SUBJECT 3: SEASONS & SUN POWER

Task 1 💻 Internet + Spread sheet

1. Find the sunrise and sunset times on the first and the 16th of each month of the year at the place you live in.
2. Work out the duration of a solar day: round off your answer to the nearest minute.
3. Draw a diagram that gives the duration of the solar day in terms of the date.
4. Send your results to your peers from abroad: draw a diagram to compare each region. What is your conclusion?

Task 2: Solstice, equinox (Video)

Watch the video and fill in the blanks

The seasons are caused by the _ _ _ _ of the Earth's rotational axis away or toward the sun as it travels through its year-long path around the sun.

The Earth has a tilt of _ _ _ _ degrees relative to the "ecliptic plane" (the imaginary surface formed by it's almost-cicular path around the sun).
The tilt toward the sun is maximized during Northern Hemisphere summer in late June : This is the "_ _ _ _ _ _ _ _ _ _ _ _ _ _ _". At this time, the amount of sunlight reaching the Northern Hemisphere is at a _ _ _ _ _ _ _ .

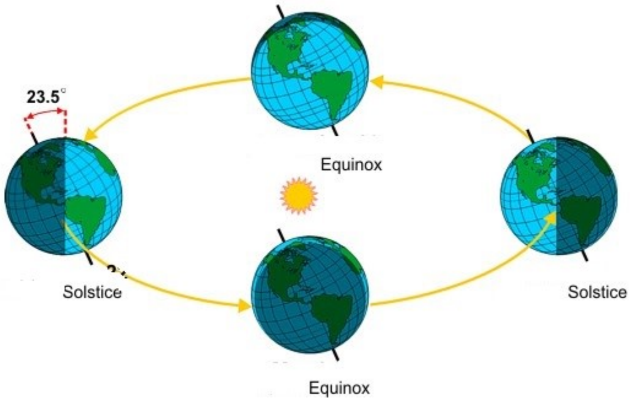
In late December, on the date of the "_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ ", the Earth's tilt away from the sun is maximized, leading to a _ _ _ _ _ _ _ of sunlight reaching the Northern Hemisphere.

The seasons are reversed in the Southern Hemisphere : The tilt toward the sun is maximized during Southern Hemisphere summer in late _ _ _ _ _ _ _ _ .

This is the "_ _ _ _ _ _ _ _ _ _ _ _ _ _ _". At this time, the amount of sunlight reaching the Northern Hemisphere is at a _ _ _ _ _ _ _ .

In late _ _ _ _ , on the date of the "_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ ", the Earth's tilt away from the sun is maximized, leading to a _ _ _ _ _ _ _ of sunlight reaching the Southern Hemisphere.

Task 3 Match the words with their definitions:



Summer Solstice	●	●the imaginary surface formed by it's almost-cicular path around the sun
Winter Solstice	●	●occurs when the tilt of Earth’s axis is most inclined away from the Sun
Tilt	●	●at this time the tilt of the Earth’s axis is inclined neither away from nor towards the Sun
Equinox	●	●An inclination from the horizontal or vertical; a slant
Ecliptic plane	●	●occurs when the tilt of Earth’s axis is most inclined toward the Sun

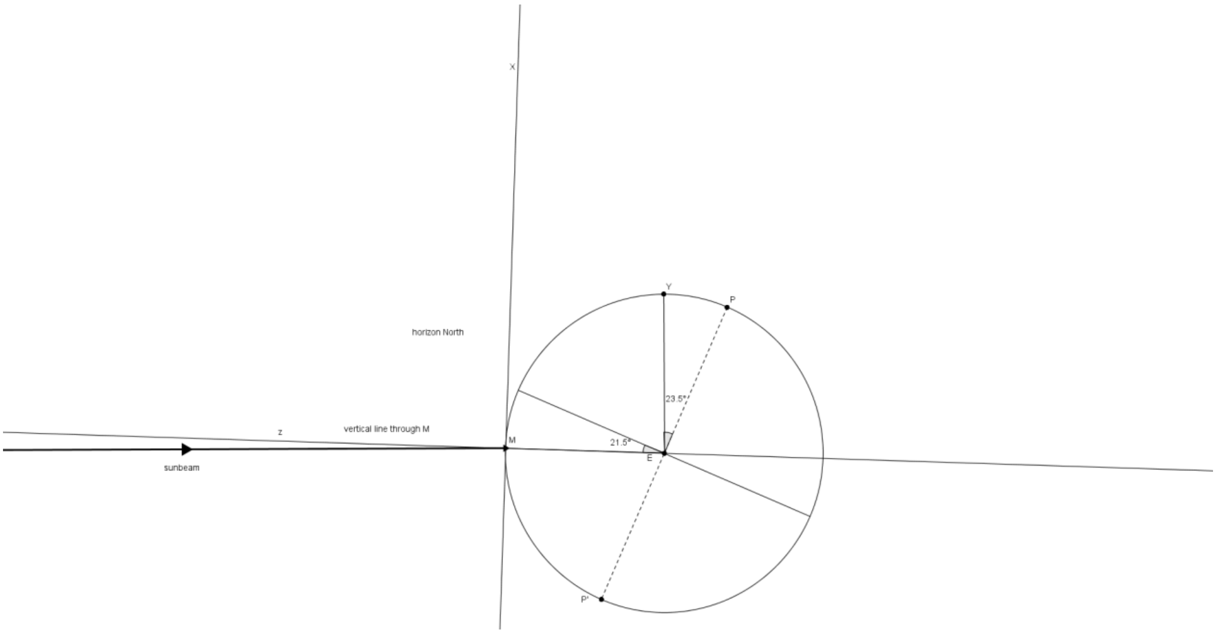
Task 4: The Sun’s height at noon (/2)

The aim of the following problem is to compute the height of the Sun above the horizon at noon at the summer solstice, then at the winter solstice.

