19 53	19 53	19 53	19 53	19 52	19 52	19 52	19 52
5	20 16	20 15	20 14	20 12	20 11	20 09	20 07	20 05	20 03	20 01	19 58	19 55	19 52	19 48
6	20 41	20 38	20 36	20 33	20 30	20 26	20 23	20 19	20 15	20 10	20 04	19 58	19 51	19 43
7	21 07	21 03	21 00	20 55	20 51	20 46	20 40	20 34	20 28	20 20	20 12	20 02	19 51	19 38
8	21 37	21 32	21 27	21 21	21 15	21 09	21 01	20 53	20 44	20 34	20 23	20 09	19 53	19 33
9	22 11	22 06	21 59	21 52	21 45	21 37	21 28	21 18	21 06	20 53	20 38	20 20	19 57	19 28

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	17 24	17 31	17 38	17 46	17 55	18 05	18 15	18 28	18 41	18 58	19 17	19 41	20 14	21 08
17	18 13	18 19	18 25	18 32	18 40	18 48	18 58	19 08	19 20	19 33	19 49	20 08	20 32	21 03
18	18 55	19 00	19 05	19 11	19 17	19 24	19 31	19 39	19 48	19 58	20 10	20 23	20 39	20 59
19	19 32	19 36	19 39	19 43	19 48	19 52	19 57	20 03	20 09	20 16	20 24	20 32	20 42	20 54
20	20 05	20 07	20 10	20 12	20 14	20 17	20 20	20 23	20 26	20 30	20 34	20 39	20 44	20 50
21	20 36	20 37	20 37	20 38	20 38	20 39	20 39	20 40	20 41	20 41	20 42	20 43	20 44	20 46
22	21 06	21 05	21 04	21 03	21 01	21 00	20 58	20 57	20 55	20 53	20 50	20 48	20 45	20 41
23	21 37	21 35	21 32	21 29	21 26	21 22	21 19	21 14	21 10	21 05	20 59	20 53	20 45	20 37
24	22 11	22 07	22 02	21 58	21 53	21 47	21 41	21 35	21 27	21 19	21 10	20 59	20 47	20 32
25	22 48	22 43	22 37	22 31	22 24	22 17	22 09	22 00	21 50	21 38	21 25	21 09	20 50	20 26
26	23 32	23 25	23 18	23 11	23 02	22 53	22 43	22 32	22 19	22 05	21 47	21 26	20 58	20 19
27	.. ..	.. ..	.. ..	23 58	23 49	23 39	23 28	23 15	23 00	22 43	22 22	21 56	21 19	19 54
28	0 21	0 14	0 06	.. ..	.. ..	.. ..	.. ..	.. ..	23 55	23 37	23 16	22 48	22 08	▬
29	1 17	1 10	1 02	0 54	0 44	0 34	0 23	0 10	.. ..	.. ..	.. ..	.. ..	23 31	22 38
30	2 17	2 11	2 03	1 56	1 47	1 38	1 27	1 15	1 02	0 46	0 27	0 03	.. ..	.. ..
31	3 20	3 14	3 08	3 01	2 54	2 46	2 37	2 28	2 16	2 03	1 48	1 30	1 07	0 37
Sept. 1	4 23	4 18	4 13	4 08	4 03	3 56	3 49	3 42	3 33	3 24	3 13	3 00	2 44	2 25
2	5 25	5 22	5 18	5 14	5 10	5 06	5 01	4 56	4 50	4 43	4 36	4 27	4 17	4 05
3	6 25	6 23	6 21	6 19	6 17	6 14	6 11	6 08	6 05	6 01	5 57	5 52	5 46	5 39
4	7 24	7 24	7 23	7 22	7 22	7 21	7 20	7 19	7 18	7 17	7 15	7 14	7 12	7 10
5	8 23	8 23	8 24	8 25	8 26	8 27	8 28	8 29	8 30	8 31	8 33	8 34	8 36	8 39
6	9 21	9 23	9 25	9 27	9 29	9 32	9 35	9 38	9 42	9 46	9 50	9 55	10 01	10 08
7	10 19	10 22	10 26	10 29	10 34	10 38	10 43	10 48	10 54	11 01	11 08	11 17	11 27	11 39
8	11 18	11 23	11 28	11 33	11 38	11 44	11 51	11 59	12 07	12 17	12 28	12 40	12 56	13 14
9	12 18	12 24	12 30	12 36	12 43	12 51	13 00	13 10	13 20	13 33	13 48	14 05	14 27	14 56

▬ indicates Moon continuously below horizon.
.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	.. ..	.. ..	.. ..	23 49	23 38	23 28	23 11	22 56	22 42	22 29	22 14	21 57	21 48	21 37
9	0 41	0 19	0 03	.. ..	.. ..	.. ..	.. ..	23 46	23 30	23 13	22 56	22 36	22 25	22 11
10	1 52	1 26	1 06	0 50	0 36	0 24	0 04	.. ..	.. ..	.. ..	23 43	23 20	23 07	22 53
11	3 01	2 30	2 08	1 49	1 34	1 21	0 58	0 38	0 20	0 02	.. ..	.. ..	23 57	23 41
12	4 02	3 30	3 06	2 47	2 31	2 17	1 53	1 33	1 14	0 55	0 34	0 11	.. ..	.. ..
13	4 51	4 21	3 58	3 40	3 24	3 11	2 48	2 28	2 09	1 51	1 31	1 08	0 54	0 39
14	5 30	5 04	4 44	4 27	4 13	4 01	3 41	3 23	3 06	2 49	2 31	2 10	1 58	1 44
15	5 58	5 38	5 22	5 09	4 58	4 48	4 31	4 16	4 02	3 48	3 33	3 16	3 06	2 55
16	6 20	6 06	5 55	5 46	5 38	5 31	5 19	5 08	4 58	4 48	4 37	4 24	4 17	4 09
17	6 38	6 31	6 25	6 19	6 15	6 11	6 04	5 58	5 52	5 46	5 40	5 33	5 29	5 24
18	6 54	6 53	6 52	6 51	6 50	6 49	6 48	6 46	6 45	6 44	6 43	6 42	6 41	6 40
19	7 10	7 15	7 18	7 22	7 24	7 27	7 31	7 35	7 38	7 42	7 46	7 50	7 53	7 56
20	7 27	7 38	7 46	7 54	8 00	8 05	8 15	8 24	8 32	8 40	8 49	8 59	9 05	9 12
21	7 47	8 04	8 17	8 29	8 38	8 47	9 01	9 14	9 27	9 39	9 52	10 08	10 16	10 27
22	8 12	8 35	8 53	9 08	9 21	9 32	9 51	10 07	10 23	10 39	10 56	11 15	11 27	11 40
23	8 46	9 14	9 36	9 53	10 08	10 21	10 43	11 02	11 20	11 38	11 58	12 20	12 33	12 49
24	9 31	10 02	10 26	10 45	11 01	11 14	11 38	11 58	12 17	12 36	12 57	13 21	13 35	13 51
25	10 28	11 00	11 23	11 42	11 58	12 11	12 34	12 55	13 13	13 32	13 52	14 15	14 29	14 45
26	11 36	12 04	12 26	12 43	12 57	13 10	13 31	13 50	14 07	14 24	14 42	15 04	15 16	15 30
27	12 50	13 13	13 31	13 45	13 57	14 08	14 26	14 42	14 57	15 12	15 28	15 46	15 56	16 08
28	14 05	14 22	14 36	14 47	14 57	15 05	15 20	15 33	15 44	15 56	16 09	16 23	16 31	16 40
29	15 19	15 31	15 41	15 49	15 55	16 01	16 11	16 20	16 29	16 37	16 46	16 56	17 02	17 08
30	16 32	16 39	16 44	16 48	16 52	16 55	17 01	17 06	17 11	17 16	17 21	17 27	17 30	17 34
Oct. 1	17 43	17 45	17 46	17 47	17 48	17 49	17 50	17 51	17 52	17 53	17 54	17 56	17 56	17 57
2	18 54	18 51	18 48	18 45	18 43	18 41	18 38	18 35	18 32	18 30	18 27	18 24	18 22	18 20

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	8 38	8 55	9 09	9 20	9 30	9 39	9 54	10 07	10 19	10 31	10 44	10 59	11 08	11 18
9	8 58	9 20	9 38	9 52	10 05	10 15	10 34	10 50	11 05	11 20	11 36	11 55	12 06	12 18
10	9 25	9 52	10 13	10 30	10 44	10 57	11 18	11 36	11 54	12 11	12 30	12 51	13 04	13 18
11	10 02	10 33	10 56	11 14	11 30	11 44	12 07	12 27	12 46	13 04	13 24	13 48	14 01	14 17
12	10 52	11 24	11 48	12 07	12 23	12 37	13 01	13 21	13 40	13 59	14 19	14 43	14 56	15 12
13	11 58	12 28	12 51	13 09	13 24	13 37	13 59	14 18	14 36	14 54	15 13	15 35	15 48	16 02
14	13 17	13 42	14 01	14 17	14 30	14 41	15 01	15 17	15 33	15 48	16 05	16 24	16 35	16 47
15	14 44	15 03	15 18	15 30	15 40	15 48	16 04	16 17	16 29	16 41	16 54	17 08	17 17	17 26
16	16 16	16 27	16 37	16 44	16 51	16 57	17 07	17 16	17 24	17 32	17 40	17 50	17 55	18 01
17	17 48	17 53	17 57	18 00	18 03	18 06	18 10	18 14	18 17	18 21	18 24	18 28	18 31	18 33
18	19 20	19 18	19 17	19 16	19 15	19 14	19 13	19 12	19 10	19 09	19 08	19 06	19 05	19 04
19	20 52	20 44	20 37	20 32	20 27	20 23	20 16	20 09	20 03	19 58	19 51	19 44	19 40	19 35
20	22 24	22 09	21 57	21 47	21 39	21 32	21 19	21 08	20 58	20 47	20 36	20 24	20 17	20 09
21	23 54	23 32	23 15	23 02	22 50	22 40	22 22	22 07	21 53	21 39	21 24	21 07	20 57	20 46
22	.. ..	.. ..	.. ..	.. ..	23 59	23 46	23 25	23 07	22 50	22 33	22 15	21 54	21 42	21 28
23	1 18	0 51	0 30	0 13	.. ..	.. ..	.. ..	.. ..	23 48	23 29	23 09	22 46	22 32	22 16
24	2 32	2 01	1 38	1 19	1 03	0 50	0 26	0 06	.. ..	.. ..	.. ..	23 41	23 27	23 11
25	3 31	3 00	2 36	2 17	2 01	1 47	1 24	1 03	0 44	0 25	0 05	.. ..	.. ..	.. ..
26	4 15	3 47	3 25	3 07	2 52	2 39	2 17	1 57	1 39	1 21	1 02	0 39	0 26	0 10
27	4 47	4 23	4 04	3 49	3 36	3 24	3 05	2 47	2 31	2 15	1 58	1 38	1 26	1 12
28	5 10	4 51	4 36	4 24	4 13	4 04	3 48	3 34	3 20	3 07	2 52	2 36	2 26	2 15
29	5 27	5 14	5 03	4 54	4 46	4 39	4 27	4 16	4 06	3 56	3 45	3 33	3 25	3 17
30	5 42	5 33	5 26	5 20	5 15	5 11	5 03	4 56	4 49	4 43	4 36	4 28	4 23	4 18
Oct. 1	5 54	5 50	5 47	5 44	5 42	5 40	5 37	5 34	5 31	5 28	5 25	5 21	5 19	5 17
2	6 05	6 06	6 07	6 08	6 08	6 09	6 10	6 11	6 12	6 12	6 13	6 14	6 15	6 15

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	21 37	21 32	21 27	21 21	21 15	21 09	21 01	20 53	20 44	20 34	20 23	20 09	19 53	19 33
9	22 11	22 06	21 59	21 52	21 45	21 37	21 28	21 18	21 06	20 53	20 38	20 20	19 57	19 28
10	22 53	22 46	22 39	22 31	22 22	22 13	22 02	21 50	21 37	21 21	21 02	20 39	20 08	19 20
11	23 41	23 34	23 27	23 18	23 09	22 59	22 48	22 35	22 20	22 03	21 41	21 14	20 36	▭
12	.. ..	.. ..	.. ..	.. ..	.. ..	23 57	23 46	23 33	23 19	23 02	22 41	22 14	21 37	20 07
13	0 39	0 32	0 24	0 16	0 07	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 39	23 11	22 29
14	1 44	1 37	1 31	1 23	1 15	1 06	0 56	0 45	0 33	0 18	0 00	.. ..	.. ..	.. ..
15	2 55	2 49	2 44	2 38	2 31	2 24	2 16	2 08	1 58	1 46	1 33	1 18	0 59	0 35
16	4 09	4 05	4 01	3 57	3 52	3 47	3 42	3 36	3 29	3 21	3 13	3 03	2 51	2 37
17	5 24	5 22	5 20	5 18	5 15	5 12	5 09	5 06	5 02	4 58	4 54	4 48	4 42	4 35
18	6 40	6 40	6 39	6 39	6 38	6 38	6 37	6 37	6 36	6 35	6 35	6 34	6 33	6 32
19	7 56	7 57	7 59	8 00	8 02	8 04	8 06	8 08	8 10	8 13	8 16	8 19	8 23	8 28
20	9 12	9 15	9 18	9 21	9 25	9 29	9 34	9 38	9 44	9 50	9 57	10 05	10 14	10 25
21	10 27	10 31	10 36	10 41	10 47	10 54	11 00	11 08	11 17	11 27	11 38	11 51	12 07	12 27
22	11 40	11 46	11 52	11 59	12 07	12 15	12 24	12 34	12 46	13 00	13 16	13 35	14 00	14 34
23	12 49	12 55	13 03	13 11	13 20	13 30	13 41	13 53	14 07	14 24	14 44	15 10	15 46	16 57
24	13 51	13 58	14 06	14 14	14 24	14 34	14 46	14 59	15 14	15 32	15 55	16 24	17 07	▬
25	14 45	14 52	14 59	15 08	15 17	15 27	15 38	15 50	16 05	16 22	16 43	17 09	17 46	19 05
26	15 30	15 36	15 43	15 51	15 59	16 08	16 17	16 28	16 41	16 55	17 13	17 33	18 00	18 37
27	16 08	16 13	16 19	16 25	16 32	16 39	16 47	16 56	17 06	17 18	17 31	17 46	18 05	18 28
28	16 40	16 44	16 49	16 54	16 59	17 04	17 10	17 17	17 25	17 33	17 43	17 54	18 06	18 22
29	17 08	17 11	17 14	17 18	17 21	17 25	17 29	17 34	17 39	17 45	17 51	17 58	18 06	18 16
30	17 34	17 35	17 37	17 39	17 41	17 43	17 45	17 48	17 51	17 54	17 57	18 01	18 06	18 11
Oct. 1	17 57	17 58	17 58	17 58	17 59	17 59	18 00	18 00	18 01	18 02	18 03	18 04	18 05	18 06
2	18 20	18 19	18 18	18 18	18 16	18 15	18 14	18 13	18 11	18 10	18 08	18 06	18 03	18 01

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	11 18	11 23	11 28	11 33	11 38	11 44	11 51	11 59	12 07	12 17	12 28	12 40	12 56	13 14
9	12 18	12 24	12 30	12 36	12 43	12 51	13 00	13 10	13 20	13 33	13 48	14 05	14 27	14 56
10	13 18	13 25	13 32	13 39	13 48	13 57	14 07	14 19	14 32	14 47	15 06	15 29	15 59	16 47
11	14 17	14 24	14 32	14 40	14 49	14 59	15 10	15 23	15 38	15 55	16 16	16 43	17 21	▭
12	15 12	15 19	15 27	15 35	15 44	15 54	16 06	16 18	16 33	16 50	17 11	17 38	18 15	19 46
13	16 02	16 09	16 16	16 24	16 32	16 41	16 51	17 03	17 16	17 31	17 49	18 11	18 40	19 21
14	16 47	16 53	16 59	17 05	17 12	17 20	17 28	17 37	17 48	18 00	18 13	18 30	18 49	19 14
15	17 26	17 30	17 35	17 40	17 45	17 51	17 57	18 04	18 11	18 20	18 29	18 41	18 53	19 09
16	18 01	18 04	18 07	18 10	18 13	18 17	18 21	18 25	18 30	18 35	18 41	18 47	18 55	19 04
17	18 33	18 34	18 36	18 37	18 38	18 40	18 41	18 43	18 45	18 47	18 50	18 52	18 55	18 59
18	19 04	19 04	19 03	19 03	19 02	19 02	19 01	19 00	18 59	18 59	18 58	18 57	18 55	18 54
19	19 35	19 33	19 31	19 29	19 26	19 24	19 21	19 18	19 14	19 10	19 06	19 01	18 55	18 49
20	20 09	20 05	20 01	19 57	19 53	19 48	19 43	19 37	19 31	19 24	19 16	19 06	18 56	18 43
21	20 46	20 41	20 35	20 30	20 23	20 16	20 09	20 01	19 51	19 41	19 29	19 14	18 58	18 37
22	21 28	21 22	21 15	21 08	21 00	20 51	20 42	20 31	20 19	20 05	19 48	19 28	19 03	18 28
23	22 16	22 09	22 02	21 54	21 45	21 35	21 23	21 11	20 56	20 39	20 19	19 53	19 17	18 05
24	23 11	23 04	22 56	22 47	22 38	22 28	22 16	22 03	21 47	21 29	21 07	20 38	19 55	▬
25	.. ..	.. ..	23 56	23 48	23 39	23 29	23 18	23 06	22 51	22 35	22 14	21 48	21 11	19 53
26	0 10	0 04	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 50	23 34	23 13	22 47	22 10
27	1 12	1 06	1 00	0 53	0 45	0 36	0 27	0 16	0 04	.. ..	.. ..	.. ..	.. ..	.. ..
28	2 15	2 10	2 05	1 59	1 53	1 46	1 38	1 30	1 21	1 10	0 57	0 43	0 25	0 02
29	3 17	3 13	3 09	3 05	3 01	2 56	2 50	2 44	2 37	2 29	2 21	2 11	1 59	1 44
30	4 18	4 15	4 13	4 10	4 07	4 04	4 00	3 56	3 52	3 47	3 42	3 36	3 29	3 20
Oct. 1	5 17	5 16	5 15	5 13	5 12	5 11	5 09	5 07	5 06	5 03	5 01	4 58	4 55	4 52
2	6 15	6 15	6 16	6 16	6 16	6 17	6 17	6 17	6 18	6 18	6 19	6 20	6 20	6 21

▭ indicates Moon continuously above horizon.
▬ indicates Moon continuously below horizon.
.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	17 43	17 45	17 46	17 47	17 48	17 49	17 50	17 51	17 52	17 53	17 54	17 56	17 56	17 57
2	18 54	18 51	18 48	18 45	18 43	18 41	18 38	18 35	18 32	18 30	18 27	18 24	18 22	18 20
3	20 05	19 56	19 49	19 43	19 38	19 34	19 26	19 19	19 13	19 07	19 00	18 53	18 49	18 44
4	21 17	21 03	20 51	20 42	20 34	20 27	20 15	20 05	19 55	19 45	19 35	19 24	19 17	19 09
5	22 29	22 10	21 54	21 42	21 31	21 22	21 06	20 52	20 39	20 26	20 12	19 57	19 48	19 38
6	23 41	23 16	22 57	22 41	22 28	22 17	21 57	21 41	21 25	21 09	20 53	20 34	20 22	20 10
7	.. ..	.. ..	23 59	23 41	23 26	23 13	22 51	22 31	22 14	21 56	21 37	21 15	21 02	20 48
8	0 51	0 21	.. ..	.. ..	.. ..	.. ..	23 44	23 24	23 05	22 46	22 26	22 02	21 48	21 33
9	1 54	1 21	0 57	0 38	0 22	0 08	.. ..	.. ..	23 58	23 39	23 19	22 55	22 41	22 25
10	2 47	2 15	1 51	1 32	1 16	1 02	0 38	0 17	.. ..	.. ..	.. ..	23 53	23 40	23 25
11	3 28	2 59	2 38	2 20	2 05	1 52	1 30	1 11	0 53	0 35	0 16	.. ..	.. ..	.. ..
12	3 59	3 36	3 18	3 03	2 50	2 39	2 20	2 03	1 48	1 32	1 15	0 56	0 45	0 32
13	4 23	4 06	3 52	3 41	3 31	3 22	3 07	2 54	2 42	2 30	2 17	2 02	1 53	1 43
14	4 42	4 31	4 22	4 15	4 08	4 02	3 53	3 44	3 36	3 28	3 19	3 09	3 03	2 56
15	4 58	4 53	4 49	4 46	4 43	4 41	4 36	4 32	4 29	4 25	4 21	4 17	4 14	4 11
16	5 13	5 15	5 16	5 17	5 18	5 18	5 20	5 21	5 22	5 23	5 24	5 26	5 27	5 28
17	5 29	5 37	5 43	5 48	5 53	5 57	6 04	6 10	6 16	6 22	6 28	6 36	6 40	6 45
18	5 48	6 02	6 13	6 22	6 30	6 38	6 50	7 01	7 12	7 22	7 33	7 46	7 54	8 03
19	6 10	6 31	6 47	7 01	7 12	7 22	7 40	7 55	8 09	8 24	8 39	8 57	9 08	9 20
20	6 41	7 07	7 28	7 45	7 59	8 11	8 33	8 51	9 08	9 26	9 45	10 06	10 19	10 34
21	7 22	7 53	8 17	8 36	8 51	9 05	9 29	9 49	10 08	10 27	10 48	11 11	11 25	11 42
22	8 17	8 49	9 13	9 33	9 49	10 03	10 27	10 47	11 06	11 26	11 46	12 10	12 24	12 41
23	9 23	9 53	10 16	10 34	10 49	11 02	11 25	11 44	12 02	12 20	12 40	13 02	13 15	13 30
24	10 37	11 02	11 22	11 37	11 50	12 02	12 21	12 38	12 54	13 10	13 27	13 46	13 58	14 11
25	11 53	12 12	12 28	12 40	12 51	13 00	13 16	13 30	13 43	13 56	14 09	14 25	14 34	14 44

