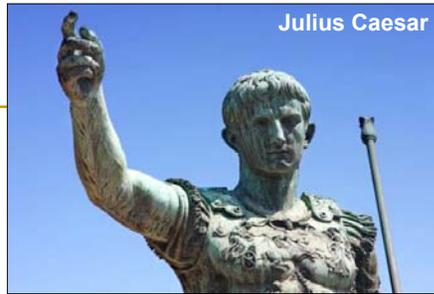


# International Calendar



by

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## Part 1 : Basic Knowledge

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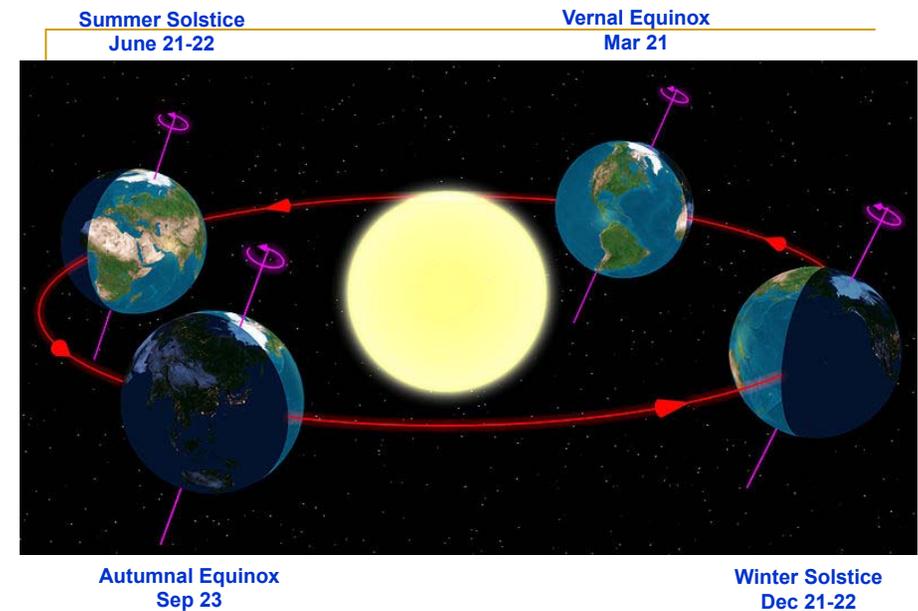
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# Calendar

- **Calendar** is a system that divides time to be day, month and year. It is easy for all people to use it.
- We see that the movement of the sun and the moon is cyclic. It has had a great influence on designing almost every calendar. Usually a calendar is consistent with the sun cycle (the cycle of the season) or the cycle of the moon phase, or both.
- People started to observe full moons and new moons. Then they developed how to count a year related to the season.
- **Day** is a time unit for the rotation of the Earth around itself.

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The world's Seasonal Chart

Source: <http://th.wikipedia.org/wiki/อายัน>

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## Lunar and Solar Years

**Equinox** is a vocabulary in astronomy. It means the time that the sun is perpendicular to the equator of the Earth. This will happen twice a year. On those days, the night time is equal to the daytime.

**Vernal Equinox** is on March 21. It is the Spring season in the northern hemisphere and the Fall season in the southern hemisphere. (Also known as Spring Equinox.)

**Autumnal Equinox** is on September 22. is on March 21. It is the Fall season in the northern hemisphere and the Spring season in the southern hemisphere. (Also known as Fall Equinox.)