We’ll consider the Earth’s orbit is a circle, and its axial tilt is approximately 23.5°.

<u>Summer solstice at solar noon in Reunion (21.5°S)</u>

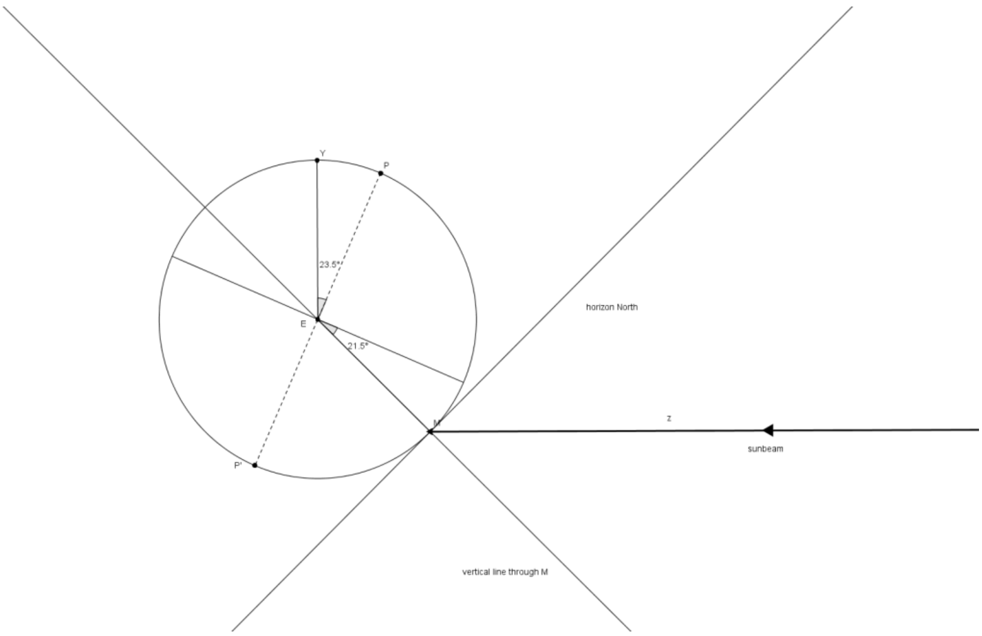
Below, the bold line represents a sunbeam. We assume it is solar midday in Reunion. [Mz) is vertical with respect to the horizon and [Mx) shows horizon North.



1. Determine the angle that horizon North makes with the sun’s direction $\widehat{xMs}$, which is called sun’s height.
2. Find the relationship between the sun’s height h and the latitude φ.

<u>At the winter solstice solar noon in Reunion (21.5°S)</u>

Repeat the process for winter solstice.



Task 5 💻 Heat absorbed by the ground (/3)

We intend to work out the quantity of solar energy absorbed by the ground, first at winter solstice, secondly at summer solstice at a given latitude. The atmosphere's absorption is neglected in this problem. The sun's height is given by the formula:

$$\sin h = \sin\varphi \sin\delta + \cos\varphi \cos\delta \cos H,$$

given:

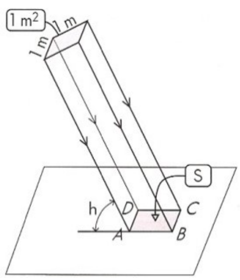
H: hour angle (0° at noon, varying of 15° per hour)
δ: The declination of the Sun(angle between the rays of the Sun and the plane of the Earth's equator)
φ: latitude of the place.

At solstices, the angle between the rays of the Sun and the plane of the Earth's equator reaches its maximum value of 23°26'. Therefore δ = +23°26' at the northern summer solstice and δ = −23°26' at the southern summer solstice. At the moment of each equinox, the centre of the Sun seems to pass through the celestial equator, and δ is 0°.

The latitude of Reunion is φ =-21.5° (S).

<u>For each solstice :</u>

1. Find the hours of sunrise and sunset (solar hour).
2. A sunbeam of section 1m² lightens and heats the horizontal ground.



Calculate the area of the surface ABCD in terms of h.

3. The power of the sunbeam is 1370 W. Compute the power received by 1m² of horizontal surface in terms of h.
4. Compute the sun's height and the power received by 1m² every hour (spreadsheet).
5. Compute the total power received by 1m² of horizontal ground all day long and draw a chart.
6. Repeat the process with the latitude of New Delhi, then of Paris.
7. Compare.

Task 6

Write an article of 10 lines for the blog that explains the phenomena of seasons using the words : TILT – SOLSTICE- EQUINOXE-SUN POWER-LENGTH OF THE DAY-SOUTHERN HEMISPHERE-HEIGHT OF THE SUN-LATITUDE