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	5 54	5 50	5 47	5 44	5 42	5 40	5 37	5 34	5 31	5 28	5 25	5 21	5 19	5 17
2	6 05	6 06	6 07	6 08	6 08	6 09	6 10	6 11	6 12	6 12	6 13	6 14	6 15	6 15
3	6 16	6 22	6 27	6 31	6 35	6 38	6 43	6 48	6 52	6 56	7 01	7 07	7 10	7 13
4	6 29	6 40	6 48	6 55	7 02	7 07	7 17	7 25	7 33	7 41	7 50	8 00	8 05	8 12
5	6 43	6 59	7 12	7 22	7 31	7 39	7 53	8 05	8 16	8 27	8 39	8 53	9 01	9 11
6	7 01	7 22	7 38	7 52	8 04	8 14	8 31	8 46	9 01	9 15	9 30	9 48	9 58	10 10
7	7 24	7 50	8 10	8 27	8 41	8 53	9 13	9 31	9 48	10 05	10 23	10 44	10 56	11 10
8	7 56	8 27	8 50	9 08	9 23	9 37	10 00	10 19	10 38	10 57	11 16	11 39	11 53	12 08
9	8 40	9 13	9 37	9 56	10 13	10 27	10 51	11 11	11 30	11 50	12 10	12 34	12 48	13 04
10	9 39	10 10	10 34	10 53	11 09	11 22	11 46	12 06	12 24	12 43	13 03	13 26	13 39	13 55
11	10 50	11 18	11 39	11 56	12 11	12 23	12 44	13 02	13 19	13 36	13 54	14 15	14 27	14 40
12	12 12	12 34	12 51	13 05	13 17	13 27	13 45	14 00	14 14	14 28	14 43	15 00	15 09	15 21
13	13 40	13 55	14 07	14 17	14 26	14 33	14 46	14 57	15 08	15 18	15 29	15 41	15 48	15 56
14	15 10	15 19	15 26	15 32	15 37	15 41	15 48	15 55	16 01	16 07	16 13	16 20	16 24	16 29
15	16 43	16 45	16 46	16 47	16 49	16 49	16 51	16 53	16 54	16 55	16 56	16 58	16 59	17 00
16	18 16	18 11	18 07	18 04	18 01	17 59	17 55	17 51	17 47	17 44	17 40	17 36	17 33	17 30
17	19 51	19 39	19 30	19 22	19 15	19 09	18 59	18 50	18 42	18 34	18 25	18 15	18 09	18 03
18	21 25	21 06	20 52	20 40	20 29	20 20	20 05	19 51	19 39	19 26	19 13	18 58	18 49	18 39
19	22 57	22 31	22 11	21 56	21 42	21 30	21 11	20 53	20 37	20 21	20 04	19 44	19 33	19 20
20	.. ..	23 48	23 25	23 07	22 51	22 38	22 15	21 55	21 37	21 18	20 59	20 36	20 23	20 07
21	0 19	.. ..	.. ..	.. ..	23 54	23 40	23 16	22 56	22 36	22 17	21 56	21 32	21 18	21 02
22	1 26	0 54	0 30	0 10	.. ..	.. ..	.. ..	23 52	23 34	23 15	22 54	22 31	22 17	22 01
23	2 17	1 46	1 23	1 05	0 49	0 36	0 12	.. ..	.. ..	.. ..	23 52	23 31	23 18	23 04
24	2 52	2 26	2 06	1 50	1 36	1 24	1 03	0 45	0 28	0 11	.. ..	.. ..	.. ..	.. ..
25	3 18	2 57	2 40	2 27	2 15	2 05	1 48	1 32	1 18	1 04	0 48	0 30	0 20	0 07

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	17 57	17 58	17 58	17 58	17 59	17 59	18 00	18 00	18 01	18 02	18 03	18 04	18 05	18 06
2	18 20	18 19	18 18	18 18	18 16	18 15	18 14	18 13	18 11	18 10	18 08	18 06	18 03	18 01
3	18 44	18 42	18 40	18 37	18 35	18 32	18 29	18 26	18 22	18 18	18 13	18 08	18 02	17 56
4	19 09	19 06	19 02	18 59	18 55	18 50	18 45	18 40	18 34	18 27	18 20	18 12	18 02	17 50
5	19 38	19 33	19 28	19 23	19 17	19 11	19 04	18 57	18 49	18 39	18 29	18 17	18 02	17 45
6	20 10	20 04	19 58	19 52	19 45	19 37	19 28	19 19	19 08	18 56	18 42	18 25	18 04	17 38
7	20 48	20 41	20 34	20 27	20 18	20 09	19 59	19 47	19 34	19 19	19 01	18 39	18 11	17 29
8	21 33	21 25	21 18	21 09	21 00	20 50	20 39	20 26	20 11	19 54	19 33	19 06	18 28	▭
9	22 25	22 18	22 10	22 02	21 52	21 42	21 30	21 17	21 02	20 44	20 22	19 54	19 12	▭
10	23 25	23 19	23 11	23 03	22 55	22 45	22 34	22 22	22 08	21 52	21 32	21 07	20 34	19 33
11	.. ..	.. ..	.. ..	.. ..	.. ..	23 57	23 48	23 38	23 27	23 14	22 58	22 39	22 16	21 44
12	0 32	0 26	0 20	0 13	0 06	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 46
13	1 43	1 38	1 33	1 28	1 23	1 16	1 10	1 02	0 54	0 44	0 33	0 20	0 05	.. ..
14	2 56	2 53	2 50	2 47	2 43	2 39	2 35	2 30	2 25	2 19	2 12	2 04	1 55	1 44
15	4 11	4 10	4 09	4 07	4 06	4 04	4 02	4 00	3 58	3 55	3 52	3 49	3 46	3 41
16	5 28	5 28	5 29	5 29	5 30	5 30	5 31	5 32	5 32	5 33	5 34	5 35	5 37	5 38
17	6 45	6 47	6 49	6 52	6 55	6 57	7 01	7 04	7 08	7 13	7 17	7 23	7 30	7 37
18	8 03	8 07	8 11	8 15	8 20	8 25	8 31	8 38	8 45	8 53	9 02	9 13	9 26	9 41
19	9 20	9 25	9 31	9 38	9 44	9 52	10 00	10 10	10 20	10 32	10 47	11 04	11 24	11 52
20	10 34	10 41	10 48	10 56	11 04	11 14	11 24	11 36	11 50	12 05	12 25	12 49	13 21	14 15
21	11 42	11 49	11 57	12 05	12 15	12 25	12 37	12 50	13 06	13 24	13 47	14 16	15 01	▬
22	12 41	12 48	12 56	13 04	13 14	13 24	13 36	13 49	14 04	14 22	14 45	15 14	15 56	▬
23	13 30	13 37	13 44	13 52	14 00	14 10	14 20	14 32	14 46	15 01	15 20	15 43	16 14	17 02
24	14 11	14 16	14 22	14 29	14 36	14 44	14 53	15 03	15 14	15 26	15 41	15 58	16 20	16 47
25	14 44	14 49	14 54	14 59	15 05	15 11	15 18	15 25	15 34	15 43	15 54	16 06	16 21	16 39

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	5 17	5 16	5 15	5 13	5 12	5 11	5 09	5 07	5 06	5 03	5 01	4 58	4 55	4 52
2	6 15	6 15	6 16	6 16	6 16	6 17	6 17	6 17	6 18	6 18	6 19	6 20	6 20	6 21
3	7 13	7 15	7 16	7 18	7 20	7 22	7 25	7 27	7 30	7 33	7 36	7 40	7 45	7 50
4	8 12	8 15	8 18	8 21	8 24	8 28	8 32	8 37	8 42	8 48	8 55	9 02	9 11	9 21
5	9 11	9 15	9 19	9 24	9 29	9 35	9 41	9 48	9 55	10 04	10 14	10 26	10 39	10 56
6	10 10	10 16	10 21	10 28	10 34	10 42	10 50	10 59	11 09	11 21	11 34	11 51	12 10	12 36
7	11 10	11 16	11 23	11 31	11 39	11 47	11 57	12 08	12 21	12 36	12 53	13 15	13 43	14 25
8	12 08	12 15	12 23	12 31	12 40	12 50	13 01	13 14	13 29	13 46	14 07	14 33	15 11	▭
9	13 04	13 11	13 19	13 28	13 37	13 47	13 59	14 12	14 27	14 45	15 07	15 35	16 17	▭
10	13 55	14 02	14 09	14 17	14 26	14 36	14 47	14 59	15 14	15 30	15 50	16 15	16 49	17 50
11	14 40	14 47	14 53	15 00	15 08	15 17	15 26	15 36	15 48	16 02	16 18	16 37	17 02	17 34
12	15 21	15 26	15 31	15 37	15 43	15 49	15 57	16 05	16 14	16 24	16 36	16 50	17 06	17 26
13	15 56	16 00	16 04	16 08	16 12	16 17	16 22	16 27	16 34	16 41	16 48	16 57	17 08	17 20
14	16 29	16 31	16 33	16 35	16 38	16 40	16 43	16 46	16 50	16 53	16 58	17 02	17 08	17 14
15	17 00	17 00	17 00	17 01	17 01	17 02	17 02	17 03	17 04	17 04	17 05	17 06	17 07	17 08
16	17 30	17 29	17 28	17 27	17 25	17 23	17 22	17 20	17 18	17 15	17 13	17 10	17 07	17 03
17	18 03	18 00	17 57	17 54	17 50	17 47	17 42	17 38	17 33	17 27	17 21	17 14	17 06	16 57
18	18 39	18 34	18 30	18 25	18 19	18 13	18 07	17 59	17 51	17 42	17 32	17 20	17 06	16 50
19	19 20	19 14	19 08	19 01	18 54	18 46	18 37	18 27	18 16	18 03	17 48	17 30	17 09	16 40
20	20 07	20 01	19 53	19 45	19 36	19 27	19 16	19 04	18 50	18 33	18 14	17 49	17 16	16 22
21	21 02	20 54	20 46	20 38	20 28	20 18	20 06	19 52	19 37	19 18	18 56	18 26	17 41	▬
22	22 01	21 54	21 46	21 38	21 28	21 18	21 07	20 54	20 38	20 20	19 58	19 30	18 47	▬
23	23 04	22 58	22 51	22 43	22 35	22 25	22 15	22 04	21 51	21 35	21 17	20 54	20 23	19 36
24	.. ..	.. ..	23 56	23 50	23 43	23 36	23 27	23 18	23 08	22 56	22 41	22 25	22 04	21 37
25	0 07	0 02	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 54	23 41	23 24

▭ indicates Moon continuously above horizon.
▬ indicates Moon continuously below horizon.
.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	10 37	11 02	11 22	11 37	11 50	12 02	12 21	12 38	12 54	13 10	13 27	13 46	13 58	14 11
25	11 53	12 12	12 28	12 40	12 51	13 00	13 16	13 30	13 43	13 56	14 09	14 25	14 34	14 44
26	13 08	13 22	13 33	13 42	13 50	13 56	14 08	14 18	14 28	14 37	14 48	14 59	15 06	15 13
27	14 21	14 29	14 36	14 42	14 47	14 51	14 58	15 05	15 11	15 17	15 23	15 30	15 34	15 39
28	15 33	15 36	15 38	15 41	15 42	15 44	15 47	15 49	15 52	15 54	15 56	15 59	16 01	16 03
29	16 44	16 42	16 40	16 39	16 37	16 36	16 35	16 33	16 32	16 30	16 29	16 27	16 26	16 25
30	17 54	17 47	17 42	17 37	17 33	17 29	17 23	17 17	17 12	17 07	17 02	16 56	16 52	16 49
31	19 06	18 54	18 44	18 35	18 28	18 22	18 12	18 02	17 54	17 45	17 36	17 26	17 20	17 13
Nov. 1	20 19	20 01	19 47	19 35	19 25	19 16	19 02	18 49	18 37	18 25	18 12	17 58	17 50	17 40
2	21 32	21 08	20 50	20 35	20 23	20 12	19 53	19 37	19 22	19 07	18 51	18 33	18 23	18 11
3	22 43	22 14	21 53	21 35	21 20	21 08	20 46	20 28	20 10	19 53	19 34	19 13	19 01	18 47
4	23 48	23 16	22 52	22 33	22 17	22 03	21 40	21 19	21 01	20 42	20 21	19 58	19 45	19 29
5	.. ..	.. ..	23 47	23 28	23 11	22 57	22 33	22 12	21 53	21 33	21 13	20 49	20 35	20 18
6	0 45	0 12	.. ..	.. ..	.. ..	23 48	23 25	23 05	22 46	22 27	22 07	21 44	21 31	21 15
7	1 29	0 59	0 35	0 17	0 01	.. ..	.. ..	23 56	23 40	23 23	23 05	22 44	22 32	22 18
8	2 02	1 37	1 17	1 00	0 47	0 35	0 14	.. ..	.. ..	.. ..	.. ..	23 46	23 36	23 25
9	2 27	2 07	1 52	1 39	1 27	1 18	1 01	0 46	0 32	0 18	0 03	.. ..	.. ..	.. ..
10	2 47	2 33	2 22	2 13	2 04	1 57	1 45	1 34	1 24	1 14	1 03	0 50	0 43	0 35
11	3 03	2 55	2 49	2 44	2 39	2 35	2 28	2 21	2 15	2 09	2 03	1 56	1 51	1 47
12	3 18	3 16	3 15	3 13	3 12	3 11	3 09	3 08	3 06	3 05	3 04	3 02	3 01	3 00
13	3 33	3 37	3 40	3 43	3 46	3 48	3 52	3 55	3 59	4 02	4 06	4 10	4 12	4 15
14	3 49	3 59	4 08	4 15	4 21	4 27	4 36	4 45	4 53	5 01	5 09	5 19	5 25	5 32
15	4 09	4 26	4 39	4 51	5 01	5 09	5 24	5 37	5 49	6 02	6 15	6 31	6 40	6 50
16	4 35	4 58	5 17	5 32	5 45	5 56	6 16	6 33	6 49	7 05	7 22	7 43	7 54	8 08
17	5 11	5 40	6 03	6 21	6 36	6 49	7 12	7 32	7 50	8 09	8 29	8 52	9 06	9 22

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	2 52	2 26	2 06	1 50	1 36	1 24	1 03	0 45	0 28	0 11	.. ..	.. ..	.. ..	.. ..
25	3 18	2 57	2 40	2 27	2 15	2 05	1 48	1 32	1 18	1 04	0 48	0 30	0 20	0 07
26	3 36	3 21	3 08	2 58	2 49	2 42	2 28	2 16	2 05	1 54	1 41	1 27	1 19	1 10
27	3 51	3 41	3 32	3 25	3 19	3 14	3 05	2 56	2 49	2 41	2 32	2 23	2 17	2 11
28	4 03	3 58	3 54	3 50	3 47	3 44	3 39	3 35	3 30	3 26	3 22	3 17	3 14	3 10
29	4 14	4 14	4 13	4 13	4 13	4 12	4 12	4 11	4 11	4 10	4 10	4 09	4 09	4 09
30	4 25	4 30	4 33	4 36	4 38	4 41	4 45	4 48	4 51	4 54	4 58	5 02	5 04	5 07
31	4 37	4 46	4 53	5 00	5 05	5 10	5 18	5 25	5 32	5 39	5 46	5 55	5 59	6 05
Nov. 1	4 50	5 04	5 16	5 25	5 33	5 41	5 53	6 04	6 14	6 25	6 36	6 48	6 56	7 04
2	5 06	5 26	5 41	5 54	6 05	6 14	6 31	6 45	6 58	7 12	7 26	7 43	7 53	8 04
3	5 28	5 52	6 11	6 27	6 40	6 52	7 12	7 29	7 45	8 01	8 19	8 39	8 51	9 04
4	5 56	6 25	6 48	7 06	7 21	7 34	7 56	8 16	8 34	8 52	9 12	9 35	9 48	10 03
5	6 35	7 08	7 32	7 51	8 08	8 22	8 46	9 06	9 26	9 45	10 05	10 29	10 43	11 00
6	7 28	8 01	8 25	8 44	9 01	9 15	9 39	9 59	10 18	10 38	10 58	11 22	11 36	11 52
7	8 34	9 04	9 26	9 44	9 59	10 12	10 35	10 54	11 12	11 30	11 49	12 11	12 23	12 38
8	9 50	10 15	10 34	10 49	11 02	11 13	11 33	11 49	12 05	12 20	12 37	12 55	13 06	13 19
9	11 13	11 32	11 46	11 58	12 08	12 17	12 32	12 45	12 57	13 09	13 22	13 37	13 45	13 54
10	12 39	12 51	13 01	13 09	13 15	13 21	13 31	13 40	13 48	13 57	14 05	14 15	14 20	14 27
11	14 08	14 13	14 18	14 21	14 24	14 27	14 32	14 36	14 39	14 43	14 47	14 51	14 54	14 57
12	15 38	15 37	15 36	15 35	15 35	15 34	15 33	15 32	15 31	15 30	15 29	15 28	15 27	15 26
13	17 11	17 03	16 57	16 51	16 47	16 43	16 36	16 30	16 24	16 18	16 12	16 05	16 01	15 57
14	18 46	18 31	18 19	18 09	18 01	17 53	17 41	17 29	17 19	17 09	16 58	16 46	16 38	16 30
15	20 21	19 59	19 41	19 27	19 15	19 05	18 47	18 32	18 17	18 03	17 48	17 30	17 20	17 09
16	21 51	21 23	21 01	20 43	20 29	20 16	19 54	19 36	19 18	19 01	18 42	18 20	18 08	17 53
17	23 10	22 37	22 13	21 54	21 38	21 23	21 00	20 39	20 20	20 01	19 40	19 16	19 02	18 46

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	14 11	14 16	14 22	14 29	14 36	14 44	14 53	15 03	15 14	15 26	15 41	15 58	16 20	16 47
25	14 44	14 49	14 54	14 59	15 05	15 11	15 18	15 25	15 34	15 43	15 54	16 06	16 21	16 39
26	15 13	15 17	15 20	15 24	15 28	15 33	15 37	15 43	15 49	15 55	16 03	16 11	16 21	16 32
27	15 39	15 41	15 43	15 45	15 48	15 51	15 54	15 57	16 01	16 04	16 09	16 14	16 20	16 26
28	16 03	16 03	16 04	16 05	16 06	16 07	16 08	16 10	16 11	16 12	16 14	16 16	16 18	16 21
29	16 25	16 25	16 24	16 24	16 23	16 23	16 22	16 21	16 21	16 20	16 19	16 18	16 17	16 15
30	16 49	16 47	16 45	16 43	16 41	16 39	16 36	16 34	16 31	16 27	16 24	16 20	16 15	16 10
31	17 13	17 10	17 07	17 04	17 00	16 56	16 52	16 47	16 42	16 36	16 30	16 22	16 14	16 04
Nov. 1	17 40	17 36	17 31	17 27	17 22	17 16	17 10	17 03	16 55	16 47	16 37	16 26	16 13	15 58
2	18 11	18 06	18 00	17 54	17 47	17 40	17 32	17 23	17 13	17 01	16 48	16 33	16 14	15 51
3	18 47	18 40	18 34	18 26	18 18	18 09	18 00	17 49	17 36	17 22	17 05	16 44	16 18	15 41
4	19 29	19 22	19 14	19 06	18 57	18 47	18 36	18 23	18 09	17 52	17 31	17 05	16 29	15 13
5	20 18	20 11	20 03	19 55	19 45	19 35	19 23	19 10	18 54	18 36	18 13	17 44	17 00	▭
6	21 15	21 08	21 00	20 52	20 43	20 33	20 21	20 09	19 54	19 37	19 15	18 48	18 09	▭
7	22 18	22 11	22 05	21 57	21 49	21 40	21 30	21 19	21 07	20 52	20 34	20 13	19 45	19 04
8	23 25	23 20	23 14	23 08	23 02	22 55	22 47	22 38	22 28	22 17	22 04	21 49	21 30	21 06
9	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 55	23 47	23 38	23 28	23 16	23 02
10	0 35	0 31	0 27	0 23	0 18	0 13	0 08	0 02	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
11	1 47	1 44	1 42	1 40	1 37	1 34	1 31	1 28	1 24	1 20	1 15	1 09	1 03	0 56
12	3 00	2 59	2 59	2 58	2 58	2 57	2 56	2 56	2 55	2 54	2 53	2 52	2 50	2 49
13	4 15	4 16	4 17	4 19	4 20	4 22	4 24	4 26	4 28	4 30	4 33	4 36	4 40	4 44
14	5 32	5 35	5 38	5 41	5 45	5 49	5 53	5 58	6 04	6 10	6 17	6 25	6 34	6 45
15	6 50	6 55	7 00	7 05	7 11	7 17	7 24	7 32	7 41	7 51	8 03	8 16	8 33	8 53
16	8 08	8 14	8 21	8 28	8 36	8 44	8 54	9 04	9 17	9 31	9 48	10 08	10 35	11 12
17	9 22	9 29	9 36	9 45	9 54	10 04	10 16	10 29	10 44	11 01	11 23	11 51	12 31	▬