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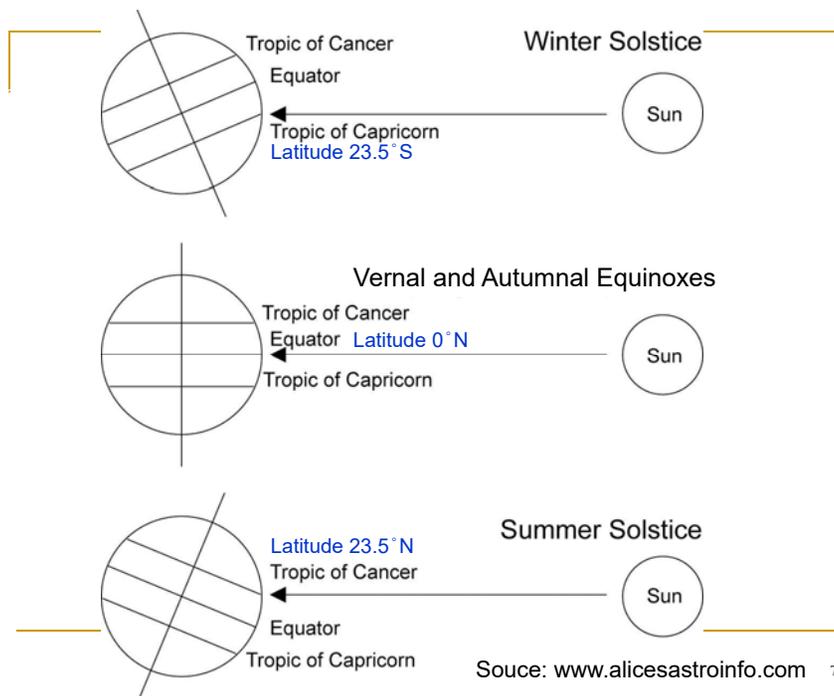
## Lunar and Solar Years (cont.)

**Solstice** In the orbit of the Earth around the sun, there is a phenomenon called "solstice" occurring twice a year.

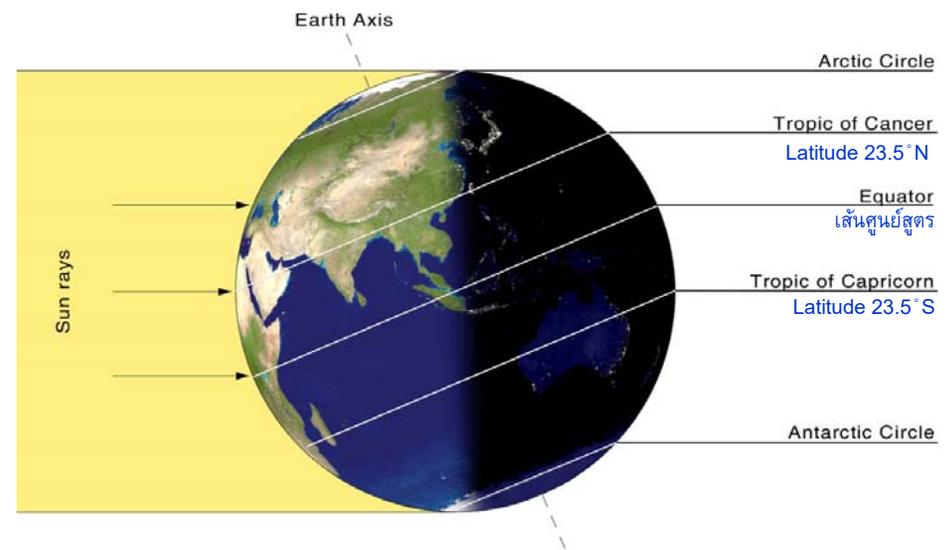
**Summer Solstice or North Solstice** is the day that the Sun is perpendicular to the Earth's surface at latitude 23.5 degrees north, which occurs on June 20 or 21.

**Winter Solstice or South Solstice** is the day that the Sun is perpendicular to the Earth's surface at latitude 23.5 degrees south, which occurs on December 22 or 23.

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## Calendar (cont.)

- **Year** is a time unit of the rotation of the Earth around the Sun for 1 cycle. It can be defined in many ways. We show only some definitions used widely.
  - **Sidereal Year** refers to the amount of time that the Earth moves 1 round around the Sun, using a star in the sky as a reference point. A sidereal year is 365.25636 days.
  - **Tropical Year** or **Solar Year** is the amount of time that the Sun (appearing to the Earth) moving from an Vernal Equinox to the next Vernal Equinox, which is 365.24219 days long. (Because of the tremors of the Earth's axis, Vernal Equinox moves along the equator. That made the sidereal year is 20-minute shorter.),

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## Calendar (cont.)

