

# *Space Week, Calendars, Clocks and Time*

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Quiz!

Q1: Is the Earth closer to the sun in spring, summer, autumn or winter?

Q2: How many days are there in a year?

Q3: How many hours are there in a day?

Q4: How many minutes are there in an hour?

Q5: How many seconds are there in a minute?

Marking: Swap with your neighbour.

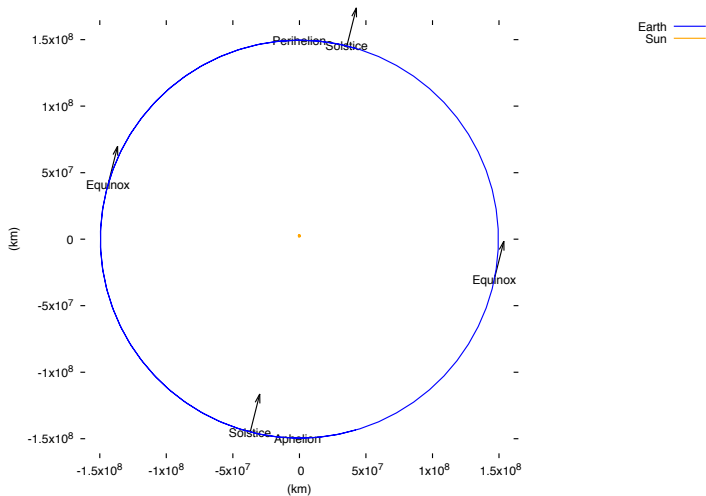


## Question 1

*Is the Earth closer to the sun in spring, summer, autumn or winter?*

- Spring, Summer, Autumn and Winter: all can be wrong!
- The sun's orbit is almost a circle.
- Perihelion was 2-1-2016 (147M km), Aphelion 4-7-2016 (152M km).
- You need to know which summer!

# Question 1



## Question 2

*How many days are there in a year?*

- In the modern calendar 365 or 366 days.
- Depending on leap year.
- Why leap years?
- Solar vs. Calendar days and years.

## Question 2

Solar year would be  $\approx 365.24219$  solar days.

If we leap every 4 years, average is:

$$365 + \frac{1 + 0 + 0 + 0}{4} = 365.25.$$

Too long by 0.00781 days per year, or almost 1 day in 100 years.

September 1752

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

## Question 2

New rule:

- If year is divisible by 400 it is a leap year, otherwise
- if year is divisible by 100 it is not a leap year, otherwise
- if year is divisible by 4 it is a leap year.

Gives

$$365 + \frac{97}{400} = 365.2425.$$

too long by 0.00031, or about one day in 4000 years.

## Question 3

*How many hours are there in a day?*

- Usually 24, but once a year we get 23 or 25.
- For Daylight Savings.
- Idea: If the sun is up, we could be too.
- First brought in in first world war.

30 October 2016

Sun 30 Oct 2016 00:00:00 IST	Sun 30 Oct 2016 13:00:00 GMT
Sun 30 Oct 2016 01:00:00 IST	Sun 30 Oct 2016 14:00:00 GMT
Sun 30 Oct 2016 01:00:00 GMT	Sun 30 Oct 2016 15:00:00 GMT
Sun 30 Oct 2016 02:00:00 GMT	Sun 30 Oct 2016 16:00:00 GMT
Sun 30 Oct 2016 03:00:00 GMT	Sun 30 Oct 2016 17:00:00 GMT
Sun 30 Oct 2016 04:00:00 GMT	Sun 30 Oct 2016 18:00:00 GMT
Sun 30 Oct 2016 05:00:00 GMT	Sun 30 Oct 2016 19:00:00 GMT
Sun 30 Oct 2016 06:00:00 GMT	Sun 30 Oct 2016 20:00:00 GMT
Sun 30 Oct 2016 07:00:00 GMT	Sun 30 Oct 2016 21:00:00 GMT
Sun 30 Oct 2016 08:00:00 GMT	Sun 30 Oct 2016 22:00:00 GMT
Sun 30 Oct 2016 09:00:00 GMT	Sun 30 Oct 2016 23:00:00 GMT
Sun 30 Oct 2016 10:00:00 GMT	
Sun 30 Oct 2016 11:00:00 GMT	
Sun 30 Oct 2016 12:00:00 GMT	

## Question 4

*How many minutes are there in an hour?*

- 60.

Humans got hours by cutting days into 24 parts minutes by cutting hours into 60 parts.

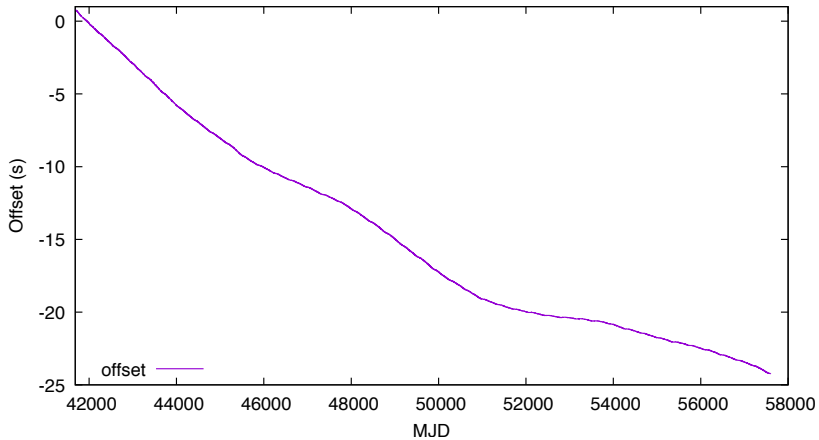
## Question 5

*How many seconds are there in a minute?*

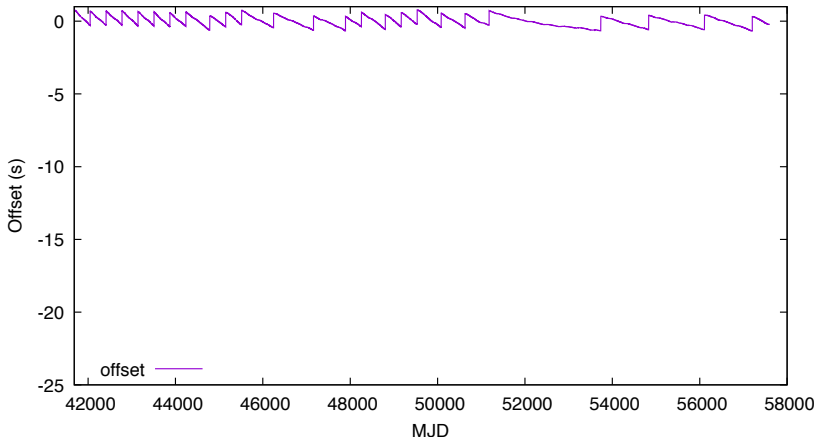
- Mostly 60, but sometimes 61!
- Modern seconds come from atomic clocks.
- Atomic clocks are very accurate.
- The Earth is slowing down though!
- December 31 2016 will have 23:59:60 GMT!



TAI UT1 offset, Feb 73 to Oct 16



UTC UT1 offset, Feb 73 to Oct 16



## *Summary*

- Years/Seasons caused by Earth's axis pointing to/from sun.
- Days caused by Earth's rotation on axis.
- We need leap years to keep them in line.
- Hours and minutes don't have link to astronomical world.
- Seconds come from atomic clock.
- We have leap seconds to keep them in line with the astronomy.