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	.. ..	.. ..	23 56	23 50	23 43	23 36	23 27	23 18	23 08	22 56	22 41	22 25	22 04	21 37
25	0 07	0 02	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 54	23 41	23 24
26	1 10	1 06	1 01	0 57	0 51	0 46	0 39	0 33	0 25	0 16	0 06	.. ..	.. ..	.. ..
27	2 11	2 08	2 05	2 02	1 58	1 54	1 50	1 46	1 41	1 35	1 28	1 21	1 12	1 02
28	3 10	3 09	3 07	3 05	3 04	3 02	2 59	2 57	2 54	2 51	2 48	2 44	2 40	2 35
29	4 09	4 08	4 08	4 08	4 08	4 08	4 07	4 07	4 07	4 06	4 06	4 05	4 05	4 04
30	5 07	5 08	5 09	5 10	5 12	5 13	5 15	5 17	5 19	5 21	5 23	5 26	5 30	5 33
31	6 05	6 07	6 10	6 13	6 16	6 19	6 23	6 27	6 31	6 36	6 42	6 48	6 55	7 04
Nov. 1	7 04	7 08	7 12	7 16	7 21	7 26	7 31	7 38	7 45	7 52	8 01	8 11	8 23	8 38
2	8 04	8 09	8 14	8 20	8 26	8 33	8 41	8 49	8 59	9 09	9 22	9 37	9 55	10 17
3	9 04	9 10	9 17	9 24	9 31	9 40	9 49	10 00	10 12	10 26	10 43	11 03	11 29	12 05
4	10 03	10 10	10 18	10 26	10 35	10 44	10 55	11 08	11 22	11 39	11 59	12 25	13 01	14 16
5	11 00	11 07	11 15	11 23	11 33	11 43	11 55	12 08	12 24	12 42	13 04	13 34	14 18	▭
6	11 52	11 59	12 07	12 15	12 24	12 34	12 46	12 59	13 14	13 31	13 53	14 20	15 00	▭
7	12 38	12 44	12 52	12 59	13 08	13 17	13 27	13 38	13 51	14 06	14 24	14 46	15 15	15 57
8	13 19	13 24	13 30	13 36	13 43	13 51	13 59	14 08	14 19	14 31	14 44	15 01	15 20	15 45
9	13 54	13 59	14 03	14 08	14 13	14 19	14 25	14 32	14 39	14 48	14 58	15 09	15 22	15 37
10	14 27	14 29	14 32	14 35	14 39	14 43	14 47	14 51	14 56	15 01	15 07	15 14	15 22	15 31
11	14 57	14 58	14 59	15 01	15 02	15 04	15 06	15 07	15 10	15 12	15 14	15 17	15 21	15 24
12	15 26	15 26	15 26	15 25	15 25	15 24	15 24	15 23	15 23	15 22	15 21	15 20	15 19	15 18
13	15 57	15 55	15 53	15 51	15 48	15 46	15 43	15 40	15 36	15 33	15 28	15 24	15 18	15 12
14	16 30	16 27	16 23	16 19	16 14	16 10	16 04	15 59	15 52	15 45	15 37	15 28	15 18	15 05
15	17 09	17 03	16 58	16 52	16 46	16 39	16 31	16 22	16 13	16 02	15 50	15 35	15 18	14 57
16	17 53	17 47	17 40	17 33	17 24	17 15	17 05	16 54	16 42	16 27	16 09	15 48	15 21	14 43
17	18 46	18 39	18 31	18 22	18 13	18 02	17 51	17 38	17 23	17 05	16 43	16 15	15 34	▬

▭ indicates Moon continuously above horizon.
▬ indicates Moon continuously below horizon.
.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	4 35	4 58	5 17	5 32	5 45	5 56	6 16	6 33	6 49	7 05	7 22	7 43	7 54	8 08
17	5 11	5 40	6 03	6 21	6 36	6 49	7 12	7 32	7 50	8 09	8 29	8 52	9 06	9 22
18	6 00	6 33	6 57	7 17	7 33	7 47	8 11	8 32	8 52	9 11	9 32	9 57	10 11	10 27
19	7 04	7 36	8 00	8 19	8 35	8 49	9 12	9 32	9 51	10 10	10 30	10 54	11 07	11 23
20	8 18	8 46	9 07	9 24	9 38	9 50	10 11	10 30	10 47	11 04	11 22	11 43	11 55	12 09
21	9 36	9 58	10 15	10 29	10 41	10 51	11 08	11 24	11 38	11 52	12 07	12 24	12 34	12 46
22	10 53	11 09	11 22	11 32	11 41	11 49	12 02	12 14	12 25	12 36	12 47	13 01	13 08	13 17
23	12 08	12 18	12 27	12 34	12 40	12 45	12 54	13 02	13 09	13 16	13 24	13 33	13 38	13 44
24	13 21	13 26	13 30	13 33	13 36	13 39	13 43	13 47	13 50	13 54	13 58	14 02	14 05	14 08
25	14 32	14 32	14 31	14 31	14 31	14 31	14 31	14 31	14 31	14 31	14 31	14 31	14 31	14 31
26	15 42	15 37	15 33	15 29	15 26	15 23	15 19	15 15	15 11	15 07	15 03	14 59	14 56	14 53
27	16 54	16 43	16 35	16 28	16 22	16 16	16 07	15 59	15 52	15 45	15 37	15 28	15 23	15 17
28	18 06	17 50	17 38	17 27	17 18	17 10	16 57	16 45	16 34	16 24	16 12	15 59	15 52	15 43
29	19 20	18 58	18 41	18 27	18 16	18 06	17 48	17 33	17 19	17 05	16 50	16 33	16 24	16 13
30	20 33	20 06	19 45	19 28	19 14	19 02	18 41	18 23	18 07	17 50	17 32	17 12	17 00	16 47
Dec. 1	21 41	21 10	20 47	20 28	20 12	19 58	19 35	19 15	18 57	18 38	18 18	17 56	17 42	17 27
2	22 42	22 09	21 44	21 24	21 08	20 54	20 29	20 08	19 49	19 30	19 09	18 45	18 31	18 15
3	23 30	22 58	22 35	22 15	21 59	21 46	21 22	21 02	20 42	20 23	20 03	19 39	19 25	19 09
4	.. ..	23 39	23 18	23 01	22 46	22 34	22 12	21 53	21 36	21 18	20 59	20 38	20 25	20 10
5	0 07	.. ..	23 54	23 40	23 28	23 17	22 59	22 43	22 28	22 13	21 57	21 39	21 28	21 15
6	0 33	0 11	.. ..	.. ..	.. ..	23 57	23 43	23 31	23 19	23 08	22 55	22 41	22 33	22 23
7	0 54	0 38	0 25	0 14	0 05	.. ..	.. ..	.. ..	.. ..	.. ..	23 53	23 44	23 38	23 32
8	1 10	1 00	0 52	0 45	0 39	0 34	0 25	0 17	0 09	0 01	.. ..	.. ..	.. ..	.. ..
9	1 25	1 20	1 17	1 14	1 11	1 09	1 05	1 01	0 58	0 55	0 51	0 47	0 45	0 42
10	1 39	1 40	1 41	1 42	1 43	1 44	1 45	1 46	1 47	1 49	1 50	1 51	1 52	1 53

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	21 51	21 23	21 01	20 43	20 29	20 16	19 54	19 36	19 18	19 01	18 42	18 20	18 08	17 53
17	23 10	22 37	22 13	21 54	21 38	21 23	21 00	20 39	20 20	20 01	19 40	19 16	19 02	18 46
18	.. ..	23 38	23 14	22 55	22 39	22 25	22 01	21 40	21 21	21 01	20 40	20 16	20 02	19 45
19	0 10	.. ..	.. ..	23 45	23 31	23 18	22 56	22 36	22 18	22 00	21 41	21 18	21 05	20 49
20	0 53	0 25	0 03	.. ..	.. ..	.. ..	23 44	23 27	23 12	22 56	22 39	22 20	22 08	21 55
21	1 23	1 00	0 42	0 27	0 14	0 03	.. ..	.. ..	.. ..	23 48	23 35	23 19	23 10	23 00
22	1 44	1 26	1 12	1 01	0 51	0 42	0 27	0 14	0 01	.. ..	.. ..	.. ..	.. ..	.. ..
23	2 00	1 48	1 38	1 29	1 22	1 16	1 05	0 56	0 46	0 37	0 27	0 16	0 10	0 02
24	2 13	2 06	2 00	1 55	1 51	1 47	1 40	1 35	1 29	1 24	1 18	1 11	1 07	1 02
25	2 24	2 22	2 20	2 18	2 17	2 16	2 14	2 12	2 10	2 08	2 06	2 04	2 03	2 01
26	2 35	2 37	2 39	2 41	2 43	2 44	2 46	2 48	2 50	2 52	2 54	2 56	2 58	2 59
27	2 46	2 53	2 59	3 04	3 09	3 12	3 19	3 25	3 31	3 36	3 42	3 49	3 53	3 57
28	2 58	3 11	3 21	3 29	3 36	3 42	3 53	4 03	4 12	4 21	4 31	4 42	4 49	4 56
29	3 13	3 31	3 45	3 56	4 06	4 15	4 30	4 43	4 56	5 08	5 22	5 37	5 46	5 56
30	3 32	3 55	4 13	4 28	4 40	4 51	5 10	5 26	5 42	5 57	6 14	6 33	6 44	6 57
Dec. 1	3 58	4 26	4 47	5 05	5 19	5 32	5 54	6 13	6 31	6 48	7 07	7 29	7 42	7 57
2	4 34	5 05	5 29	5 49	6 05	6 18	6 42	7 03	7 22	7 41	8 01	8 25	8 39	8 55
3	5 22	5 55	6 20	6 40	6 56	7 10	7 34	7 55	8 15	8 34	8 55	9 19	9 33	9 49
4	6 24	6 55	7 19	7 38	7 53	8 07	8 30	8 50	9 08	9 27	9 46	10 09	10 22	10 37
5	7 37	8 04	8 24	8 41	8 55	9 07	9 27	9 45	10 01	10 17	10 35	10 55	11 06	11 20
6	8 58	9 18	9 34	9 48	9 59	10 08	10 25	10 39	10 53	11 06	11 20	11 36	11 46	11 56
7	10 21	10 35	10 47	10 56	11 04	11 11	11 23	11 33	11 43	11 53	12 03	12 14	12 21	12 28
8	11 46	11 54	12 00	12 05	12 10	12 14	12 21	12 27	12 32	12 38	12 44	12 50	12 54	12 58
9	13 12	13 13	13 15	13 16	13 17	13 18	13 19	13 20	13 21	13 22	13 24	13 25	13 26	13 26
10	14 40	14 35	14 31	14 28	14 25	14 23	14 19	14 15	14 11	14 08	14 04	14 00	13 58	13 55

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	8 08	8 14	8 21	8 28	8 36	8 44	8 54	9 04	9 17	9 31	9 48	10 08	10 35	11 12
17	9 22	9 29	9 36	9 45	9 54	10 04	10 16	10 29	10 44	11 01	11 23	11 51	12 31	▬
18	10 27	10 35	10 43	10 52	11 01	11 12	11 24	11 38	11 54	12 12	12 36	13 07	13 55	▬
19	11 23	11 30	11 38	11 46	11 55	12 05	12 17	12 29	12 44	13 01	13 22	13 48	14 26	15 47
20	12 09	12 15	12 22	12 29	12 37	12 45	12 55	13 06	13 18	13 32	13 48	14 08	14 34	15 08
21	12 46	12 51	12 56	13 02	13 09	13 15	13 23	13 31	13 41	13 52	14 04	14 18	14 35	14 57
22	13 17	13 21	13 25	13 29	13 34	13 39	13 44	13 51	13 57	14 05	14 14	14 24	14 35	14 49
23	13 44	13 46	13 49	13 52	13 55	13 58	14 02	14 06	14 10	14 15	14 21	14 27	14 34	14 42
24	14 08	14 09	14 10	14 12	14 13	14 15	14 17	14 19	14 21	14 23	14 26	14 29	14 32	14 36
25	14 31	14 31	14 31	14 31	14 31	14 31	14 31	14 31	14 31	14 31	14 31	14 31	14 31	14 31
26	14 53	14 52	14 51	14 49	14 48	14 46	14 44	14 42	14 40	14 38	14 35	14 32	14 29	14 25
27	15 17	15 15	15 12	15 09	15 06	15 03	14 59	14 55	14 51	14 46	14 40	14 34	14 27	14 19
28	15 43	15 39	15 35	15 31	15 26	15 21	15 16	15 10	15 03	14 56	14 47	14 37	14 26	14 13
29	16 13	16 08	16 02	15 57	15 50	15 44	15 36	15 28	15 19	15 08	14 57	14 43	14 26	14 06
30	16 47	16 41	16 34	16 27	16 20	16 11	16 02	15 52	15 40	15 26	15 11	14 52	14 28	13 57
Dec. 1	17 27	17 20	17 13	17 05	16 56	16 46	16 35	16 23	16 09	15 53	15 33	15 09	14 35	13 39
2	18 15	18 07	17 59	17 51	17 41	17 31	17 19	17 06	16 50	16 32	16 10	15 41	14 57	▭
3	19 09	19 02	18 54	18 46	18 36	18 26	18 14	18 01	17 46	17 28	17 06	16 37	15 54	▭
4	20 10	20 04	19 56	19 49	19 40	19 31	19 20	19 09	18 55	18 39	18 20	17 57	17 25	16 33
5	21 15	21 10	21 04	20 57	20 50	20 43	20 34	20 24	20 14	20 01	19 47	19 29	19 07	18 39
6	22 23	22 19	22 14	22 10	22 04	21 58	21 52	21 45	21 37	21 28	21 18	21 06	20 52	20 35
7	23 32	23 29	23 26	23 23	23 20	23 16	23 12	23 08	23 03	22 57	22 51	22 44	22 36	22 26
8	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
9	0 42	0 41	0 40	0 38	0 37	0 35	0 34	0 32	0 30	0 27	0 25	0 22	0 19	0 15
10	1 53	1 54	1 54	1 55	1 55	1 56	1 57	1 57	1 58	1 59	2 00	2 01	2 03	2 04

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	17 53	17 47	17 40	17 33	17 24	17 15	17 05	16 54	16 42	16 27	16 09	15 48	15 21	14 43
17	18 46	18 39	18 31	18 22	18 13	18 02	17 51	17 38	17 23	17 05	16 43	16 15	15 34	▬
18	19 45	19 38	19 30	19 21	19 12	19 01	18 49	18 35	18 19	18 01	17 37	17 07	16 18	▬
19	20 49	20 43	20 35	20 27	20 18	20 08	19 57	19 45	19 30	19 13	18 53	18 27	17 50	16 29
20	21 55	21 49	21 43	21 36	21 28	21 20	21 11	21 01	20 49	20 35	20 19	20 00	19 35	19 01
21	23 00	22 55	22 50	22 45	22 39	22 32	22 25	22 17	22 08	21 58	21 47	21 33	21 17	20 57
22	.. ..	23 59	23 55	23 51	23 47	23 43	23 38	23 32	23 26	23 19	23 12	23 03	22 52	22 40
23	0 02	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
24	1 02	1 00	0 58	0 56	0 54	0 51	0 48	0 45	0 41	0 37	0 33	0 28	0 22	0 15
25	2 01	2 01	2 00	1 59	1 58	1 57	1 57	1 55	1 54	1 53	1 52	1 50	1 48	1 46
26	2 59	3 00	3 01	3 01	3 02	3 03	3 04	3 05	3 06	3 08	3 09	3 11	3 13	3 15
27	3 57	3 59	4 01	4 04	4 06	4 09	4 12	4 15	4 19	4 22	4 27	4 32	4 38	4 45
28	4 56	5 00	5 03	5 07	5 11	5 15	5 20	5 26	5 32	5 38	5 46	5 55	6 05	6 17
29	5 56	6 01	6 06	6 11	6 17	6 23	6 30	6 37	6 46	6 56	7 07	7 20	7 36	7 55
30	6 57	7 02	7 09	7 15	7 23	7 31	7 39	7 49	8 01	8 14	8 29	8 47	9 10	9 41
Dec. 1	7 57	8 04	8 11	8 19	8 27	8 37	8 47	8 59	9 13	9 29	9 48	10 13	10 46	11 42
2	8 55	9 02	9 10	9 19	9 28	9 39	9 50	10 03	10 19	10 37	10 59	11 28	12 11	▭
3	9 49	9 56	10 04	10 13	10 22	10 33	10 44	10 58	11 13	11 31	11 53	12 22	13 05	▭
4	10 37	10 44	10 52	11 00	11 08	11 18	11 29	11 41	11 55	12 11	12 30	12 54	13 26	14 19
5	11 20	11 25	11 32	11 39	11 46	11 54	12 03	12 13	12 25	12 38	12 53	13 11	13 33	14 02
6	11 56	12 01	12 06	12 11	12 17	12 23	12 30	12 38	12 47	12 56	13 07	13 20	13 35	13 53
7	12 28	12 32	12 35	12 39	12 43	12 48	12 52	12 58	13 03	13 10	13 17	13 26	13 35	13 46
8	12 58	13 00	13 02	13 04	13 06	13 09	13 11	13 14	13 17	13 21	13 25	13 29	13 34	13 40
9	13 26	13 27	13 27	13 27	13 28	13 28	13 29	13 29	13 30	13 30	13 31	13 32	13 33	13 34
10	13 55	13 54	13 52	13 51	13 50	13 48	13 46	13 44	13 42	13 40	13 38	13 35	13 31	13 28

▭ indicates Moon continuously above horizon.
▬ indicates Moon continuously below horizon.
.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec. 9	1 25	1 20	1 17	1 14	1 11	1 09	1 05	1 01	0 58	0 55	0 51	0 47	0 45	0 42
10	1 39	1 40	1 41	1 42	1 43	1 44	1 45	1 46	1 47	1 49	1 50	1 51	1 52	1 53
11	1 53	2 01	2 07	2 12	2 16	2 20	2 27	2 33	2 38	2 44	2 50	2 58	3 02	3 07
12	2 10	2 24	2 35	2 44	2 52	2 59	3 11	3 22	3 32	3 42	3 53	4 06	4 13	4 22
13	2 32	2 52	3 08	3 21	3 33	3 42	4 00	4 15	4 29	4 43	4 59	5 16	5 27	5 39
14	3 02	3 28	3 49	4 05	4 20	4 32	4 53	5 12	5 29	5 46	6 05	6 27	6 40	6 55
15	3 44	4 15	4 39	4 58	5 14	5 28	5 51	6 12	6 31	6 50	7 11	7 35	7 49	8 06
16	4 41	5 14	5 38	5 58	6 14	6 28	6 53	7 13	7 33	7 52	8 13	8 37	8 51	9 08
17	5 53	6 23	6 45	7 03	7 19	7 32	7 54	8 14	8 32	8 50	9 09	9 32	9 45	10 00
18	7 12	7 36	7 55	8 11	8 24	8 35	8 54	9 11	9 27	9 42	9 59	10 18	10 29	10 42
19	8 32	8 51	9 05	9 17	9 27	9 36	9 52	10 05	10 17	10 30	10 43	10 58	11 07	11 16
20	9 50	10 03	10 13	10 21	10 28	10 34	10 45	10 55	11 04	11 12	11 22	11 32	11 39	11 45
21	11 05	11 12	11 17	11 22	11 26	11 30	11 36	11 42	11 47	11 52	11 57	12 03	12 07	12 11
22	12 17	12 19	12 20	12 22	12 23	12 24	12 25	12 27	12 28	12 29	12 31	12 32	12 33	12 34
23	13 28	13 25	13 22	13 20	13 18	13 16	13 13	13 11	13 08	13 06	13 03	13 01	12 59	12 57
24	14 39	14 31	14 24	14 18	14 13	14 09	14 01	13 55	13 49	13 43	13 36	13 29	13 25	13 21
25	15 51	15 37	15 26	15 17	15 09	15 02	14 50	14 40	14 31	14 21	14 11	13 59	13 53	13 45
26	17 04	16 45	16 29	16 17	16 06	15 57	15 41	15 27	15 14	15 02	14 48	14 32	14 24	14 13
27	18 18	17 53	17 33	17 18	17 05	16 53	16 34	16 17	16 01	15 45	15 28	15 09	14 58	14 46
28	19 29	18 59	18 37	18 18	18 03	17 50	17 28	17 08	16 50	16 32	16 13	15 51	15 38	15 24
29	20 34	20 01	19 36	19 17	19 01	18 46	18 22	18 02	17 43	17 23	17 03	16 39	16 25	16 09
30	21 27	20 55	20 30	20 11	19 55	19 41	19 17	18 56	18 36	18 17	17 56	17 32	17 18	17 02
31	22 08	21 39	21 17	20 59	20 44	20 31	20 09	19 49	19 31	19 13	18 53	18 31	18 17	18 02
32	22 38	22 14	21 56	21 41	21 28	21 17	20 57	20 40	20 25	20 09	19 52	19 32	19 21	19 07
33	23 01	22 43	22 29	22 17	22 07	21 58	21 43	21 29	21 17	21 04	20 50	20 35	20 26	20 15