- Year that we use in the international calendar nowadays is the solar year.
  - We have many different calendars since the nature used for developing calendars does not units fitting perfectly with other units. For examples, day does not fit with year and month does not fit with year.
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## Calendar (cont.)

- We found that
    - 1) the number of days in a lunar month is not a whole number but between 29 and 30 days.
    - 2) the number days of a year is not a whole number but between 365 and 366 days. That made one year is between 12 and 13 lunar month.
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## Calendar (cont.)

- **Calendars** can be separated to be 4 main groups as the following:
    - 1) **Lunar calendars** are a calendars based on the moon's natural cycle by using the shape of the moon which is called the Moon age, which is related to the crescent of the full moon and the new moons. The duration of a month was set up to be closest to the cycle of the moon age. This will not be related to the cycle of the Sun. The only lunar calendar using nowadays is Moslem calendar.
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## Calendar (cont.)

2) **Solar calendars** are calendars based on the seasonal cycle. This is due to the movement of the Earth around the Sun. The best example of solar calendars is the Gregorian calendar using widest around the world.

3) **Lunisolar calendars** are calendar based on seasonal cycle and the cycle of the moon. These calendars used both the shape of the moon and the movement of the Earth around the Sun. An example of these calendars is Thai Lunisolar calendar. It is also called Thai Lunar calendar since it focuses on the cycle of the moon. This makes many people get confused.

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## Calendar (cont.)

4) **Other calendars** are calendars using the cycles of the sun or the moon very little. Some of them don't use those cycles at all. Some calendars may be consistent with astronomical cycles, such as the cycle of Venus.

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## Calendar (cont.)

- The oldest calendars used lunar months and years because of the ease of observation. However, most calendars are adjusted with the solar year. For exception, some calendars, such as the Hindu calendar and the Chinese calendar, are adjusted with the sidereal year.)
- **The international calendar** is the most widely used calendar in the world. It is called the **Gregorian solar calendar** or **Gregorian calendar**.

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## International Calendar

### Part 2 : Julian Calendar

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## Julian Calendar

- **Julian solar calendar** is also called Julian calendar. The Julian calendar is used since 45 BC. Julius Caesar assigned a Greek astronomer Sosigenes to improve the Roman calendar.
- The original Roman calendar uses the moon as an appointment and uses the sun and stars as a frame to determine a year. Some years has 12 lunar months but some has 13 lunar months. We also found that in Chinese and Indian calendars.
- Julian calendar does not use the moon as an appointment but uses days in each zodiac as an appointment by using the Sun and stars as a setting frame.

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## Julian Calendar (cont.)

- Using the Julian calendar, it was changed from the old calendar by setting for a cycle of 4 years, 3 years has 365 days and a year has 366 days. Therefore, one year in the Julian calendar is 365.25 days.
- 365.25 days is counting a round starting from a specific day to the next same day. It is day in the Spring that the daytime and the night time are equal. It is called **the starting day of the Aries** (Equinox of Spring) It was scheduled to be March 25 since it is believed that this calculation is correct.

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## Julian Calendar (cont.)

- In the year 325, there was a meeting for improving the Julian calendar in Nicaea or Nice since it was noticed that the beginning of the Aries moved from the original. They changed the beginning of the Aries to be on Mar 21.

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## Julian Calendar (cont.)

- Julian calendar was a popular European calendar until the end of the 16th century. **Each year has 365 days, but except for the year divided by 4, the number is 366 days** by adding February 29. For examples,
  - ❑ Since 404, 500 and 1500 can **be divided** by 4 there **is** February 29 on those years.
  - ❑ Since 401, 402 and 2001 can **not be divided** by 4 there **is not** February 29 on those years.

