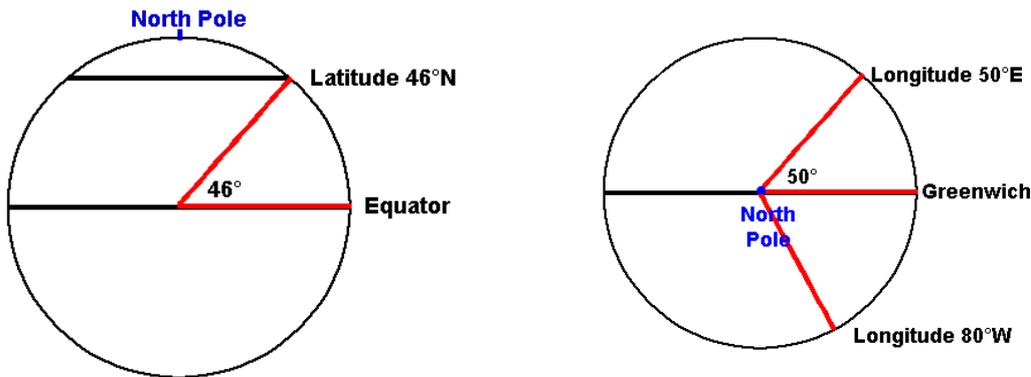


Help! Where am I?

To determine the position of a point on Earth, we normally use coordinates, which are a little bit like the coordinates in a Cartesian coordinate system. But instead of lines, there are the meridians and the parallels. The Equator represents the x -axis and the Greenwich meridian the y -axis.

Part 1: Definitions



1. Using the words below, define the *latitude* of a point on Earth as precisely as possible!

angle – centre of the Earth – Equator – North – South

The Latitude of a point is the angle measured at the centre of the Earth, between the Equator and where you are. It is expressed either north or south, and varies from 0° to 90° .

2. The same question for the *longitude* of a point.

angle – centre of the Earth – Greenwich Meridian – East -West

The Longitude of a point is the angle at centre of the Earth, between where you are and Greenwich. It can be measured either east or west and varies from 0° to 180° .

Part 2: Distances on earth using spherical coordinates

1. Using the site tools.freeside.sk/geolocator/geolocator.html, find out which towns are having respectively the following coordinates:

($48^\circ 50' 11''$ N, $2^\circ 19' 48''$ E): **Paris**

($41^\circ 48'$ N, $12^\circ 38'$ E): **Rome**

($33^\circ 25'$ S, $70^\circ 42'$ W): **Santiago (Chile)**

Notation used: $2^\circ 19' 48''$ means $(2 + \frac{19}{60} + \frac{48}{3600})^\circ$ or $2^\circ 19$ min 48 sec

2. Knowing that the radius of the Earth is approximately 6 367 km, find the length of a meridian.

$2 \times \pi \times 6\,367 \text{ km} = 12\,734 \times \pi$, which is approximately 40 005 km.

3. Use the answers above to find the distances between:

- a. Paris and the North Pole; $(90^\circ - (48+50/60+11/3600)) \times 40\,005 / 360 = \text{about } 4\,574 \text{ km}$
 - b. Paris and the Equator: $(48+50/60+11/3600) \times 40\,005 / 360 = \text{about } 4\,574 \text{ km}$
 - c.
 - d. Rome and the South Pole; $(90 + 41+48/60) \times 40\,005 / 360 = \text{about } 14\,646 \text{ km}$
 - e. Rome and the Equator. $(41+48/60) \times 40\,005 / 360 = \text{about } 4\,645 \text{ km}$
4. What are the coordinates of Saint-Valery-en-Caux? You can use the following site: en.wikipedia.org $49^\circ 51' 50'' \text{ N}, 0^\circ 42' 28'' \text{ E}$
 5. Two points on Earth that are *diametrically opposite* are called *antipodes*.
 - a. In which country is the antipode of Saint Valery situated? **The coordinates of the antipode of Saint Valery are $49^\circ 51' 50'' \text{ S}, 179^\circ 17' 32'' \text{ W}$ which is in the Pacific Ocean next to New Zealand.**
 - b. Where is the antipode of Santiago situated? **The coordinates are $33^\circ 25' \text{ N}, 109^\circ 18' \text{ E}$: This is in China.**
 6. Anchorage (Alaska, USA) and Saint Petersburg (Russia) are diametrically opposite on the polar circle.
 - a. Find the coordinates of these towns to verify this information.

Anchorage: $61^\circ 13' 6'' \text{ N}, 149^\circ 53' 57'' \text{ W}$

Saint Petersburg: $59^\circ 56' 0'' \text{ N}, 30^\circ 20' 0'' \text{ E}$

The polar circle is situated at approximately 66° N , so the two towns are both almost situated on it. $149^\circ 53' 57'' + 30^\circ 20' 0'' = 180^\circ 13' 57''$. This information seems correct.

- b. A plane has to go from the airport of Anchorage (Alaska, USA) to Saint Petersburg (Russia). It can either travel along the polar circle, or via the North Pole. The pilot wants to go there as quickly as possible. Which advice can you give him? (*Hint: Use Pythagoras' theorem, trigonometry*)

Along the polar circle: To find the length of the polar circle, we have to find its radius R. Using Pythagoras' theorem and trigonometry:

$R^2 = 6,367^2 + (6367 \times \cos 30^\circ)^2$ which is about 3,183 km. The distance travelled would therefore be 3,183 km x pi, which is appr 10,000 km.

Via the North Pole: $(30^\circ + 30^\circ) \times 40,005 / 360$ which is about 6667 km.

The pilot should therefore choose the second path.