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec. 9	13 12	13 13	13 15	13 16	13 17	13 18	13 19	13 20	13 21	13 22	13 24	13 25	13 26	13 26
10	14 40	14 35	14 31	14 28	14 25	14 23	14 19	14 15	14 11	14 08	14 04	14 00	13 58	13 55
11	16 10	15 59	15 50	15 42	15 36	15 30	15 20	15 11	15 03	14 55	14 47	14 37	14 32	14 25
12	17 43	17 25	17 10	16 58	16 48	16 39	16 24	16 11	15 59	15 46	15 33	15 18	15 10	15 00
13	19 16	18 50	18 31	18 15	18 02	17 50	17 30	17 13	16 57	16 41	16 24	16 05	15 53	15 40
14	20 41	20 11	19 47	19 29	19 13	19 00	18 37	18 17	17 58	17 40	17 20	16 57	16 44	16 28
15	21 53	21 20	20 55	20 36	20 19	20 05	19 41	19 20	19 01	18 41	18 20	17 56	17 41	17 25
16	22 46	22 15	21 52	21 33	21 17	21 04	20 41	20 20	20 01	19 42	19 22	18 58	18 44	18 28
17	23 22	22 56	22 36	22 20	22 06	21 54	21 34	21 16	20 59	20 42	20 23	20 02	19 50	19 35
18	23 48	23 27	23 12	22 58	22 47	22 37	22 20	22 06	21 52	21 37	21 22	21 05	20 55	20 43
19	.. ..	23 51	23 40	23 30	23 22	23 15	23 02	22 51	22 40	22 29	22 18	22 05	21 57	21 48
20	0 06	.. ..	.. ..	23 57	23 52	23 47	23 39	23 32	23 25	23 18	23 10	23 01	22 56	22 51
21	0 20	0 11	0 04	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 56	23 54	23 51
22	0 32	0 28	0 25	0 22	0 19	0 17	0 13	0 10	0 07	0 03	0 00	.. ..	.. ..	.. ..
23	0 43	0 44	0 44	0 45	0 45	0 46	0 46	0 47	0 47	0 48	0 48	0 49	0 49	0 50
24	0 54	0 59	1 04	1 08	1 11	1 14	1 19	1 24	1 28	1 32	1 36	1 42	1 45	1 48
25	1 06	1 16	1 25	1 32	1 38	1 43	1 53	2 01	2 09	2 17	2 25	2 34	2 40	2 46
26	1 19	1 35	1 48	1 58	2 07	2 15	2 28	2 40	2 51	3 03	3 15	3 28	3 37	3 46
27	1 37	1 58	2 14	2 28	2 39	2 49	3 07	3 22	3 36	3 51	4 06	4 24	4 34	4 46
28	2 00	2 26	2 46	3 03	3 16	3 29	3 49	4 07	4 24	4 41	4 59	5 20	5 33	5 47
29	2 32	3 02	3 25	3 44	4 00	4 13	4 36	4 56	5 15	5 34	5 54	6 17	6 31	6 47
30	3 16	3 49	4 14	4 33	4 50	5 04	5 28	5 49	6 08	6 28	6 49	7 13	7 27	7 43
31	4 14	4 47	5 11	5 30	5 46	6 00	6 23	6 44	7 03	7 22	7 42	8 05	8 19	8 34
32	5 26	5 54	6 15	6 33	6 47	7 00	7 21	7 40	7 57	8 14	8 32	8 53	9 05	9 19
33	6 45	7 08	7 25	7 40	7 52	8 02	8 20	8 35	8 50	9 04	9 19	9 36	9 46	9 58

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec. 9	0 42	0 41	0 40	0 38	0 37	0 35	0 34	0 32	0 30	0 27	0 25	0 22	0 19	0 15
10	1 53	1 54	1 54	1 55	1 55	1 56	1 57	1 57	1 58	1 59	2 00	2 01	2 03	2 04
11	3 07	3 09	3 11	3 13	3 16	3 19	3 22	3 25	3 29	3 33	3 38	3 44	3 50	3 57
12	4 22	4 26	4 30	4 34	4 39	4 44	4 50	4 56	5 03	5 11	5 20	5 30	5 43	5 58
13	5 39	5 44	5 50	5 56	6 03	6 10	6 19	6 28	6 38	6 50	7 04	7 21	7 41	8 08
14	6 55	7 01	7 08	7 16	7 25	7 34	7 45	7 57	8 10	8 26	8 45	9 10	9 42	10 37
15	8 06	8 13	8 21	8 30	8 39	8 50	9 02	9 15	9 31	9 49	10 13	10 43	11 30	▬
16	9 08	9 15	9 23	9 32	9 41	9 52	10 04	10 17	10 33	10 51	11 14	11 43	12 28	▬
17	10 00	10 06	10 14	10 21	10 30	10 39	10 50	11 02	11 15	11 31	11 50	12 13	12 44	13 31
18	10 42	10 47	10 54	11 00	11 07	11 15	11 23	11 33	11 44	11 56	12 10	12 27	12 48	13 14
19	11 16	11 21	11 25	11 30	11 36	11 42	11 48	11 55	12 03	12 12	12 23	12 34	12 48	13 05
20	11 45	11 49	11 52	11 55	11 59	12 03	12 08	12 12	12 18	12 24	12 31	12 38	12 47	12 57
21	12 11	12 13	12 15	12 17	12 19	12 21	12 24	12 26	12 29	12 33	12 36	12 41	12 46	12 51
22	12 34	12 35	12 35	12 36	12 37	12 37	12 38	12 39	12 39	12 40	12 41	12 42	12 44	12 45
23	12 57	12 56	12 56	12 55	12 54	12 53	12 52	12 50	12 49	12 48	12 46	12 44	12 42	12 39
24	13 21	13 18	13 16	13 14	13 11	13 09	13 06	13 03	12 59	12 55	12 51	12 46	12 40	12 34
25	13 45	13 42	13 39	13 35	13 31	13 26	13 22	13 16	13 11	13 04	12 57	12 49	12 39	12 28
26	14 13	14 09	14 04	13 59	13 53	13 47	13 40	13 33	13 25	13 16	13 05	12 53	12 38	12 21
27	14 46	14 40	14 34	14 27	14 20	14 12	14 04	13 54	13 44	13 31	13 17	13 00	12 40	12 13
28	15 24	15 17	15 10	15 02	14 54	14 45	14 34	14 23	14 10	13 54	13 36	13 14	12 44	12 01
29	16 09	16 02	15 54	15 46	15 36	15 26	15 15	15 02	14 47	14 29	14 07	13 39	12 59	▭
30	17 02	16 55	16 47	16 38	16 29	16 18	16 07	15 53	15 38	15 19	14 57	14 27	13 43	▭
31	18 02	17 55	17 48	17 40	17 31	17 21	17 10	16 58	16 44	16 27	16 07	15 41	15 06	13 56
32	19 07	19 01	18 55	18 48	18 41	18 32	18 23	18 13	18 01	17 48	17 32	17 12	16 48	16 14
33	20 15	20 11	20 06	20 00	19 54	19 48	19 41	19 33	19 24	19 15	19 03	18 50	18 33	18 13

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec. 9	13 26	13 27	13 27	13 27	13 28	13 28	13 29	13 29	13 30	13 30	13 31	13 32	13 33	13 34
10	13 55	13 54	13 52	13 51	13 50	13 48	13 46	13 44	13 42	13 40	13 38	13 35	13 31	13 28
11	14 25	14 23	14 20	14 17	14 13	14 10	14 06	14 01	13 56	13 51	13 45	13 38	13 30	13 21
12	15 00	14 56	14 51	14 46	14 41	14 35	14 28	14 21	14 14	14 05	13 55	13 43	13 30	13 13
13	15 40	15 35	15 28	15 22	15 14	15 06	14 58	14 48	14 37	14 24	14 10	13 52	13 31	13 03
14	16 28	16 22	16 14	16 06	15 57	15 47	15 37	15 24	15 10	14 54	14 34	14 10	13 37	12 41
15	17 25	17 17	17 09	17 01	16 51	16 40	16 28	16 15	15 59	15 40	15 17	14 47	13 59	▬
16	18 28	18 21	18 13	18 05	17 55	17 45	17 33	17 20	17 05	16 46	16 24	15 54	15 10	▬
17	19 35	19 29	19 22	19 14	19 06	18 57	18 47	18 35	18 22	18 07	17 49	17 26	16 56	16 09
18	20 43	20 37	20 32	20 26	20 19	20 12	20 04	19 55	19 44	19 33	19 19	19 03	18 43	18 18
19	21 48	21 44	21 40	21 35	21 31	21 25	21 19	21 13	21 06	20 57	20 48	20 37	20 24	20 09
20	22 51	22 48	22 46	22 43	22 39	22 36	22 32	22 28	22 24	22 19	22 13	22 06	21 58	21 49
21	23 51	23 50	23 49	23 47	23 46	23 44	23 43	23 41	23 39	23 36	23 34	23 31	23 27	23 23
22	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
23	0 50	0 50	0 50	0 50	0 50	0 51	0 51	0 51	0 52	0 52	0 52	0 53	0 53	0 54
24	1 48	1 49	1 51	1 53	1 55	1 57	1 59	2 01	2 04	2 07	2 10	2 14	2 18	2 23
25	2 46	2 49	2 52	2 55	2 59	3 03	3 07	3 11	3 16	3 22	3 28	3 36	3 44	3 54
26	3 46	3 50	3 54	3 59	4 04	4 10	4 16	4 23	4 30	4 39	4 49	5 00	5 13	5 30
27	4 46	4 51	4 57	5 03	5 10	5 17	5 26	5 35	5 45	5 57	6 10	6 27	6 47	7 12
28	5 47	5 53	6 00	6 08	6 16	6 25	6 35	6 46	6 59	7 14	7 32	7 54	8 22	9 06
29	6 47	6 54	7 01	7 10	7 19	7 29	7 40	7 53	8 08	8 26	8 47	9 15	9 55	▭
30	7 43	7 50	7 58	8 07	8 17	8 27	8 39	8 52	9 08	9 26	9 49	10 18	11 03	▭
31	8 34	8 41	8 49	8 57	9 06	9 16	9 27	9 40	9 54	10 11	10 32	10 58	11 34	12 44
32	9 19	9 25	9 32	9 39	9 47	9 56	10 05	10 16	10 28	10 42	10 59	11 19	11 44	12 18
33	9 58	10 03	10 08	10 14	10 21	10 27	10 35	10 43	10 53	11 03	11 16	11 30	11 47	12 08

▭ indicates Moon continuously above horizon.
▬ indicates Moon continuously below horizon.
.. .. indicates phenomenon will occur the next day.

CONTENTS OF THE ECLIPSE SECTION

SUMMARY OF ECLIPSES AND TRANSITS FOR 2020

There are six eclipses, two of the Sun and four of the Moon. All times are expressed in Universal Time using $\Delta T = +70^{s}.0$. There are no transits of Mercury or Venus across the Sun.

I. *A penumbral eclipse of the Moon*, January 10. See map on page 70. The eclipse begins at $17^{h}\ 06^{m}$ and ends at $21^{h}\ 14^{m}$. It is visible from Australia, Asia, Europe, Africa, extreme eastern South America, northern North America, the Atlantic Ocean, the Indian Ocean and the Pacific Ocean.

II. *A penumbral eclipse of the Moon*, June 5. See map on page 71. The eclipse begins at $17^{h}\ 43^{m}$ and ends at $21^{h}\ 07^{m}$. It is visible from Australia, Antarctica, Asia, Africa, Europe, eastern South America, the Indian Ocean, the south Atlantic Ocean, and the western Pacific Ocean.

III. *An annular eclipse of the Sun*, June 21. See map on page 73. The eclipse begins at $03^{h}\ 46^{m}$ and ends at $09^{h}\ 34^{m}$. Maximum duration of annularity is $1^{m}\ 17^{s}$. It is visible from Africa, eastern Europe, Asia, extreme northern Australia, the Indian Ocean, and the Pacific Ocean.

IV. *A penumbral eclipse of the Moon*, July 5. See map on page 77. The eclipse begins at $03^{h}\ 04^{m}$ and ends at $05^{h}\ 56^{m}$. It is visible from Antarctica, Africa, western Europe, South America, North America, the Atlantic Ocean, and the eastern Pacific Ocean.

V. *A penumbral eclipse of the Moon*, November 30. See map on page 78. The eclipse begins at $07^{h}\ 30^{m}$ and ends at $11^{h}\ 56^{m}$. It is visible from northwestern Europe, South America, North America, Australia, Asia, the north Atlantic Ocean, and the Pacific Ocean.

VI. *A total eclipse of the Sun*, December 14. See map on page 80. The eclipse begins at $13^{h}\ 34^{m}$ and ends at $18^{h}\ 53^{m}$. Maximum duration of totality is $2^{m}\ 14^{s}$. It is visible from southern South America, Antarctica, southwestern Africa, the Pacific Ocean, and the south Atlantic Ocean.

Local circumstances and animations for upcoming eclipses can be found on *The Astronomical Almanac Online* at http://asa.hmnao.com or http://asa.usno.navy.mil.

Local circumstances and animations for upcoming eclipses can be found on *The Astronomical Almanac Online* at http://asa.hmnao.com or http://asa.usno.navy.mil.

General Information

The elements and circumstances are computed according to Bessel's method from apparent right ascensions and declinations of the Sun and Moon. Semidiameters of the Sun and Moon used in the calculation of eclipses do not include irradiation. The adopted semidiameter of the Sun at unit distance is $15'\ 59''.64$ from the IAU (1976) Astronomical Constants. The apparent semidiameter of the Moon is equal to arcsin ($k \sin \pi$), where π is the Moon's horizontal parallax and k is an adopted constant. In 1982, the IAU adopted $k = 0.272\ 5076$, corresponding to the mean radius of Watts' datum as determined by observations of occultations and to the adopted radius of the Earth.

Standard corrections of $+0''.5$ and $-0''.25$ have been applied to the longitude and latitude of the Moon, respectively, to help correct for the difference between the center of figure and the center of mass.

Refraction is neglected in calculating solar and lunar eclipses. Because the circumstances of eclipses are calculated for the surface of the ellipsoid, refraction is not included in Besselian element polynomials. For local predictions, corrections for refraction are unnecessary; they are required only in precise comparisons of theory with observation in which many other refinements are also necessary.

All time arguments are given provisionally in Universal Time, using $\Delta T(A) = +70^{s}.0$. Once an updated value of ΔT is known, the data on these pages may be expressed in Universal Time as follows:

Define $\delta T = \Delta T - \Delta T(A)$, in units of seconds of time.
Change the times of circumstances given in preliminary Universal Time by subtracting δT.
Correct the tabulated longitudes, $\lambda(A)$, using $\lambda = \lambda(A) + 0.00417807 \times \delta T$ (longitudes are in degrees).
Leave all other quantities unchanged.
The correction of δT is included in the Besselian elements.
Longitude is positive to the east, and negative to the west.

Explanation of Solar Eclipse Diagram

The solar eclipse diagrams in *The Astronomical Almanac* show the region over which different phases of each eclipse may be seen and the times at which these phases occur. Each diagram has a series of dashed curves that show the outline of the Moon's penumbra on the Earth's surface at one-hour intervals. Short dashes show the leading edge and long dashes show the trailing edge. Except for certain extreme cases, the shadow outline moves generally from west to east. The Moon's shadow cone first contacts the Earth's surface where "First Contact" is indicated on the diagram. "Last Contact" is where the Moon's shadow cone last contacts the Earth's surface. The path of the central eclipse, whether for a total, annular, or annular-total eclipse, is marked by two closely spaced curves that cut across all of the dashed curves. These two curves mark the extent of the Moon's umbral shadow on the Earth's surface. Viewers within these boundaries will observe a total, annular, or annular-total eclipse, and viewers outside these boundaries will see a partial eclipse.

Solid curves labeled "Northern" and "Southern Limit of Eclipse" represent the furthest extent north or south of the Moon's penumbra on the Earth's surface. Viewers outside of

these boundaries will not experience any eclipse. When only one of these two curves appears, only part of the Moon's penumbra touches the Earth; the other part is projected into space north or south of the Earth. The solid curves labeled "Eclipse begins at Sunset" and "Eclipse ends at Sunrise" define the other limits.

Another set of solid curves appears on some diagrams as two teardrop shapes (or lobes) on either end of the eclipse path, and on other diagrams as a distorted figure eight. These lobes represent in time the intersection of the Moon's penumbra with the Earth's terminator as the eclipse progresses. As time elapses, the Earth's terminator moves east-to-west while the Moon's penumbra moves west-to-east. These lobes connect to form an elongated figure eight on a diagram when part of the Moon's penumbra stays in contact with the Earth's terminator throughout the eclipse. The lobes become two separate teardrop shapes when the Moon's penumbra breaks contact with the Earth's terminator during the beginning of the eclipse and reconnects with it near the end. In the east, the outer portion of the lobe is labeled "Eclipse begins at Sunset" and marks the first contact between the Moon's penumbra and Earth's terminator in the east. Observers on this curve just fail to see the eclipse. The inner part of the lobe is labeled "Eclipse ends at Sunset" and marks the last contact between the Moon's penumbra and the Earth's terminator in the east. Observers on this curve just see the whole eclipse. The curve bisecting this lobe is labeled "Maximum Eclipse at Sunset" and is part of the sunset terminator at maximum eclipse. Viewers in the eastern half of the lobe will see the Sun set before maximum eclipse; *i.e.* see less than half of the eclipse. Viewers in the western half of the lobe will see the Sun set after maximum eclipse; *i.e.* see more than half of the eclipse. A similar description holds for the western lobe except everything occurs at sunrise instead of sunset.

Computing Local Circumstances for Solar Eclipses

The solar eclipse maps show the path of the eclipse, beginning and ending times of the eclipse, and the region of visibility, including restrictions due to rising and setting of the Sun. The short-dash and long-dash lines show, respectively, the progress of the leading and trailing edge of the penumbra; thus, at a given location, the times of the first and last contact may be interpolated. If further precision is desired, Besselian elements can be utilized.

Besselian elements characterize the geometric position of the shadow of the Moon relative to the Earth. The exterior tangents to the surfaces of the Sun and Moon form the umbral cone; the interior tangents form the penumbral cone. The common axis of these two cones is the axis of the shadow. To form a system of geocentric rectangular coordinates, the geocentric plane perpendicular to the axis of the shadow is taken as the xy-plane. This is called the fundamental plane. The x-axis is the intersection of the fundamental plane with the plane of the equator; it is positive toward the east. The y-axis is positive toward the north. The z-axis is parallel to the axis of the shadow and is positive toward the Moon. The tabular values of x and y are the coordinates, in units of the Earth's equatorial radius, of the intersection of the axis of the shadow with the fundamental plane. The direction of the axis of the shadow is specified by the declination d and hour angle μ of the point on the celestial sphere toward which the axis is directed.

The radius of the umbral cone is regarded as positive for an annular eclipse and negative for a total eclipse. The angles f_1 and f_2 are the angles at which the tangents that form the penumbral and umbral cones, respectively, intersect the axis of the shadow.

To predict accurate local circumstances, calculate the geocentric coordinates $\rho \sin \phi'$ and $\rho \cos \phi'$ from the geodetic latitude ϕ and longitude λ, using the relationships given on pages K11–K12 of *The Astronomical Almanac*. Inclusion of the height h in this calculation is all that is necessary to obtain the local circumstances at high altitudes.

Obtain approximate times for the beginning, middle and end of the eclipse from the eclipse map. For each of these three times compute — from the Besselian element polynomials — the values of x, y, $\sin d$, $\cos d$, μ and l_1 (the radius of the penumbra on the fundamental plane). If the eclipse is central (i.e., total, annular or annular-total), then, at the approximate time of the middle of the eclipse, l_2 (the radius of the umbra on the fundamental plane) is required instead of l_1. The hourly variations x', y' of x and y are needed, and may be obtained by evaluating the derivative of the polynomial expressions for x and y. Values of μ', d', $\tan f_1$ and $\tan f_2$ are nearly constant throughout the eclipse and are given immediately following the Besselian polynomials.

For each of the three approximate times, calculate the coordinates ξ, η, ζ for the observer and the hourly variations ξ' and η' from

$$\begin{aligned}
\xi &= \rho\cos\phi'\sin\theta,\\
\eta &= \rho\sin\phi'\cos d - \rho\cos\phi'\sin d\cos\theta,\\
\zeta &= \rho\sin\phi'\sin d + \rho\cos\phi'\cos d\cos\theta,\\
\xi' &= \mu'\rho\cos\phi'\cos\theta,\\
\eta' &= \mu'\xi\sin d - \zeta d',
\end{aligned}$$

where

$$\theta = \mu + \lambda$$

for longitudes measured positive towards the east.

Next, calculate

$$\begin{aligned}
u &= x - \xi & u' &= x' - \xi'\\
v &= y - \eta & v' &= y' - \eta'\\
m^2 &= u^2 + v^2 & n^2 &= u'^2 + v'^2 \qquad (m, n > 0)
\end{aligned}$$

$$\begin{aligned}
L_i &= l_i - \zeta\tan f_i\\
D &= uu' + vv'\\
\Delta &= \tfrac{1}{n}(uv' - u'v)\\
\sin\psi &= \tfrac{\Delta}{L_i},
\end{aligned}$$

where $i = 1, 2$.

At the approximate times of the beginning and end of the eclipse, L_1 is required. At the approximate time of the middle of the eclipse, L_2 is required if the eclipse is central; L_1 is required if the eclipse is partial.

Neglecting the variation of L, the correction τ to be applied to the approximate time of the middle of the eclipse to obtain the *Universal Time of greatest phase* (in hours) is

$$\tau = -\frac{D}{n^2},$$

which may be expressed in minutes by multiplying by 60. The correction τ to be applied to the approximate times of the beginning and end of the eclipse to obtain the *Universal Times of the penumbral contacts* (in hours) is

$$\tau = \frac{L_1}{n}\cos\psi - \frac{D}{n^2},$$

which may be expressed in minutes by multiplying by 60.