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## Julian Calendar (cont.)

■ Exercises – For the Julian calendar, consider if the following years has February 29.

- ❑ 1544
- ❑ 1600
- ❑ 1601
- ❑ 1700
- ❑ 1901
- ❑ 2200
- ❑ 2044

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- ❑ 2400

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## Julian Calendar (cont.)

- 1 year in the Julian calendar is 365.25 days but 1 year astronomical season. The solar year is 365.24219 days.
- So the error of each Julian calendar year comparing to the seasonal year is

$$365.25 - 365.24219 = 0.00781 \text{ day.}$$

Every 400 years, the error is  $0.00781 \times 400 = 3.124$  days  
or approximately 3 days.

- So the **Julian calendar is walking slower than the real sky**. We can say that Julian calendar adding too many days of February 29 **about 3 days for each 400 years**.

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## International Calendar

### Part 3 : Gregorian Calendar

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## Gregorian Calendar

- **Gregorian Solar Calendar** is the most commonly used calendar in modern times. It is widely used throughout the world, including Thailand. One calendar year is 365.2425 days (closer to 1 solar year or astronomical year or 365.24219 days rather than Julian calendar).

- So the error of each Gregorian calendar year comparing to the seasonal year is

$$365.2425 - 365.24219 = 0.00031 \text{ day.}$$

- The year containing February 29 is called **leap year**.

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- The year not containing February 29 is called **common year**.

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## Gregorian Calendar (cont.)

- The rules for adding February 29 are the following:
  - For a year not ending 00,
    - if that year can be divided by 4, it has February 29. (Leap year)
    - if that year can not be divided by 4, it does not have February 29. (Common year)
    - Notice that the calculation for the years not ending with 00 is as same as the calculation in the Julian calendar.

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## Gregorian Calendar (cont.)

- For a year ending 00,
  - if that year can be divided by 400, it has February 29. (leap year)
  - if that year can not be divided by 400, it does not have February 29. (Common year)
  - Notice that the years ending with 00 can be divided by 4. Therefore, in the Julian calendar they have February 29 but in the Gregorian calendar some years have February 29 but some don't.
  - Therefore, every 400 years the Gregorian has 3 days of February 29 lesser than the Julian calendar.

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## Gregorian Calendar (cont.)

- For examples,
  - in 1804, it doesn't end with 00 and can be divided by 4 it has February 29.
  - in 1901, it doesn't end with 00 and can not be divided by 4 it doesn't have February 29.
  - in 2000, it ends with 00 and can be divided by 400 it has February 29 ☺
  - in 2100, it ends with 00 and can not be divided by 400 it doesn't have February 29.

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## Gregorian Calendar (cont.)

- Exercises – For the Gregorian calendar, consider if the following years has February 29.
  - 1544
  - 1600
  - 1601
  - 1700
  - 1901
  - 2200
  - 2044
  - 2400

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## Gregorian Calendar (cont.)

- In October 1582, the Pope Gregory XIII
  - changed from Julian calendar to the new calendar with 365.2425 days a year. (We now call the Gregorian system.)
  - adjusted days to move faster. From the beginning of Christianity in the Roman Empire in the 3rd century, there were about 10 more extra days. That means the Julian calendar is moving too slow for 10 days.
  - decided to [remove October 5-14, 1582](#), from the official Roman calendar in order to the new calendar is more consistent with the season.

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A.D.	Countries Started to Use the Gregorian Calendar (Show only some countries.)	Number of Days taking off
1582	France (most areas), Italy, Poland, Portugal, Spain	10 days
1583	Austria, Germany (Catholic states)	10 days
1587	Hungary	10 days
1610	Germany (Prussia)	10 days
1752	Canada (most areas), United Kingdom (and colonies), United States (most areas)	11 days
1872/1873	Japan	12 days
1911/1912	China	12 days
1916	Bulgaria	13 days
1918	Estonia, Russia	13 days
1923	Greece	13 days
1926/1927	Turkey	13 days <sup>30</sup>