Perpetual Easter and Passover Calculator

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url: http://www.staff.science.uu.nl/~gent0113/easter/eastercalculator.htm

Astronomical and Gregorian Easter Sunday

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The date of Easter Sunday is commonly defined as the first Sunday that falls after the full moon, sometimes called the Easter or Paschal Full Moon, that occurs after the spring equinox. As the precise computation of the moments of the spring equinox and the astronomical full moon is complex and laborious the determination of Easter Sunday has always been based on a simplified method.

The date of the spring equinox is hereby fixed as 21 March and the 'ecclesiastical' full moon dates are obtained from a table based on the mean motions of the sun and the moon. The Easter Full Moon is the tabular full moon that occurs on or after 21 March and the first Sunday that occurs afterwards is Easter Sunday. The earliest possible date for Easter Sunday is thus 22 March, which can only occur when the Easter Full Moon falls on Saturday 21 March.

As the astronomical spring equinox can actually occur on 19, 20 or 21 March and the astronomical full moon can also fall a day earlier or later than its mean tabular date it sometimes happens that the Easter date, as computed from the true motions of the sun and the moon, differs from the date as determined from the ecclesiastical rules.

The following tables list the years between 1583 and 2500 when the dates of astronomical Easter Sunday and Gregorian Easter Sunday are different. The tables are based on Jean Meeus, *Mathematical Astronomy Morsels* (Richmond: Willmann-Bell, 1997), pp. 364–366 and *Mathematical Astronomy Morsels V* (Richmond: Willmann-Bell, 2009), p. 390. Also tabulated are the golden number (G) and the Easter date difference in weeks (Δw).

[Anomalous Easter Dates:] From 1583 to 2000

Year	Easter Sunday				Year	Easter Sunday			
	Astronomical	Gregorian	G	Δw		Astronomical	Gregorian	G	Δw
1590	25 March	22 April	14	+4	1825	10 April	3 April	2	–1
1598	29 March	22 March	3	–1	1829	26 April	19 April	6	–1
1609	26 April	19 April	14	–1	1845	30 March	23 March	3	–1
1622	3 April	27 March	8	–1	1876	9 April	16 April	15	+1
1629	8 April	15 April	15	+1	1900	22 April	15 April	1	–1
1666	21 March	25 April	14	+5	1903	19 April	12 April	4	–1
1685	25 March	22 April	14	+4	1923	8 April	1 April	5	–1

Year					Year				
1693	29 March	22 March	3	–1	1924	23 March	20 April	6	+4
1700	4 April	11 April	10	+1	1927	24 April	17 April	9	–1
1724	9 April	16 April	15	+1	1943	28 March	25 April	6	+4
1744	29 March	5 April	16	+1	1954	25 April	18 April	17	–1
1778	12 April	19 April	12	+1	1962	25 March	22 April	6	+4
1798	1 April	8 April	13	+1	1967	2 April	26 March	11	–1
1802	25 April	18 April	17	–1	1974	7 April	14 April	18	+1
1818	29 March	22 March	14	–1	1981	26 April	19 April	6	–1

From 2001 to 2500

Year	Easter Sunday				Year	Easter Sunday			
	Astronomical	Gregorian	G	Δw		Astronomical	Gregorian	G	Δw
2019	24 March	21 April	6	+4	2296	22 March	19 April	17	+4
2038	28 March	25 April	6	+4	2299	23 April	16 April	1	–1
2045	2 April	9 April	13	+1	2316	9 April	16 April	18	+1
2049	25 April	18 April	17	–1	2336	29 March	5 April	19	+1
2057	25 March	22 April	6	+4	2339	2 April	26 March	3	–1
2069	7 April	14 April	18	+1	2353	26 April	22 March	17	–5
2076	22 March	19 April	6	+4	2372	23 April	26 March	17	–4
2089	27 March	3 April	9	+1	2390	1 April	8 April	16	+1
2095	27 March	24 April	6	+4	2394	24 April	17 April	1	–1
2096	8 April	15 April	7	+1	2410	28 March	25 April	17	+4
2106	25 April	18 April	17	–1	2417	9 April	2 April	5	–1
2114	25 March	22 April	6	+4	2421	25 April	18 April	9	–1
2119	2 April	26 March	11	–1	2429	25 March	22 April	17	+4
2133	22 March	19 April	6	+4	2437	29 March	22 March	6	–1
2147	23 April	16 April	1	–1	2448	22 March	19 April	17	+4
2150	19 April	12 April	4	–1	2451	23 April	16 April	1	–1
2170	8 April	1 April	5	–1	2467	27 March	24 April	17	+4
2171	24 March	21 April	6	+4	2468	8 April	15 April	18	+1
2174	24 April	17 April	9	–1	2471	12 April	5 April	2	–1
2190	28 March	25 April	6	+4	2486	24 March	21 April	17	+4
2201	26 April	19 April	17	–1	2488	28 March	4 April	19	+1
2221	8 April	15 April	18	+1	2491	1 April	25 March	3	–1
2245	20 April	13 April	4	–1	2492	20 April	13 April	4	–1
2277	25 March	22 April	17	+4	2495	17 April	10 April	7	–1

According to the traditional Easter reckoning, both Dionysian and Gregorian, the extreme possible dates for Easter Sunday are 22 March and 25 April.