If the eclipse is central, use the approximate time for the middle of the eclipse as a first approximation to the times of umbral contact. The correction τ to be applied to obtain the *Universal Times of the umbral contacts* is

$$\tau = \frac{L_2}{n}\cos\psi - \frac{D}{n^2},$$

which may be expressed in minutes by multiplying by 60.

In the last two equations, the ambiguity in the quadrant of ψ is removed by noting that $\cos\psi$ must be *negative* for the beginning of the eclipse, for the beginning of the annular phase, or for the end of the total phase; $\cos\psi$ must be *positive* for the end of the eclipse, the end of the annular phase, or the beginning of the total phase.

For greater accuracy, the times resulting from the calculation outlined above should be used in place of the original approximate times, and the entire procedure repeated at least once. The calculations for each of the contact times and the time of greatest phase should be performed separately.

The *magnitude of greatest partial eclipse*, in units of the solar diameter is

$$M_1 = \frac{L_1 - m}{(2L_1 - 0.5459)},$$

where the value of m at the time of greatest phase is used. If the magnitude is negative at the time of greatest phase, no eclipse is visible from the location.

The *magnitude of the central phase*, in the same units is

$$M_2 = \frac{L_1 - L_2}{(L_1 + L_2)}.$$

The *position angle of a point of contact* measured eastward (counterclockwise) from the north point of the solar limb is given by

$$\tan P = \frac{u}{v},$$

where u and v are evaluated at the times of contacts computed in the final approximation. The quadrant of P is determined by noting that $\sin P$ has the algebraic sign of u, except for the contacts of the total phase, for which $\sin P$ has the opposite sign to u.

The position angle of the point of contact measured eastward from the vertex of the solar limb is given by

$$V = P - C,$$

where C, the parallactic angle, is obtained with sufficient accuracy from

$$\tan C = \frac{\xi}{\eta},$$

with $\sin C$ having the same algebraic sign as ξ, and the results of the final approximation again being used. The vertex point of the solar limb lies on a great circle arc drawn from the zenith to the center of the solar disk.

Lunar Eclipses

A calculator to produce local circumstances of recent and upcoming lunar eclipses is provided at http://aa.usno.navy.mil/data/docs/LunarEclipse.php

In calculating lunar eclipses, the radius of the geocentric shadow of the Earth is increased by one-fiftieth part to allow for the effect of the atmosphere. Refraction is neglected in calculating solar and lunar eclipses. Standard corrections of $+0''.5$ and $-0''.25$ have been applied to the longitude and latitude of the Moon, respectively, to help correct for the difference between the center of figure and the center of mass.

Explanation of Lunar Eclipse Diagram

Information on lunar eclipses is presented in the form of a diagram consisting of two parts. The upper panel shows the path of the Moon relative to the penumbral and umbral shadows of the Earth. The lower panel shows the visibility of the eclipse from the surface of the Earth. The title of the upper panel includes the type of eclipse, its place in the sequence of eclipses for the year and the Greenwich calendar date of the eclipse. The inner darker circle is the umbral shadow of the Earth and the outer lighter circle is that of the penumbra. The axis of the shadow of the Earth is denoted by (+) with the ecliptic shown for reference purposes. A 30-arcminute scale bar is provided on the right hand side of the diagram and the orientation is given by the cardinal points displayed on the small graphic on the left hand side of the diagram. The position angle (PA) is measured from North point of the lunar disk along the limb of the Moon to the point of contact. It is shown on the graphic by the use of an arc extending anti-clockwise (eastwards) from North terminated with an arrow head.

Moon symbols are plotted at the principal phases of the eclipse to show its position relative to the umbral and penumbral shadows. The UT times of the different phases of the eclipse to the nearest tenth of a minute are printed above or below the Moon symbols as appropriate. P1 and P4 are the first and last external contacts of the penumbra respectively and denote the beginning and end of the penumbral eclipse respectively. U1 and U4 are the first and last external contacts of the umbra denoting the beginning and end of the partial phase of the eclipse respectively. U2 and U3 are the first and last internal contacts of the umbra and denote the beginning and end of the total phase respectively. MID is the middle of the eclipse. The position angle is given for P1 and P4 for penumbral eclipses and U1 and U4 for partial and total eclipses. The UT time of the geocentric opposition in right ascension of the Sun and Moon and the magnitude of the eclipse are given above or below the Moon symbols as appropriate.

The lower panel is a cylindrical equidistant map projection showing the Earth centered on the longitude at which the Moon is in the zenith at the middle of the eclipse. The visibility of the eclipse is displayed by plotting the Moon rise/set terminator for the principal phases of the eclipse for which timing information is provided in the upper panel. The terminator for the middle of the eclipse is not plotted for the sake of clarity.

The unshaded area indicates the region of the Earth from which all the eclipse is visible, whereas the darkest shading indicates the area from which the eclipse is invisible. The different shades of gray indicate regions where the Moon is either rising or setting during the principal phases of the eclipse. The Moon is rising on the left hand side of the diagram after the eclipse has started and is setting on the right hand side of the diagram before the eclipse ends. Labels are provided to this effect.

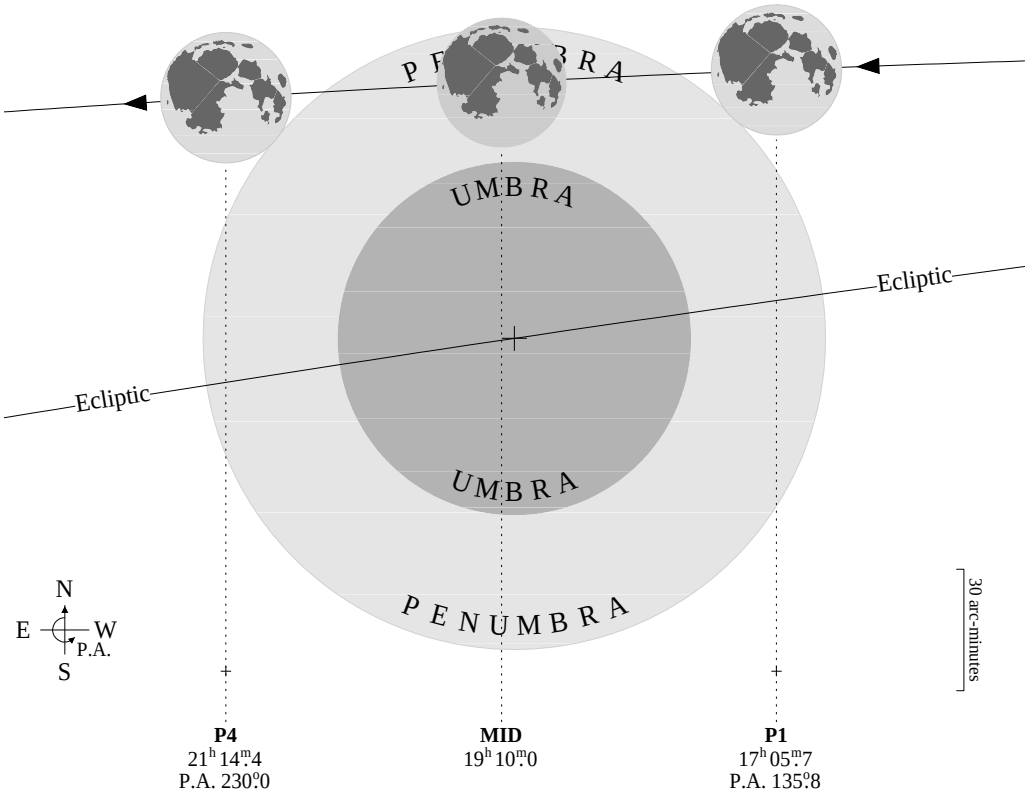
Symbols are plotted showing the locations for which the Moon is in the zenith at the principal phases of the eclipse. The points at which the Moon is in the zenith at P1 and P4 are denoted by (+), at U1 and U4 by ($\odot$) and at U2 and U3 by ($\oplus$). These symbols are also plotted on the upper panel where appropriate. The value of ΔT used for the calculation of the eclipse circumstances is given below the diagram. Country boundaries are also provided to assist the user in determining the visibility of the eclipse at a particular location.

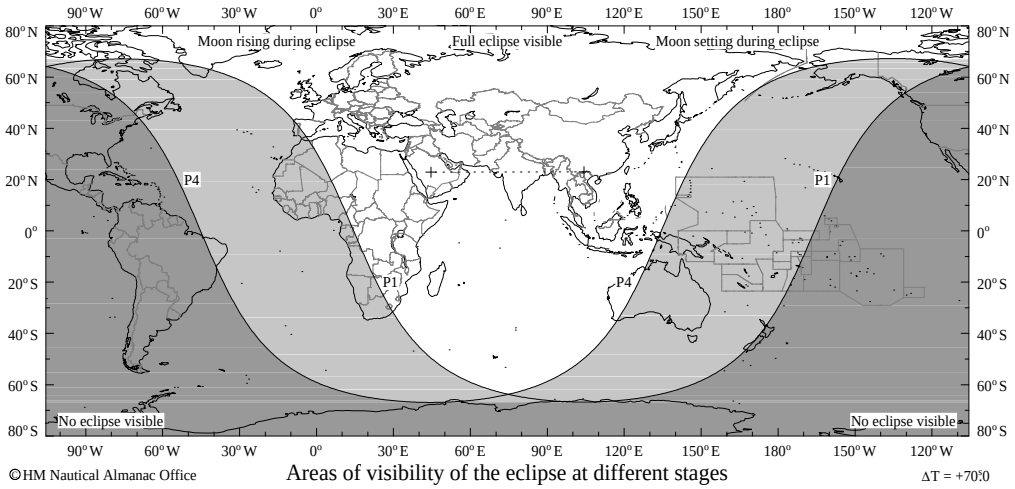
I. - Penumbral Eclipse of the Moon

2020 January 10

UT of geocentric opposition in RA: January $10^{d}\ 19^{h}\ 4^{m}\ 13\overset{s}{.}638$

Penumbral magnitude of the eclipse: 0.921





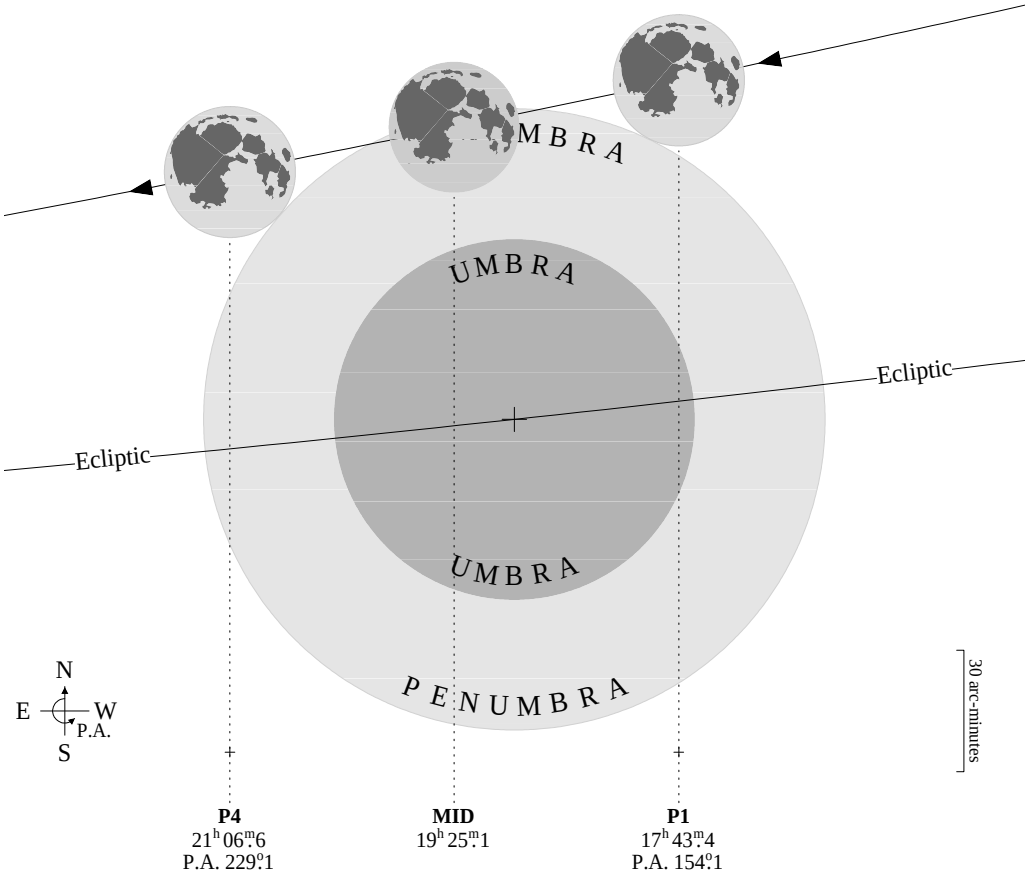
Areas of visibility of the eclipse at different stages

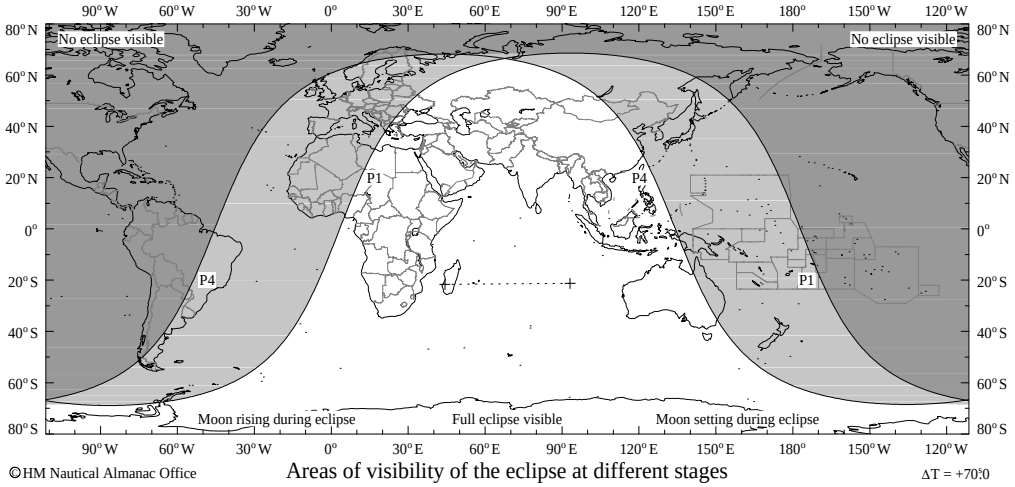
$\Delta T = +70\overset{s}{.}0$

II. - Penumbral Eclipse of the Moon — 2020 June 05

UT of geocentric opposition in RA: June $5^{d}\ 18^{h}\ 57^{m}\ 47\overset{s}{.}927$

Penumbral magnitude of the eclipse: 0.593





Areas of visibility of the eclipse at different stages

$\Delta T = +70\overset{s}{.}0$

III. – Annular Eclipse of the Sun, 2020 June 21

CIRCUMSTANCES OF THE ECLIPSE

Universal Time of geocentric conjunction in right ascension, June $21^d\ 06^h\ 41^m\ 24^s.442$
Julian Date = 2459021.7787551107

		UT d	h	m	Longitude °	′	Latitude °	′
Eclipse begins	June	21	03	46.0	+ 34	24.7	– 1	02.1
Beginning of southern limit of umbra		21	04	48.2	+ 17	59.5	+ 0	56.8
Beginning of center line; central eclipse begins		21	04	48.5	+ 17	47.9	+ 1	16.1
Beginning of northern limit of umbra		21	04	48.7	+ 17	36.4	+ 1	35.4
Central eclipse at local apparent noon		21	06	41.4	+ 80	06.8	+30	35.2
End of northern limit of umbra		21	08	31.5	+147	46.4	+11	46.1
End of center line; central eclipse ends		21	08	31.7	+147	35.3	+11	28.2
End of southern limit of umbra		21	08	31.9	+147	24.3	+11	10.4
Eclipse ends		21	09	34.1	+130	58.0	+ 9	10.6

BESSELIAN ELEMENTS

Let $t = (\mathrm{UT} - 3^h) + \delta T/3600$ in units of hours.

These equations are valid over the range $0^h.708 \le t \le 6^h.742$. Do not use t outside the given range, and do not omit any terms in the series.

Intersection of the axis of shadow with the fundamental plane:

$$x = -1.95918170 + 0.53061943\ t + 0.00010863\ t^2 - 0.00000693\ t^3$$
$$y = -0.07064647 + 0.05263114\ t - 0.00015153\ t^2 - 0.00000079\ t^3$$

Direction of the axis of shadow:

$$\sin d = +0.39773251 - 0.00000295\ t - 0.00000011\ t^2$$
$$\cos d = +0.91750135 + 0.00000136\ t + 0.00000002\ t^2$$
$$\mu = 224°.53827390 + 14.99910869\ t + 0.00000039\ t^2 - 0.00000001\ t^3 - 0.00417807\ \delta T$$

Radius of the shadow on the fundamental plane:

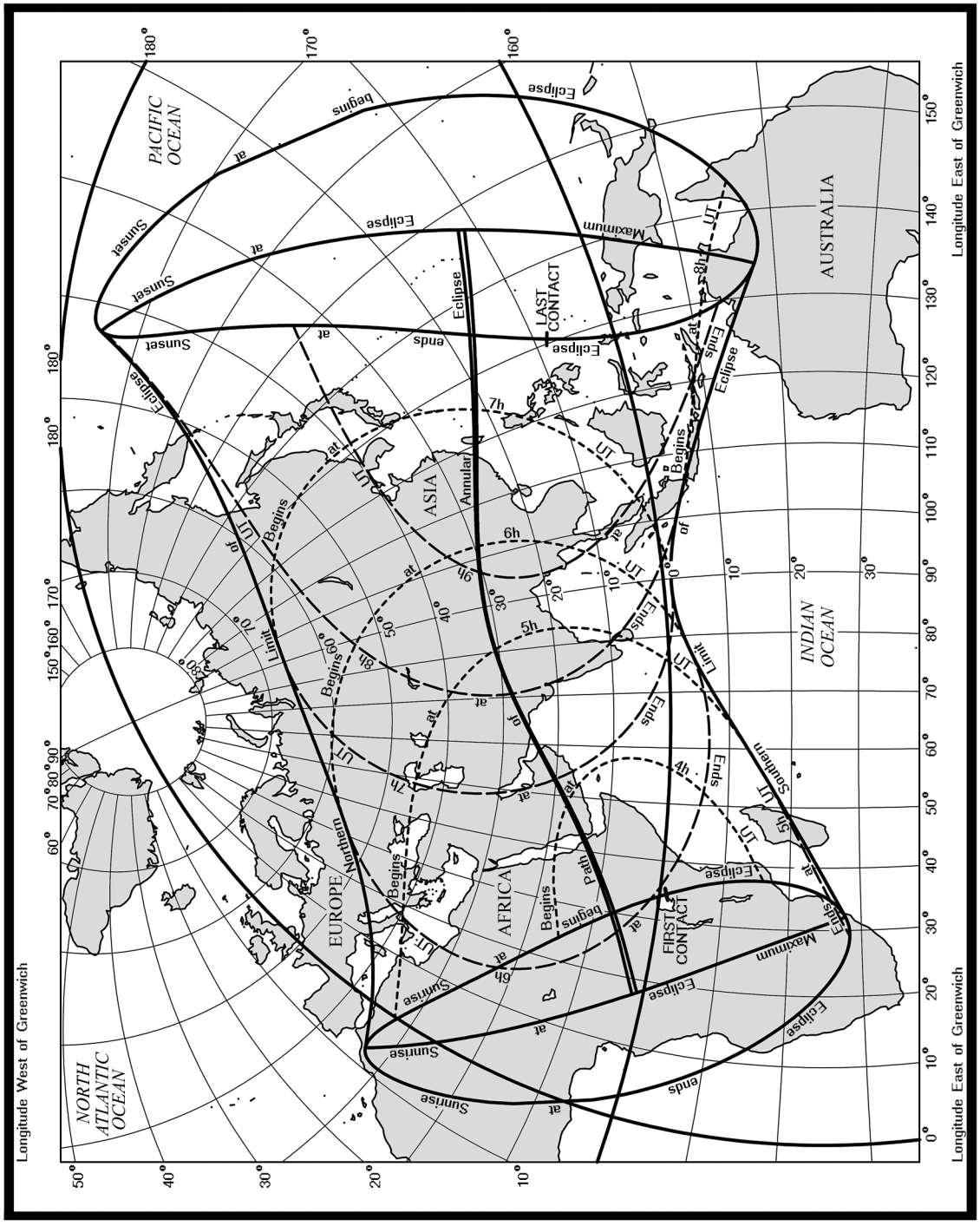
$$\text{penumbra } (l_1) = +0.55265751 - 0.00003716\ t - 0.00001066\ t^2$$
$$\text{umbra } (l_2) = +0.00624085 - 0.00003703\ t - 0.00001058\ t^2 - 0.00000001\ t^3$$

Other important quantities:

$$\tan f_1 = +0.004601$$
$$\tan f_2 = +0.004578$$
$$\mu' = +0.261784 \text{ radians per hour}$$
$$d' = -0.000004 \text{ radians per hour}$$

All time arguments are given provisionally in Universal Time, using $\Delta T(A) = 70^s.0$.

ANNULAR SOLAR ECLIPSE OF 2020 JUNE 21



PATH OF CENTRAL PHASE: ANNULAR SOLAR ECLIPSE OF JUNE 21

For limits, see Circumstances of the Eclipse.

Longitude	Latitude of: Northern Limit	Central Line	Southern Limit	Universal Time at: Northern Limit	Central Line	Southern Limit	On Central Line: Maximum Duration	Sun's Alt.	Sun's Az.
° ′	° ′	° ′	° ′	h m s	h m s	h m s	m s	°	°
+ 22 00	+ 3 32.9	+ 3 10.1	+ 2 46.7	4 49 05.7	4 48 53.3	4 48 37.6	1 17.3	5	67
+ 23 00	+ 4 00.8	+ 3 37.8	+ 3 15.2	4 49 19.1	4 49 02.5	4 48 50.0	1 16.7	6	67
+ 24 00	+ 4 28.8	+ 4 06.2	+ 3 43.7	4 49 33.2	4 49 17.3	4 49 03.1	1 16.2	7	67
+ 25 00	+ 4 57.4	+ 4 35.2	+ 4 12.9	4 49 51.9	4 49 36.6	4 49 21.0	1 15.6	8	67
+ 26 00	+ 5 26.4	+ 5 04.6	+ 4 42.6	4 50 13.9	4 49 58.1	4 49 42.4	1 14.9	9	67
+ 27 00	+ 5 55.9	+ 5 34.3	+ 5 12.6	4 50 39.0	4 50 22.9	4 50 06.8	1 14.3	11	67
+ 28 00	+ 6 25.7	+ 6 04.4	+ 5 43.1	4 51 07.4	4 50 50.9	4 50 34.5	1 13.7	12	67
+ 29 00	+ 6 55.9	+ 6 35.0	+ 6 13.9	4 51 39.2	4 51 22.4	4 51 05.6	1 13.0	13	67
+ 30 00	+ 7 26.5	+ 7 05.9	+ 6 45.2	4 52 14.4	4 51 57.3	4 51 40.2	1 12.3	14	68
+ 31 00	+ 7 57.5	+ 7 37.2	+ 7 16.9	4 52 53.2	4 52 35.8	4 52 18.4	1 11.6	16	68
+ 32 00	+ 8 28.8	+ 8 08.9	+ 7 48.9	4 53 35.8	4 53 18.1	4 53 00.4	1 10.9	17	68
+ 33 00	+ 9 00.5	+ 8 41.0	+ 8 21.3	4 54 22.1	4 54 04.1	4 53 46.2	1 10.1	18	68
+ 34 00	+ 9 32.6	+ 9 13.4	+ 8 54.1	4 55 12.3	4 54 54.1	4 54 35.9	1 09.4	19	68
+ 35 00	+10 05.0	+ 9 46.2	+ 9 27.3	4 56 06.5	4 55 48.1	4 55 29.6	1 08.6	21	69
+ 36 00	+10 37.7	+10 19.3	+10 00.7	4 57 04.7	4 56 46.1	4 56 27.5	1 07.8	22	69
+ 37 00	+11 10.7	+10 52.7	+10 34.5	4 58 07.2	4 57 48.4	4 57 29.5	1 07.0	23	69
+ 38 00	+11 44.1	+11 26.4	+11 08.6	4 59 13.9	4 58 54.9	4 58 35.9	1 06.2	25	69
+ 39 00	+12 17.7	+12 00.4	+11 43.0	5 00 24.9	5 00 05.8	4 59 46.7	1 05.3	26	70
+ 40 00	+12 51.5	+12 34.6	+12 17.7	5 01 40.3	5 01 21.2	5 01 01.9	1 04.4	28	70
+ 41 00	+13 25.6	+13 09.1	+12 52.5	5 03 00.2	5 02 41.0	5 02 21.8	1 03.6	29	70
+ 42 00	+13 59.8	+13 43.8	+13 27.6	5 04 24.7	5 04 05.5	5 03 46.2	1 02.6	30	71
+ 43 00	+14 34.2	+14 18.6	+14 02.8	5 05 53.8	5 05 34.6	5 05 15.3	1 01.7	32	71
+ 44 00	+15 08.8	+14 53.5	+14 38.2	5 07 27.5	5 07 08.3	5 06 49.0	1 00.8	33	71
+ 45 00	+15 43.4	+15 28.6	+15 13.7	5 09 05.8	5 08 46.7	5 08 27.6	0 59.8	35	72
+ 46 00	+16 18.1	+16 03.7	+15 49.2	5 10 48.8	5 10 29.9	5 10 10.8	0 58.9	36	72
+ 47 00	+16 52.8	+16 38.8	+16 24.8	5 12 36.5	5 12 17.8	5 11 58.9	0 57.9	38	73
+ 48 00	+17 27.4	+17 13.9	+17 00.3	5 14 28.9	5 14 10.3	5 13 51.6	0 56.9	39	73
+ 49 00	+18 02.0	+17 48.9	+17 35.7	5 16 25.8	5 16 07.5	5 15 49.1	0 55.9	41	74
+ 50 00	+18 36.4	+18 23.7	+18 11.0	5 18 27.4	5 18 09.4	5 17 51.2	0 54.8	42	75
+ 51 00	+19 10.7	+18 58.4	+18 46.0	5 20 33.4	5 20 15.7	5 19 57.9	0 53.8	44	75
+ 52 00	+19 44.7	+19 32.8	+19 20.9	5 22 43.9	5 22 26.5	5 22 09.0	0 52.8	46	76
+ 53 00	+20 18.4	+20 06.9	+19 55.4	5 24 58.6	5 24 41.7	5 24 24.6	0 51.8	47	77
+ 54 00	+20 51.7	+20 40.7	+20 29.6	5 27 17.6	5 27 01.0	5 26 44.4	0 50.7	49	78
+ 55 00	+21 24.7	+21 14.0	+21 03.3	5 29 40.5	5 29 24.5	5 29 08.3	0 49.7	50	78
+ 56 00	+21 57.1	+21 46.9	+21 36.6	5 32 07.4	5 31 51.8	5 31 36.1	0 48.7	52	79
+ 57 00	+22 29.1	+22 19.2	+22 09.3	5 34 38.0	5 34 22.9	5 34 07.7	0 47.7	53	80
+ 58 00	+23 00.4	+22 50.9	+22 41.4	5 37 12.0	5 36 57.5	5 36 42.9	0 46.6	55	81
+ 59 00	+23 31.1	+23 22.0	+23 12.8	5 39 49.4	5 39 35.5	5 39 21.4	0 45.7	57	82
+ 60 00	+24 01.2	+23 52.4	+23 43.6	5 42 29.9	5 42 16.6	5 42 03.1	0 44.7	58	84
+ 61 00	+24 30.5	+24 22.0	+24 13.5	5 45 13.3	5 45 00.5	5 44 47.6	0 43.7	60	85
+ 62 00	+24 58.9	+24 50.8	+24 42.7	5 47 59.3	5 47 47.1	5 47 34.8	0 42.8	61	86
+ 63 00	+25 26.6	+25 18.8	+25 10.9	5 50 47.8	5 50 36.2	5 50 24.4	0 41.9	63	88
+ 64 00	+25 53.4	+25 45.8	+25 38.3	5 53 38.4	5 53 27.4	5 53 16.2	0 41.0	64	89
+ 65 00	+26 19.2	+26 11.9	+26 04.7	5 56 30.9	5 56 20.5	5 56 10.0	0 40.2	66	91
+ 66 00	+26 44.1	+26 37.1	+26 30.1	5 59 25.2	5 59 15.4	5 59 05.4	0 39.4	67	93
+ 67 00	+27 08.0	+27 01.2	+26 54.5	6 02 20.9	6 02 11.7	6 02 02.3	0 38.6	69	95
+ 68 00	+27 30.8	+27 24.3	+27 17.8	6 05 17.9	6 05 09.2	6 05 00.5	0 37.9	70	97
+ 69 00	+27 52.6	+27 46.3	+27 40.0	6 08 15.9	6 08 07.8	6 07 59.6	0 37.2	72	100
+ 70 00	+28 13.4	+28 07.3	+28 01.2	6 11 14.7	6 11 07.1	6 10 59.5	0 36.6	73	102
+ 71 00	+28 33.0	+28 27.1	+28 21.2	6 14 14.1	6 14 07.1	6 14 00.0	0 36.0	75	106

PATH OF CENTRAL PHASE: ANNULAR SOLAR ECLIPSE OF JUNE 21

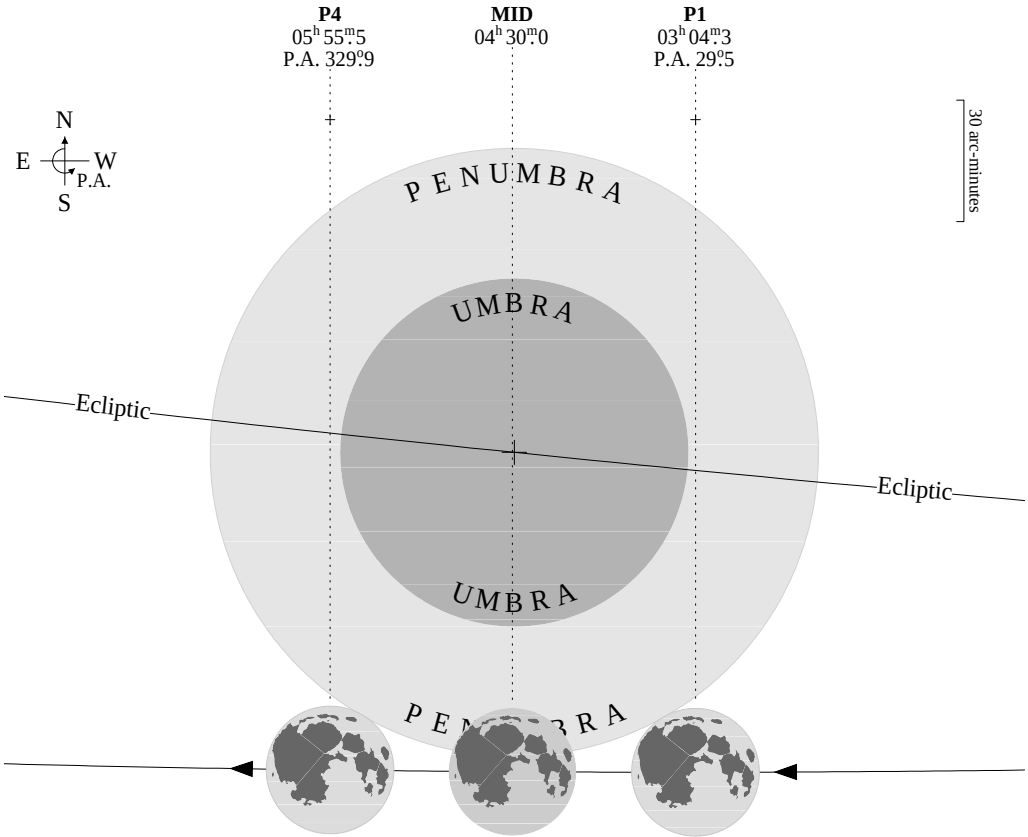
Longitude	Latitude of: Northern Limit	Central Line	Southern Limit	Universal Time at: Northern Limit	Central Line	Southern Limit	On Central Line: Maximum Duration	Sun's Alt.	Sun's Az.
° ′	° ′	° ′	° ′	h m s	h m s	h m s	m s	°	°
+ 72 00	+28 51.6	+28 45.8	+28 40.0	6 17 14.0	6 17 07.5	6 17 00.9	0 35.4	76	109
+ 73 00	+29 09.0	+29 03.4	+28 57.8	6 20 14.0	6 20 08.0	6 20 02.0	0 34.9	78	114
+ 74 00	+29 25.3	+29 19.8	+29 14.3	6 23 14.1	6 23 08.6	6 23 03.1	0 34.5	79	119
+ 75 00	+29 40.5	+29 35.1	+29 29.7	6 26 14.1	6 26 09.1	6 26 04.0	0 34.1	80	126
+ 76 00	+29 54.5	+29 49.2	+29 44.0	6 29 13.9	6 29 09.3	6 29 04.7	0 33.8	81	133
+ 77 00	+30 07.4	+30 02.2	+29 57.0	6 32 13.2	6 32 09.1	6 32 04.9	0 33.5	82	142
+ 78 00	+30 19.1	+30 14.0	+30 08.9	6 35 11.9	6 35 08.3	6 35 04.6	0 33.3	82	153
+ 79 00	+30 29.7	+30 24.7	+30 19.6	6 38 10.0	6 38 06.8	6 38 03.5	0 33.1	83	166
+ 80 00	+30 39.2	+30 34.2	+30 29.2	6 41 07.3	6 41 04.5	6 41 01.6	0 33.0	83	179
+ 81 00	+30 47.6	+30 42.6	+30 37.6	6 44 03.7	6 44 01.3	6 43 58.8	0 32.9	83	191
+ 82 00	+30 54.8	+30 49.8	+30 44.8	6 46 59.0	6 46 57.0	6 46 55.0	0 32.9	82	202
+ 83 00	+31 00.9	+30 55.9	+30 51.0	6 49 53.3	6 49 51.7	6 49 50.1	0 33.0	81	212
+ 84 00	+31 05.9	+31 00.9	+30 55.9	6 52 46.3	6 52 45.1	6 52 43.9	0 33.0	80	220
+ 85 00	+31 09.8	+31 04.8	+30 59.8	6 55 38.0	6 55 37.3	6 55 36.5	0 33.2	79	226
+ 86 00	+31 12.6	+31 07.5	+31 02.5	6 58 28.4	6 58 28.0	6 58 27.7	0 33.4	78	232
+ 87 00	+31 14.3	+31 09.2	+31 04.1	7 01 17.3	7 01 17.3	7 01 17.4	0 33.6	77	237
+ 88 00	+31 15.0	+31 09.8	+31 04.7	7 04 04.7	7 04 05.1	7 04 05.6	0 33.9	76	241
+ 89 00	+31 14.6	+31 09.4	+31 04.1	7 06 50.5	7 06 51.3	7 06 52.2	0 34.2	74	244
+ 90 00	+31 13.2	+31 07.8	+31 02.5	7 09 34.6	7 09 35.9	7 09 37.1	0 34.6	73	247
+ 91 00	+31 10.7	+31 05.3	+30 59.9	7 12 17.0	7 12 18.6	7 12 20.3	0 35.0	72	250
+ 92 00	+31 07.2	+31 01.7	+30 56.2	7 14 57.6	7 14 59.6	7 15 01.7	0 35.4	70	252
+ 93 00	+31 02.8	+30 57.1	+30 51.5	7 17 36.2	7 17 38.7	7 17 41.3	0 35.9	69	254
+ 94 00	+30 57.3	+30 51.5	+30 45.8	7 20 13.0	7 20 15.9	7 20 18.9	0 36.4	68	256
+ 95 00	+30 50.9	+30 45.0	+30 39.0	7 22 47.7	7 22 51.1	7 22 54.5	0 36.9	66	258
+ 96 00	+30 43.5	+30 37.4	+30 31.3	7 25 20.4	7 25 24.2	7 25 28.1	0 37.5	65	260
+ 97 00	+30 35.2	+30 28.9	+30 22.7	7 27 51.0	7 27 55.2	7 27 59.5	0 38.1	64	261
+ 98 00	+30 25.9	+30 19.5	+30 13.1	7 30 19.3	7 30 24.0	7 30 28.7	0 38.7	62	263
+ 99 00	+30 15.8	+30 09.2	+30 02.6	7 32 45.4	7 32 50.5	7 32 55.7	0 39.4	61	264
+100 00	+30 04.8	+29 58.0	+29 51.1	7 35 09.1	7 35 14.7	7 35 20.4	0 40.1	60	266
+101 00	+29 52.9	+29 45.9	+29 38.8	7 37 30.5	7 37 36.5	7 37 42.6	0 40.8	58	267
+102 00	+29 40.2	+29 32.9	+29 25.7	7 39 49.4	7 39 55.9	7 40 02.5	0 41.5	57	268
+103 00	+29 26.6	+29 19.1	+29 11.6	7 42 05.7	7 42 12.7	7 42 19.7	0 42.2	56	269
+104 00	+29 12.3	+29 04.5	+28 56.8	7 44 19.5	7 44 26.9	7 44 34.4	0 43.0	54	270
+105 00	+28 57.1	+28 49.1	+28 41.1	7 46 30.6	7 46 38.5	7 46 46.5	0 43.7	53	271
+106 00	+28 41.2	+28 33.0	+28 24.7	7 48 39.0	7 48 47.4	7 48 55.8	0 44.5	51	273
+107 00	+28 24.6	+28 16.1	+28 07.5	7 50 44.6	7 50 53.4	7 51 02.3	0 45.3	50	273
+108 00	+28 07.2	+27 58.4	+27 49.6	7 52 47.4	7 52 56.7	7 53 06.0	0 46.1	49	274
+109 00	+27 49.2	+27 40.1	+27 31.0	7 54 47.3	7 54 57.0	7 55 06.8	0 46.9	47	275
+110 00	+27 30.5	+27 21.1	+27 11.7	7 56 44.3	7 56 54.4	7 57 04.6	0 47.7	46	276
+111 00	+27 11.2	+27 01.4	+26 51.7	7 58 38.2	7 58 48.7	7 58 59.3	0 48.5	45	277
+112 00	+26 51.2	+26 41.2	+26 31.1	8 00 29.1	8 00 40.0	8 00 51.0	0 49.3	43	278
+113 00	+26 30.7	+26 20.3	+26 09.9	8 02 16.9	8 02 28.2	8 02 39.6	0 50.1	42	279
+114 00	+26 09.6	+25 58.9	+25 48.1	8 04 01.5	8 04 13.2	8 04 25.0	0 50.9	41	279
+115 00	+25 48.0	+25 36.9	+25 25.8	8 05 43.0	8 05 55.0	8 06 07.2	0 51.7	39	280
+116 00	+25 25.8	+25 14.4	+25 03.0	8 07 21.2	8 07 33.6	8 07 46.1	0 52.6	38	281
+117 00	+25 03.2	+24 51.5	+24 39.7	8 08 56.2	8 09 08.9	8 09 21.7	0 53.4	37	282
+118 00	+24 40.2	+24 28.1	+24 15.9	8 10 27.9	8 10 40.9	8 10 54.0	0 54.2	35	282
+119 00	+24 16.7	+24 04.2	+23 51.7	8 11 56.3	8 12 09.6	8 12 22.9	0 55.0	34	283
+120 00	+23 52.8	+23 40.0	+23 27.1	8 13 21.3	8 13 34.9	8 13 48.5	0 55.8	33	284
+121 00	+23 28.6	+23 15.4	+23 02.2	8 14 43.1	8 14 56.9	8 15 10.7	0 56.6	32	284

PATH OF CENTRAL PHASE: ANNULAR SOLAR ECLIPSE OF JUNE 21

Longitude	Latitude of: Northern Limit	Central Line	Southern Limit	Universal Time at: Northern Limit	Central Line	Southern Limit	On Central Line: Maximum Duration	Sun's Alt.	Sun's Az.
° ′	° ′	° ′	° ′	h m s	h m s	h m s	m s	°	°
+122 00	+23 04.0	+22 50.5	+22 36.8	8 16 01.5	8 16 15.4	8 16 29.5	0 57.3	30	285
+123 00	+22 39.1	+22 25.2	+22 11.2	8 17 16.5	8 17 30.7	8 17 44.9	0 58.1	29	285
+124 00	+22 14.0	+21 59.6	+21 45.3	8 18 28.2	8 18 42.5	8 18 56.9	0 58.9	28	286
+125 00	+21 48.5	+21 33.8	+21 19.1	8 19 36.5	8 19 51.0	8 20 05.5	0 59.6	26	286
+126 00	+21 22.9	+21 07.8	+20 52.7	8 20 41.5	8 20 56.1	8 21 10.7	1 00.4	25	287
+127 00	+20 57.0	+20 41.5	+20 26.0	8 21 43.2	8 21 57.8	8 22 12.6	1 01.1	24	287
+128 00	+20 30.9	+20 15.1	+19 59.2	8 22 41.5	8 22 56.3	8 23 11.0	1 01.9	23	288
+129 00	+20 04.7	+19 48.5	+19 32.2	8 23 36.6	8 23 51.4	8 24 06.2	1 02.6	21	288
+130 00	+19 38.3	+19 21.7	+19 05.1	8 24 28.4	8 24 43.2	8 24 58.0	1 03.3	20	289
+131 00	+19 11.8	+18 54.8	+18 37.8	8 25 17.0	8 25 31.8	8 25 46.6	1 04.0	19	289
+132 00	+18 45.2	+18 27.9	+18 10.5	8 26 02.4	8 26 17.1	8 26 31.9	1 04.7	18	289
+133 00	+18 18.5	+18 00.8	+17 43.1	8 26 44.6	8 26 59.3	8 27 14.0	1 05.3	17	290
+134 00	+17 51.8	+17 33.7	+17 15.6	8 27 23.7	8 27 38.3	8 27 53.0	1 06.0	15	290
+135 00	+17 25.0	+17 06.6	+16 48.1	8 27 59.8	8 28 14.3	8 28 28.8	1 06.7	14	291
+136 00	+16 58.2	+16 39.4	+16 20.6	8 28 32.7	8 28 47.1	8 29 01.5	1 07.3	13	291
+137 00	+16 31.4	+16 12.3	+15 53.1	8 29 02.7	8 29 17.0	8 29 31.2	1 07.9	12	291
+138 00	+16 04.6	+15 45.1	+15 25.6	8 29 29.8	8 29 43.9	8 29 58.0	1 08.6	11	292
+139 00	+15 37.9	+15 18.0	+14 58.1	8 29 54.0	8 30 07.9	8 30 21.8	1 09.2	10	292
+140 00	+15 11.1	+14 50.9	+14 30.7	8 30 15.4	8 30 29.0	8 30 42.9	1 09.8	8	292
+141 00	+14 44.5	+14 23.9	+14 03.3	8 30 33.3	8 30 47.6	8 31 00.7	1 10.4	7	292
+142 00	+14 17.9	+13 57.0	+13 36.1	8 30 48.3	8 31 02.2	8 31 14.6	1 10.9	6	293

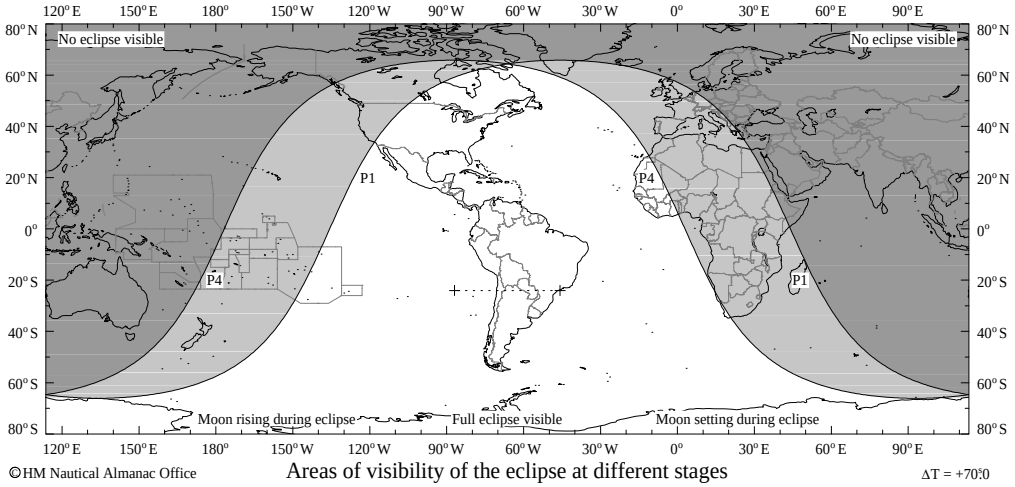
For limits, see Circumstances of the Eclipse.