In the astronomical reckoning, however, Easter Sunday can occur as early as 21 March (as in 1666) and as late as 26 April (as in 1609, 1829, 1981, 2201 and 2353). Even 20 March is a

possible date in the astronomical reckoning, when the spring equinox falls on 19 March and the full moon later on the same date (being a Saturday). However, in the period considered here (1583–2500) this never happens.

JavaScript Easter Sunday/Jewish Passover Calculator

url: http://www.staff.science.uu.nl/~gent0113/easter/eastercalculator.htm

The following JavaScript calculator determines the dates of Julian and Gregorian Easter Sunday and the date and weekday of the first day of the Jewish Passover feast (15 Nisan) for a given year. Also given are the dates of the Easter or Paschal Full Moon and miscellaneous computistical parameters such as the Dominical Letter, the Golden Number, the Epact, and the martyrology letters according to the Julian and the Gregorian calendrical reckoning.

Easter Sunday/Jewish Passover Calculator

Year (Anno Domini)   Show Gregorian dates before 1583

[-1] [   ] [+1] **Offset between Julian and Gregorian calendar** [   ] **days**

Update calculator [C] **Julian Easter mode**

Dominical Letter	**Julian reckoning** [ ]	**Gregorian reckoning** [ ]
Lunar age parameters	**Golden Number** [ ]	**Gregorian Epact** [ ]
Martyrology letters	**Julian reckoning** [ ]	**Gregorian reckoning** [ ]

Julian reckoning	**Julian calendar date**	**Gregorian calendar date**
Easter Full Moon (*luna XIV*)	[ ][ ]	[ ][ ]
Easter Sunday	[ ][ ]	[ ][ ]

Gregorian reckoning	**Gregorian calendar date**
Easter Full Moon (*luna XIV*)	[ ][ ]
Easter Sunday	[ ][ ]

Jewish Passover Feast   **15 Nisan** [ ] **AM** [ ][ ][ ]

1943: Easter Fullmoon, Gregorian Calendar: 18 April; Eastern: Sunday 25 April; Jewish Passover: Tuesday 20 April
1924: Easter Fullmoon, Gregorian Calendar: 18 April; Easter Sunday: 20 April; Jewish Passover: Saturday 19 April

The first day of the Jewish Passover feast is given according to the Julian calendar up to and including 1582 (AM 5342/43) and according to the Gregorian calendar from 1583 (AM 5343/44) onwards. Note that the Jewish Paschal Full Moon always falls on 14 Nisan.

Valid from When to When?

The JavaScript Easter Sunday/Jewish Passover calculator is based on mathematical algorithms similar to those first devised by the German mathematician Carl Friedrich Gauss (1777-1855).

The Gaussian algorithm for calculating the first day of the Jewish Passover feast (15 Nisan) is equivalent with the method currently employed in the rabbinic (or cyclic) Jewish calendar, which according to tradition was introduced by Hillel the Patriarch (Hillel II) in AD 358/359 (AM 4119). However, there is evidence (cf. Stern, 2001) that up to the 10th century AD several versions of the Jewish calendar existed simultaneously and textual evidence suggests that some of the underlying parameters and postponement rules currently employed in the rabbinic Jewish calendar were probably not introduced until the mid-10th century AD.

The Julian Easter algorithm should not be used before *c*. AD 530 as it differs slightly from the computations of the Christians of Alexandria and from the 532-year cycle of Victorius of Aquitaine that was used in the western parts of Europe up to the 8th century AD. Of course there will also be differences with the Easter dates computed from the earlier Paschal tables (based on 16- and 84-year cycles) that were previously adopted in the Western Roman Empire.

Note: A slightly different Easter reckoning is followed to this day by some Eastern Orthodox Churches, notably the Armenian Orthodox Church, the Syrian Orthodox Church (known as the Jacobites) and the Church of the East (known as the Nestorians). The latter are also known as the Non-Chalcedonian churches and, as the Armenian Orthodox Church, are located near the eastern border of the former Byzantine Empire.

These churches place the Paschal Full Moon on 6 April (instead of 5 April) when the Golden Number is 1 and when this happens to fall on a Sunday (i.e. when the Dominical Letter is E) Easter Sunday is observed a week later on 13 April (instead of 6 April). This happens four times in each 532-year cycle and since the introduction of the Dionysian Easter reckoning this has occurred in 570, 665, 760, 1007, 1102, 1197, 1292, 1539, 1634 (23 April New Style), 1729 (24 April NS) and 1824 (25 April NS). The next cases (up to 2500) will be in 2071 (26 April NS), 2166 (27 April NS), 2261 (28 April NS) and 2356 (29 April NS).

Gregorian Easter Sunday dates are only defined for the years following the Gregorian calendar reform in 1582. In the default mode the Easter/Passover calculator therefore does not output Gregorian Easter Sunday dates before 1583 as these are meaningless for chronological purposes, but if so desired the calculator can also output proleptic Gregorian calendar dates.

Assuming no change in the current rules for calculating the dates for Passover and Easter Sunday in the Jewish and Gregorian calendars, the Easter/Passover calculator should produce valid results up to at least AD 9999.

Note: The Easter/Passover calculator should NOT be used to date key events in the life of Jesus Christ or that of other early Christians as it is based on strictly cyclical algorithms that were not introduced until many centuries later.