IV. - Penumbral Eclipse of the Moon 2020 July 05



UT of geocentric opposition in RA: July $5^{d}\ 4^{h}\ 29^{m}\ 7^{s}.043$

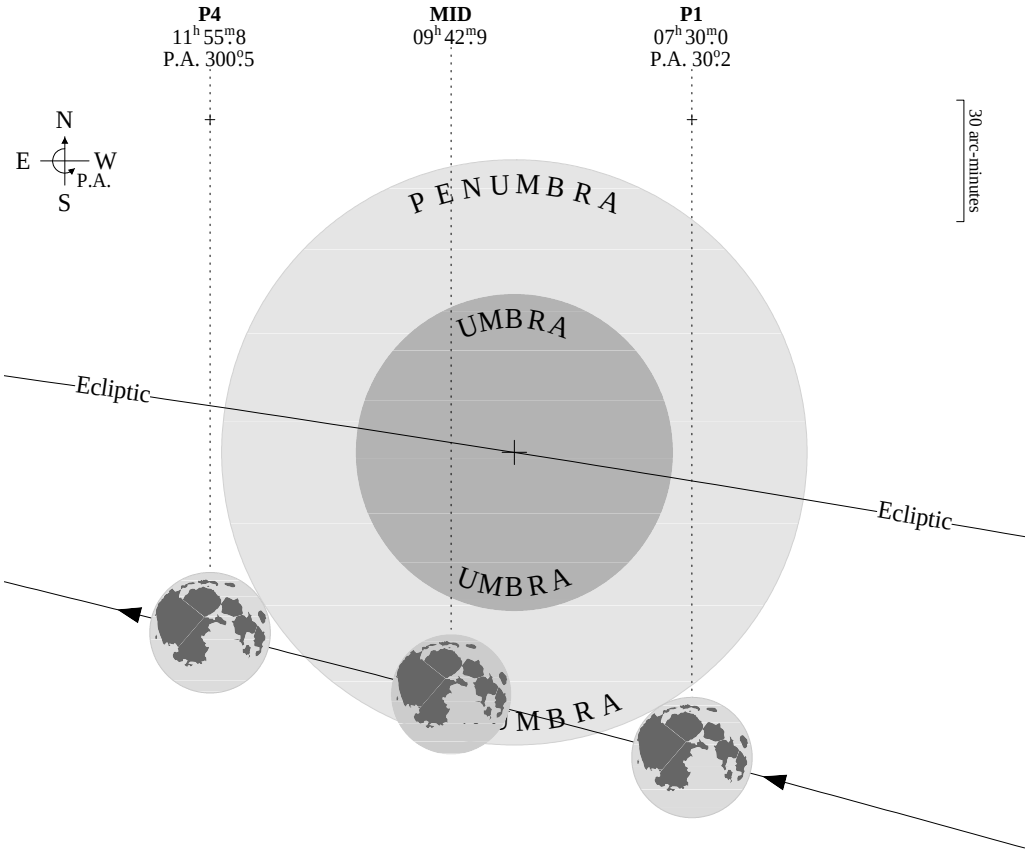
Penumbral magnitude of the eclipse: 0.380



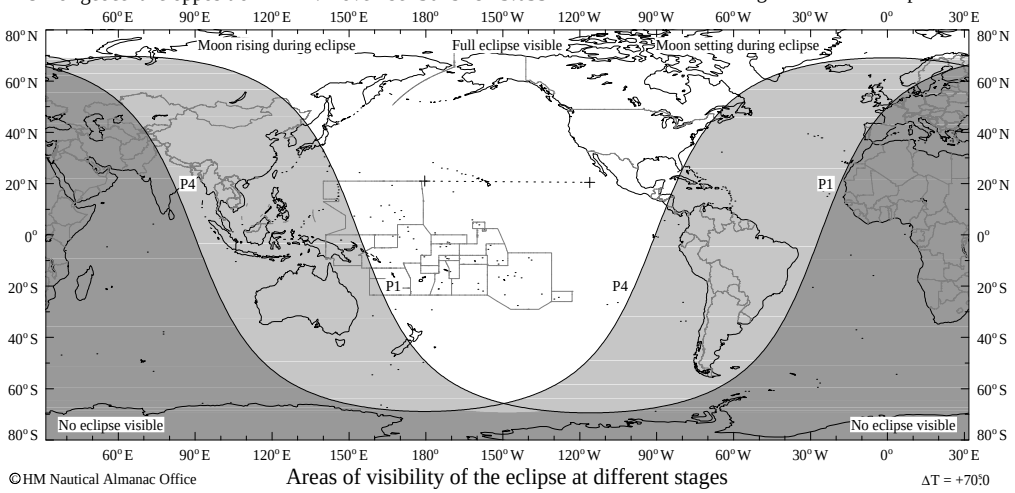
Areas of visibility of the eclipse at different stages

$\Delta T = +70^{s}.0$

V. - Penumbral Eclipse of the Moon 2020 November 30



UT of geocentric opposition in RA: November $30^{d}\ 9^{h}\ 8^{m}\ 3\overset{s}{.}035$ Penumbral magnitude of the eclipse: 0.855



Areas of visibility of the eclipse at different stages

$\Delta T = +70\overset{s}{.}0$

VI. – Total Eclipse of the Sun, 2020 December 14

CIRCUMSTANCES OF THE ECLIPSE

Universal Time of geocentric conjunction in right ascension, December $14^{d}\ 16^{h}\ 18^{m}\ 11^{s}.898$
Julian Date = 2459198.1793043795

		UT d h m	Longitude ° ′	Latitude ° ′
Eclipse begins	December	14 13 33.9	−115 39.2	− 2 06.1
Beginning of northern limit of umbra		14 14 32.7	−132 44.6	− 7 37.3
Beginning of center line; central eclipse begins		14 14 32.8	−132 50.4	− 7 46.0
Beginning of southern limit of umbra		14 14 33.0	−132 56.2	− 7 54.7
Central eclipse at local apparent noon		14 16 18.2	− 65 48.8	−40 46.2
End of southern limit of umbra		14 17 54.0	+ 11 08.7	−23 44.4
End of center line; central eclipse ends		14 17 54.1	+ 11 03.0	−23 36.8
End of northern limit of umbra		14 17 54.2	+ 10 57.3	−23 29.3
Eclipse ends		14 18 53.1	− 6 29.6	−18 01.3

BESSELIAN ELEMENTS

Let $t = (\mathrm{UT} - 13^{h}) + \delta T/3600$ in units of hours.

These equations are valid over the range $0^{h}.458 \le t \le 6^{h}.058$. Do not use t outside the given range, and do not omit any terms in the series.

Intersection of the axis of shadow with the fundamental plane:

$$x = -1.86051272 + 0.56298950\,t + 0.00010163\,t^2 - 0.00000894\,t^3$$
$$y = -0.01224017 - 0.08689564\,t + 0.00017505\,t^2 + 0.00000149\,t^3$$

Direction of the axis of shadow:

$$\sin d = -0.39477251 - 0.00003245\,t + 0.00000010\,t^2$$
$$\cos d = +0.91877893 - 0.00001397\,t + 0.00000005\,t^2$$
$$\mu = 16^{\circ}.27554193 + 14.99650374\,t - 0.00000081\,t^2 - 0.00000001\,t^3 - 0.00417807\,\delta T$$

Radius of the shadow on the fundamental plane:

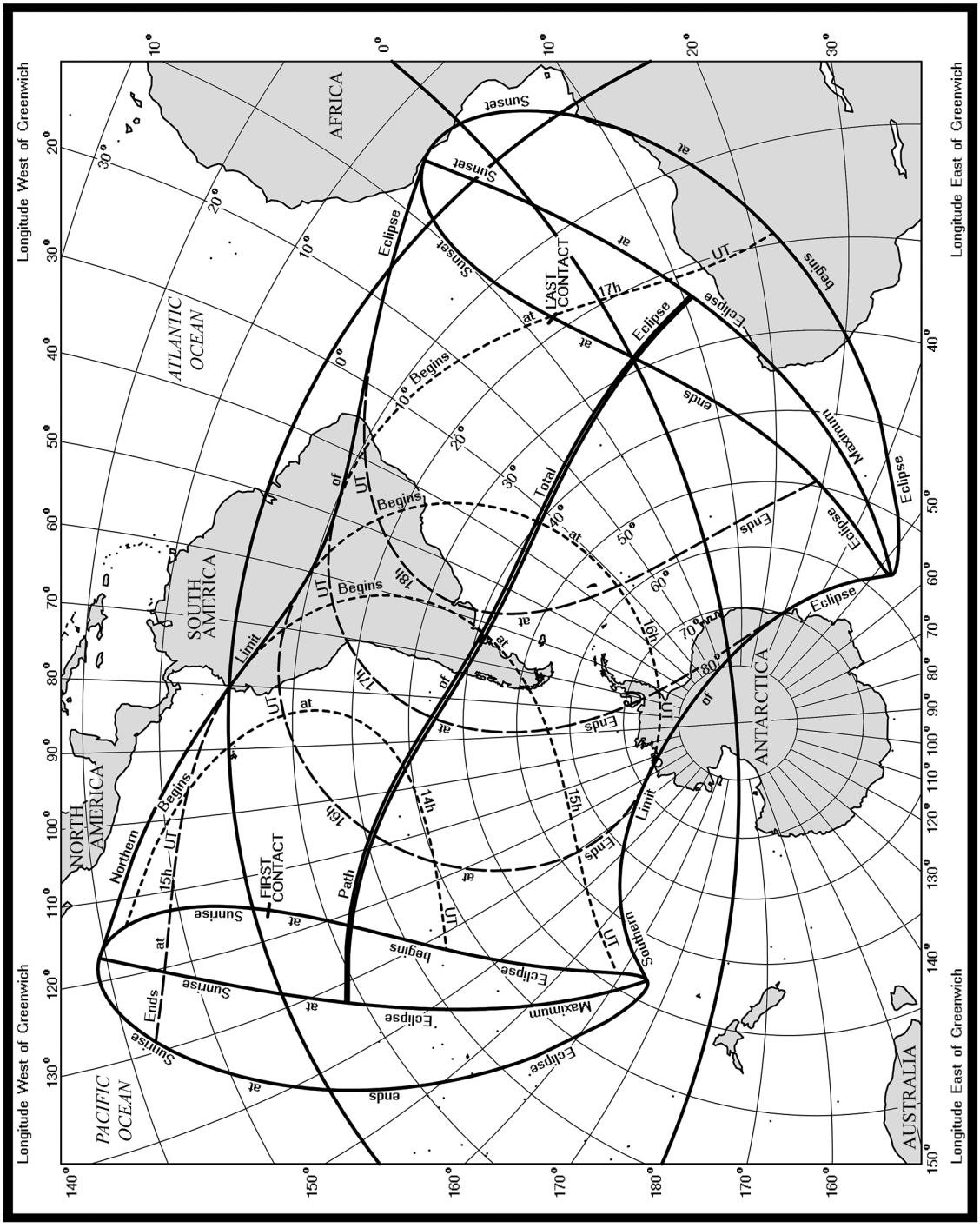
$$\text{penumbra } (l_1) = +0.54348365 + 0.00017192\,t - 0.00001257\,t^2$$
$$\text{umbra } (l_2) = -0.00288766 + 0.00017102\,t - 0.00001250\,t^2$$

Other important quantities:

$$\tan f_1 = +0.004750$$
$$\tan f_2 = +0.004727$$
$$\mu' = +0.261738 \text{ radians per hour}$$
$$d' = -0.000035 \text{ radians per hour}$$

All time arguments are given provisionally in Universal Time, using $\Delta T(A) = 70^{s}.0$.

TOTAL SOLAR ECLIPSE OF 2020 DECEMBER 14



PATH OF CENTRAL PHASE: TOTAL SOLAR ECLIPSE OF DECEMBER 14

For limits, see Circumstances of the Eclipse.

Longitude	Latitude of: Northern Limit	Central Line	Southern Limit	Universal Time at: Northern Limit	Central Line	Southern Limit	On Central Line: Maximum Duration	Sun's Alt.	Sun's Az.
° ′	° ′	° ′	° ′	h m s	h m s	h m s	m s	°	°
−128 00	− 9 44.5	− 9 57.9	−10 10.8	14 33 10.5	14 33 21.5	14 33 30.2	0 38.0	5	113
−127 00	−10 12.6	−10 26.0	−10 39.7	14 33 23.1	14 33 32.9	14 33 43.6	0 39.4	7	113
−126 00	−10 40.9	−10 55.1	−11 09.4	14 33 37.3	14 33 49.1	14 34 01.7	0 40.9	8	112
−125 00	−11 10.0	−11 24.7	−11 39.4	14 33 56.0	14 34 08.8	14 34 21.8	0 42.4	9	112
−124 00	−11 39.6	−11 54.7	−12 10.0	14 34 17.5	14 34 31.1	14 34 45.0	0 43.9	10	112
−123 00	−12 09.6	−12 25.3	−12 41.0	14 34 42.1	14 34 56.5	14 35 11.2	0 45.5	11	112
−122 00	−12 40.2	−12 56.3	−13 12.5	14 35 09.8	14 35 25.0	14 35 40.6	0 47.1	12	111
−121 00	−13 11.2	−13 27.8	−13 44.5	14 35 40.6	14 35 56.7	14 36 13.2	0 48.8	14	111
−120 00	−13 42.7	−13 59.8	−14 17.0	14 36 14.7	14 36 31.7	14 36 49.2	0 50.5	15	111
−119 00	−14 14.6	−14 32.2	−14 50.0	14 36 52.1	14 37 10.1	14 37 28.6	0 52.2	16	110
−118 00	−14 47.0	−15 05.1	−15 23.4	14 37 33.0	14 37 52.0	14 38 11.5	0 54.0	17	110
−117 00	−15 19.8	−15 38.5	−15 57.3	14 38 17.3	14 38 37.4	14 38 57.9	0 55.8	19	110
−116 00	−15 53.1	−16 12.3	−16 31.6	14 39 05.2	14 39 26.4	14 39 48.0	0 57.7	20	109
−115 00	−16 26.8	−16 46.5	−17 06.4	14 39 56.8	14 40 19.1	14 40 41.8	0 59.6	21	109
−114 00	−17 01.0	−17 21.1	−17 41.5	14 40 52.0	14 41 15.5	14 41 39.4	1 01.5	22	109
−113 00	−17 35.5	−17 56.2	−18 17.1	14 41 51.1	14 42 15.7	14 42 40.8	1 03.4	24	108
−112 00	−18 10.4	−18 31.6	−18 53.0	14 42 53.9	14 43 19.7	14 43 46.0	1 05.4	25	108
−111 00	−18 45.6	−19 07.3	−19 29.2	14 44 00.6	14 44 27.6	14 44 55.2	1 07.4	26	107
−110 00	−19 21.1	−19 43.4	−20 05.8	14 45 11.3	14 45 39.5	14 46 08.3	1 09.5	28	107
−109 00	−19 57.0	−20 19.7	−20 42.6	14 46 25.8	14 46 55.3	14 47 25.3	1 11.6	29	106
−108 00	−20 33.1	−20 56.3	−21 19.7	14 47 44.3	14 48 15.0	14 48 46.3	1 13.7	31	105
−107 00	−21 09.5	−21 33.1	−21 57.0	14 49 06.7	14 49 38.7	14 50 11.3	1 15.8	32	105
−106 00	−21 46.0	−22 10.2	−22 34.5	14 50 33.1	14 51 06.3	14 51 40.1	1 18.0	33	104
−105 00	−22 22.7	−22 47.3	−23 12.1	14 52 03.3	14 52 37.8	14 53 12.9	1 20.2	35	103
−104 00	−22 59.6	−23 24.6	−23 49.8	14 53 37.5	14 54 13.1	14 54 49.4	1 22.4	36	103
−103 00	−23 36.5	−24 01.9	−24 27.5	14 55 15.5	14 55 52.3	14 56 29.8	1 24.6	37	102
−102 00	−24 13.4	−24 39.2	−25 05.2	14 56 57.2	14 57 35.2	14 58 13.8	1 26.8	39	101
−101 00	−24 50.3	−25 16.4	−25 42.8	14 58 42.7	14 59 21.7	15 00 01.3	1 29.0	40	100
−100 00	−25 27.1	−25 53.6	−26 20.3	15 00 31.6	15 01 11.7	15 01 52.4	1 31.2	42	99
− 99 00	−26 03.7	−26 30.6	−26 57.6	15 02 24.1	15 03 05.1	15 03 46.7	1 33.4	43	98
− 98 00	−26 40.2	−27 07.4	−27 34.7	15 04 19.9	15 05 01.7	15 05 44.2	1 35.6	44	97
− 97 00	−27 16.5	−27 43.9	−28 11.5	15 06 18.8	15 07 01.5	15 07 44.7	1 37.8	46	96
− 96 00	−27 52.4	−28 20.1	−28 47.9	15 08 20.8	15 09 04.1	15 09 48.0	1 40.0	47	94
− 95 00	−28 28.0	−28 55.9	−29 23.9	15 10 25.6	15 11 09.5	15 11 53.9	1 42.1	49	93
− 94 00	−29 03.2	−29 31.2	−29 59.4	15 12 33.0	15 13 17.4	15 14 02.3	1 44.2	50	92
− 93 00	−29 37.9	−30 06.1	−30 34.5	15 14 42.9	15 15 27.7	15 16 12.9	1 46.3	51	90
− 92 00	−30 12.1	−30 40.4	−31 08.9	15 16 55.1	15 17 40.2	15 18 25.5	1 48.3	53	89
− 91 00	−30 45.7	−31 14.2	−31 42.7	15 19 09.4	15 19 54.5	15 20 40.0	1 50.3	54	87
− 90 00	−31 18.8	−31 47.3	−32 15.9	15 21 25.4	15 22 10.6	15 22 56.0	1 52.2	55	85
− 89 00	−31 51.1	−32 19.7	−32 48.3	15 23 43.2	15 24 28.2	15 25 13.4	1 54.0	57	84
− 88 00	−32 22.8	−32 51.4	−33 20.0	15 26 02.3	15 26 47.1	15 27 32.0	1 55.8	58	82
− 87 00	−32 53.7	−33 22.3	−33 50.9	15 28 22.7	15 29 07.0	15 29 51.5	1 57.6	59	80
− 86 00	−33 23.8	−33 52.4	−34 21.0	15 30 44.1	15 31 27.9	15 32 11.8	1 59.2	60	78
− 85 00	−33 53.2	−34 21.7	−34 50.2	15 33 06.3	15 33 49.5	15 34 32.7	2 00.8	61	75
− 84 00	−34 21.7	−34 50.1	−35 18.6	15 35 29.1	15 36 11.5	15 36 53.9	2 02.3	63	73
− 83 00	−34 49.3	−35 17.7	−35 46.1	15 37 52.4	15 38 33.9	15 39 15.4	2 03.7	64	70
− 82 00	−35 16.1	−35 44.3	−36 12.6	15 40 15.9	15 40 56.5	15 41 37.0	2 05.0	65	67
− 81 00	−35 41.9	−36 10.1	−36 38.3	15 42 39.6	15 43 19.1	15 43 58.5	2 06.3	66	65
− 80 00	−36 06.9	−36 34.9	−37 03.0	15 45 03.2	15 45 41.6	15 46 19.8	2 07.4	67	61
− 79 00	−36 30.9	−36 58.8	−37 26.7	15 47 26.7	15 48 03.8	15 48 40.7	2 08.5	68	58

PATH OF CENTRAL PHASE: TOTAL SOLAR ECLIPSE OF DECEMBER 14

Longitude	Latitude of: Northern Limit	Latitude of: Central Line	Latitude of: Southern Limit	Universal Time at: Northern Limit	Universal Time at: Central Line	Universal Time at: Southern Limit	On Central Line: Maximum Duration	On Central Line: Sun's Alt.	On Central Line: Sun's Az.
° ′	° ′	° ′	° ′	h m s	h m s	h m s	m s	°	°
− 78 00	−36 54.0	−37 21.8	−37 49.5	15 49 49.9	15 50 25.6	15 51 01.2	2 09.4	68	55
− 77 00	−37 16.1	−37 43.8	−38 11.4	15 52 12.6	15 52 47.0	15 53 21.1	2 10.3	69	51
− 76 00	−37 37.3	−38 04.8	−38 32.3	15 54 34.8	15 55 07.7	15 55 40.4	2 11.1	70	47
− 75 00	−37 57.6	−38 24.9	−38 52.2	15 56 56.4	15 57 27.8	15 57 58.9	2 11.7	71	43
− 74 00	−38 16.9	−38 44.1	−39 11.2	15 59 17.3	15 59 47.1	16 00 16.6	2 12.3	71	39
− 73 00	−38 35.3	−39 02.3	−39 29.3	16 01 37.4	16 02 05.6	16 02 33.5	2 12.8	72	34
− 72 00	−38 52.8	−39 19.6	−39 46.4	16 03 56.7	16 04 23.2	16 04 49.4	2 13.2	72	30
− 71 00	−39 09.3	−39 36.0	−40 02.6	16 06 15.0	16 06 39.9	16 07 04.4	2 13.6	72	25
− 70 00	−39 24.9	−39 51.4	−40 17.9	16 08 32.4	16 08 55.5	16 09 18.3	2 13.8	73	20
− 69 00	−39 39.6	−40 05.9	−40 32.3	16 10 48.8	16 11 10.2	16 11 31.3	2 13.9	73	15
− 68 00	−39 53.4	−40 19.6	−40 45.7	16 13 04.1	16 13 23.8	16 13 43.1	2 14.0	73	11
− 67 00	−40 06.2	−40 32.3	−40 58.3	16 15 18.3	16 15 36.2	16 15 53.9	2 13.9	73	6
− 66 00	−40 18.2	−40 44.1	−41 10.0	16 17 31.4	16 17 47.6	16 18 03.5	2 13.8	73	1
− 65 00	−40 29.3	−40 55.1	−41 20.8	16 19 43.4	16 19 57.9	16 20 12.0	2 13.6	72	356
− 64 00	−40 39.6	−41 05.2	−41 30.8	16 21 54.2	16 22 07.0	16 22 19.4	2 13.4	72	352
− 63 00	−40 49.0	−41 14.4	−41 39.9	16 24 03.9	16 24 14.9	16 24 25.6	2 13.0	72	347
− 62 00	−40 57.5	−41 22.8	−41 48.1	16 26 12.4	16 26 21.7	16 26 30.7	2 12.6	71	343
− 61 00	−41 05.2	−41 30.4	−41 55.6	16 28 19.7	16 28 27.3	16 28 34.7	2 12.1	71	339
− 60 00	−41 12.1	−41 37.1	−42 02.2	16 30 25.8	16 30 31.8	16 30 37.4	2 11.5	70	335
− 59 00	−41 18.1	−41 43.1	−42 08.0	16 32 30.7	16 32 35.0	16 32 39.1	2 10.9	70	332
− 58 00	−41 23.4	−41 48.2	−42 12.9	16 34 34.4	16 34 37.1	16 34 39.6	2 10.2	69	328
− 57 00	−41 27.8	−41 52.5	−42 17.1	16 36 36.8	16 36 38.0	16 36 38.9	2 09.4	68	325
− 56 00	−41 31.5	−41 56.0	−42 20.6	16 38 38.1	16 38 37.7	16 38 37.1	2 08.6	68	322
− 55 00	−41 34.3	−41 58.8	−42 23.2	16 40 38.2	16 40 36.3	16 40 34.2	2 07.7	67	319
− 54 00	−41 36.4	−42 00.7	−42 25.1	16 42 37.0	16 42 33.6	16 42 30.1	2 06.7	66	316
− 53 00	−41 37.7	−42 02.0	−42 26.2	16 44 34.6	16 44 29.8	16 44 24.9	2 05.7	65	313
− 52 00	−41 38.3	−42 02.4	−42 26.5	16 46 31.0	16 46 24.9	16 46 18.5	2 04.7	64	311
− 51 00	−41 38.1	−42 02.1	−42 26.1	16 48 26.2	16 48 18.7	16 48 11.0	2 03.6	64	308
− 50 00	−41 37.2	−42 01.1	−42 25.0	16 50 20.1	16 50 11.3	16 50 02.4	2 02.4	63	306
− 49 00	−41 35.5	−41 59.3	−42 23.1	16 52 12.8	16 52 02.8	16 51 52.6	2 01.2	62	304
− 48 00	−41 33.1	−41 56.8	−42 20.6	16 54 04.3	16 53 53.1	16 53 41.7	2 00.0	61	302
− 47 00	−41 30.0	−41 53.6	−42 17.3	16 55 54.5	16 55 42.2	16 55 29.6	1 58.7	60	300
− 46 00	−41 26.2	−41 49.7	−42 13.2	16 57 43.5	16 57 30.1	16 57 16.4	1 57.4	59	298
− 45 00	−41 21.7	−41 45.1	−42 08.5	16 59 31.2	16 59 16.7	16 59 02.1	1 56.0	58	296
− 44 00	−41 16.4	−41 39.8	−42 03.1	17 01 17.7	17 01 02.2	17 00 46.5	1 54.6	57	294
− 43 00	−41 10.5	−41 33.8	−41 57.0	17 03 02.8	17 02 46.4	17 02 29.8	1 53.1	56	292
− 42 00	−41 03.9	−41 27.0	−41 50.2	17 04 46.7	17 04 29.4	17 04 11.9	1 51.7	55	291
− 41 00	−40 56.6	−41 19.7	−41 42.7	17 06 29.3	17 06 11.2	17 05 52.8	1 50.2	54	289
− 40 00	−40 48.7	−41 11.6	−41 34.6	17 08 10.5	17 07 51.6	17 07 32.5	1 48.6	53	287
− 39 00	−40 40.0	−41 02.9	−41 25.7	17 09 50.4	17 09 30.8	17 09 11.0	1 47.1	52	286
− 38 00	−40 30.7	−40 53.5	−41 16.3	17 11 28.9	17 11 08.7	17 10 48.2	1 45.5	51	284
− 37 00	−40 20.8	−40 43.4	−41 06.1	17 13 06.0	17 12 45.2	17 12 24.1	1 43.9	50	283
− 36 00	−40 10.2	−40 32.7	−40 55.3	17 14 41.8	17 14 20.4	17 13 58.8	1 42.3	49	282
− 35 00	−39 59.0	−40 21.4	−40 43.9	17 16 16.1	17 15 54.2	17 15 32.1	1 40.6	48	280
− 34 00	−39 47.2	−40 09.4	−40 31.8	17 17 48.9	17 17 26.6	17 17 04.1	1 38.9	47	279
− 33 00	−39 34.7	−39 56.9	−40 19.1	17 19 20.2	17 18 57.6	17 18 34.6	1 37.3	46	278
− 32 00	−39 21.6	−39 43.6	−40 05.7	17 20 50.1	17 20 27.1	17 20 03.8	1 35.6	45	276
− 31 00	−39 07.9	−39 29.8	−39 51.8	17 22 18.3	17 21 55.1	17 21 31.6	1 33.9	44	275
− 30 00	−38 53.6	−39 15.4	−39 37.2	17 23 45.0	17 23 21.6	17 22 57.8	1 32.1	43	274
− 29 00	−38 38.8	−39 00.4	−39 22.1	17 25 10.1	17 24 46.5	17 24 22.6	1 30.4	42	273

PATH OF CENTRAL PHASE: TOTAL SOLAR ECLIPSE OF DECEMBER 14

Longitude	Latitude of: Northern Limit	Central Line	Southern Limit	Universal Time at: Northern Limit	Central Line	Southern Limit	On Central Line: Maximum Duration	Sun's Alt.	Sun's Az.
° ′	° ′	° ′	° ′	h m s	h m s	h m s	m s	°	°
− 28 00	−38 23.3	−38 44.8	−39 06.4	17 26 33.5	17 26 09.8	17 25 45.8	1 28.7	41	272
− 27 00	−38 07.3	−38 28.7	−38 50.0	17 27 55.2	17 27 31.5	17 27 07.4	1 26.9	40	271
− 26 00	−37 50.8	−38 11.9	−38 33.2	17 29 15.3	17 28 51.5	17 28 27.4	1 25.2	39	270
− 25 00	−37 33.7	−37 54.7	−38 15.7	17 30 33.5	17 30 09.8	17 29 45.8	1 23.4	38	269
− 24 00	−37 16.1	−37 36.9	−37 57.7	17 31 50.0	17 31 26.4	17 31 02.5	1 21.7	37	268
− 23 00	−36 57.9	−37 18.5	−37 39.2	17 33 04.6	17 32 41.2	17 32 17.4	1 19.9	36	267
− 22 00	−36 39.3	−36 59.7	−37 20.2	17 34 17.4	17 33 54.1	17 33 30.5	1 18.1	35	266
− 21 00	−36 20.2	−36 40.4	−37 00.7	17 35 28.3	17 35 05.3	17 34 41.9	1 16.4	34	265
− 20 00	−36 00.6	−36 20.6	−36 40.6	17 36 37.2	17 36 14.5	17 35 51.3	1 14.6	33	264
− 19 00	−35 40.5	−36 00.3	−36 20.1	17 37 44.2	17 37 21.7	17 36 58.9	1 12.9	32	263
− 18 00	−35 20.0	−35 39.5	−35 59.2	17 38 49.1	17 38 27.0	17 38 04.5	1 11.2	31	262
− 17 00	−34 59.1	−35 18.4	−35 37.8	17 39 52.1	17 39 30.3	17 39 08.2	1 09.4	30	261
− 16 00	−34 37.7	−34 56.8	−35 15.9	17 40 52.9	17 40 31.6	17 40 09.8	1 07.7	29	260
− 15 00	−34 16.0	−34 34.8	−34 53.6	17 41 51.6	17 41 30.7	17 41 09.5	1 06.0	28	260
− 14 00	−33 53.8	−34 12.4	−34 31.0	17 42 48.2	17 42 27.8	17 42 07.0	1 04.3	26	259
− 13 00	−33 31.4	−33 49.6	−34 08.0	17 43 42.7	17 43 22.7	17 43 02.4	1 02.6	25	258
− 12 00	−33 08.5	−33 26.5	−33 44.6	17 44 34.9	17 44 15.5	17 43 55.7	1 00.9	24	257
− 11 00	−32 45.4	−33 03.0	−33 20.8	17 45 25.0	17 45 06.1	17 44 46.8	0 59.3	23	257
− 10 00	−32 21.9	−32 39.3	−32 56.8	17 46 12.8	17 45 54.4	17 45 35.7	0 57.6	22	256
− 9 00	−31 58.1	−32 15.2	−32 32.4	17 46 58.4	17 46 40.6	17 46 22.4	0 56.0	21	255
− 8 00	−31 34.1	−31 50.8	−32 07.7	17 47 41.7	17 47 24.5	17 47 06.9	0 54.4	20	254
− 7 00	−31 09.8	−31 26.2	−31 42.8	17 48 22.8	17 48 06.1	17 47 49.1	0 52.8	19	254
− 6 00	−30 45.3	−31 01.4	−31 17.6	17 49 01.5	17 48 45.4	17 48 29.0	0 51.3	18	253
− 5 00	−30 20.5	−30 36.3	−30 52.2	17 49 38.0	17 49 22.5	17 49 06.6	0 49.7	17	253
− 4 00	−29 55.6	−30 11.0	−30 26.5	17 50 12.2	17 49 57.2	17 49 42.0	0 48.2	16	252
− 3 00	−29 30.4	−29 45.5	−30 00.7	17 50 44.0	17 50 29.7	17 50 15.1	0 46.7	15	251
− 2 00	−29 05.1	−29 19.8	−29 34.7	17 51 13.6	17 50 59.8	17 50 45.8	0 45.2	14	251
− 1 00	−28 39.6	−28 54.0	−29 08.5	17 51 40.9	17 51 27.7	17 51 14.2	0 43.7	13	250
0 00	−28 14.0	−28 28.1	−28 42.2	17 52 05.8	17 51 53.2	17 51 40.4	0 42.2	11	250
+ 1 00	−27 48.3	−28 02.0	−28 15.8	17 52 28.5	17 52 16.5	17 52 04.2	0 40.8	10	249
+ 2 00	−27 22.5	−27 35.8	−27 49.3	17 52 49.0	17 52 37.5	17 52 25.8	0 39.4	9	249
+ 3 00	−26 56.6	−27 09.6	−27 22.7	17 53 07.2	17 52 56.2	17 52 45.1	0 38.0	8	248
+ 4 00	−26 30.7	−26 43.3	−26 55.9	17 53 23.1	17 53 13.1	17 53 01.7	0 36.7	7	248
+ 5 00	−26 04.6	−26 16.9	−26 29.2	17 53 35.3	17 53 27.0	17 53 15.4	0 35.3	6	247
+ 6 00	−25 38.5	−25 50.4	−26 02.4	17 53 45.8	17 53 36.5	17 53 29.0	0 34.0	5	247

For limits, see Circumstances of the Eclipse.

Joint publications of HM Nautical Almanac Office (UKHO) and the United States Naval Observatory

These publications are available from UKHO Distributors and the Superintendent of Documents, U.S. Government Printing Office (USGPO) except where noted.

The Astronomical Almanac (AsA) and *The Astronomical Almanac Online* (AsA Online) contain ephemerides of the Sun, Moon, planets and their natural satellites, as well as data on eclipses and other astronomical phenomena. The AsA is an annual volume while AsA Online is updated annually. The data are calculated cooperatively by the British and American offices. A full list of contributors is given on page vii of the AsA (UKHO GP100) and on AsA Online.

The Nautical Almanac contains ephemerides at an interval of one hour and auxiliary astronomical data for marine navigation. (UKHO NP314)

The Air Almanac contains ephemerides at an interval of ten minutes and auxiliary astronomical data for air navigation. This publication is now distributed solely on CD-ROM and is only available from USGPO.

Rapid Sight Reduction Tables for Navigation (AP 3270 / NP 303), 3 volumes, formerly entitled *Sight Reduction Tables for Air Navigation*. Volume 1, selected stars for epoch 2020·0, containing the altitude to $1'$ and true azimuth to 1° for the seven stars most suitable for navigation, for all latitudes and hour angles of Aries.

Other publications of HM Nautical Almanac Office (UKHO)

The Star Almanac for Land Surveyors (NP 321) contains the Greenwich hour angle of Aries and the position of the Sun, tabulated for every six hours, and represented by monthly polynomial coefficients. Positions of all stars brighter than magnitude 4·0 are tabulated monthly to a precision of $0^s.1$ in right ascension and $1''$ in declination. A CD-ROM is included which contains the electronic edition plus coefficients, in ASCII format, representing the data.

NavPac and Compact Data for 2016–2020 (DP 330) contains software, algorithms and data, which are mainly in the form of polynomial coefficients, for calculating the positions of the Sun, Moon, navigational planets and bright stars. It enables navigators to compute their position at sea from sextant observations using Windows OS XP/Vista/7/8/10 for the period 1986–2020. The tabular data are also supplied as ASCII files on the CD-ROM.

Planetary and Lunar Coordinates, 2001–2020 provides low-precision astronomical data and phenomena for use well in advance of the annual ephemerides. It contains heliocentric, geocentric, spherical and rectangular coordinates of the Sun, Moon and planets, eclipse maps and auxiliary data. All the tabular ephemerides are supplied solely on CD-ROM as ASCII and Adobe's portable document format files. The full printed edition is published in the United States by Willmann-Bell Inc, PO Box 35025, Richmond VA 23235, USA.

Rapid Sight Reduction Tables for Navigation (AP 3270 / NP 303), 3 volumes, formerly entitled *Sight Reduction Tables for Air Navigation*. Volumes 2 and 3 contain altitudes to $1'$ and azimuths to 1° for integral degrees of declination from N 29° to S 29°, for relevant latitudes and all hour angles at which the zenith distance is less than 95° providing for sights of the Sun, Moon and planets.

The UK Air Almanac (AP1602) contains data useful in the planning of activities where the level of illumination is important, particularly aircraft movements, and is produced to the general requirements of the Royal Air Force. It may be downloaded from the website http://astro.ukho.gov.uk/nao/publicat/ukaa.html.

NAO Technical Notes are issued irregularly to disseminate astronomical data concerning ephemerides or astronomical phenomena.

Other publications of the United States Naval Observatory

Astronomical Papers of the American Ephemeris† are issued irregularly and contain reports of research in celestial mechanics with particular relevance to ephemerides.

U.S. Naval Observatory Circulars† are issued irregularly to disseminate astronomical data concerning ephemerides or astronomical phenomena.

U.S. Naval Observatory Circular No. 179, The IAU Resolutions on Astronomical Reference Systems, Time Scales, and Earth Rotation Models explains resolutions and their effects on the data (see Web Links).

Explanatory Supplement to The Astronomical Almanac, (3rd edition). This book is an authoritative source on the basis and derivation of information contained in *The Astronomical Almanac*. It contains material that is relevant to positional and dynamical astronomy and to chronology. The publication is a collaborative work with authors from the U.S. Naval Observatory, H.M. Nautical Almanac Office, the Jet Propulsion Laboratory, and others. This edition is published by and available from University Science Books, whose UK distributor is Palgrave Macmillan.

MICA is an interactive astronomical almanac for professional applications. Software for both PC systems with Intel processors and Apple Macintosh computers is provided on a single CD-ROM. *MICA* allows a user to compute, to full precision, much of the tabular data contained in *The Astronomical Almanac*, as well as data for specific times and locations. All calculations are made in real time and data are not interpolated from tables. MICA is a product of the U.S. Naval Observatory; it is published by and available from Willmann-Bell Inc. The latest version covers the interval 1800-2050.

† Many of these publications are available from the Nautical Almanac Office, U.S. Naval Observatory, Washington, DC 20392-5420, see Web Links on the next page for availability.

Publications of other countries

Apparent Places of Fundamental Stars is prepared by the Astronomisches Rechen-Institut, Heidelberg (http://www.ari.uni-heidelberg.de). The printed version of APFS gives the data for a few fundamental stars only, together with the explanation and examples. The apparent places of stars using the FK6 or Hipparcos catalogues are provided by the on-line database ARIAPFS (http://www.ari.uni-heidelberg.de/ariapfs). The printed booklet also contains the so-called '10-Day-Stars' and the 'Circumpolar Stars' and is available from Der Kleine Buch Verlag, Leopoldstrasse 7b, 76133 Karlsruhe, Germany.

Ephemerides of Minor Planets is prepared annually by the Institute of Applied Astronomy (http://www.ipa.nw.ru), and published by the Russian Academy of Sciences. Included in this volume are elements, opposition dates and opposition ephemerides of all numbered minor planets. This volume is available from the Institute of Applied Astronomy, Naberezhnaya Kutuzova 10, St. Petersburg, 191187 Russia.

Electronic Publications

The Astronomical Almanac Online: The companion publication of *The Astronomical Almanac*, providing data best presented in machine-readable form. It typically does not duplicate the data from the book. It does, in some cases, provide additional information or greater precision than the printed data. Examples of data found on *The Astronomical Almanac Online* are searchable databases, eclipse and occultation maps, errata found in the printed publication, and a searchable glossary. It is available at

http://asa.usno.navy.mil — WWW — **http://asa.hmnao.com**

Please refer to the relevant World Wide Web address for further details about the publications and services provided by the following organisations.

U.S. Naval Observatory

- U.S. Naval Observatory portal at http://www.usno.navy.mil/USNO
- USNO Astronomical Applications Department portal at http://aa.usno.navy.mil/
- USNO Data Services at http://aa.usno.navy.mil/data/
- NOVAS astrometry software at http://aa.usno.navy.mil/software/novas/
- *USNO Circular 179* at http://aa.usno.navy.mil/publications/docs/Circular_179.php
- *The Astronomical Almanac Online*—WWW— at http://asa.usno.navy.mil

H.M. Nautical Almanac Office

- General information at http://astro.ukho.gov.uk or http://www.gov.uk/HMNAO
- *The Astronomical Almanac Online*—WWW— at http://asa.hmnao.com/
- Eclipses Online at http://astro.ukho.gov.uk/eclipse/
- Online data services at http://astro.ukho.gov.uk/websurf/
- Crescent MoonWatch at http://astro.ukho.gov.uk/moonwatch/

International Astronomical Organizations

- IAU: International Astronomical Union at http://www.iau.org
- IERS: International Earth Rotation and Reference Systems Service at http://www.iers.org
- SOFA: IAU Standards of Fundamental Astronomy at http://www.iausofa.org
- NSFA: IAU Working Group on Numerical Standards at http://maia.usno.navy.mil/NSFA/
- CDS: Centre de Données astronomiques de Strasbourg at http://cdsweb.u-strasbg.fr

Publishers and Suppliers

- The UK Hydrographic Office (UKHO) at http://www.gov.uk/UKHO
- U.S. Government Printing Office (USGPO) at https://bookstore.gpo.gov
- University Science Books at http://www.uscibooks.com
- Willmann-Bell at http://www.willbell.com
- Macmillan Distribution at http://www.palgrave.com