1. The Earth and the Graticule

Make friends with maps!

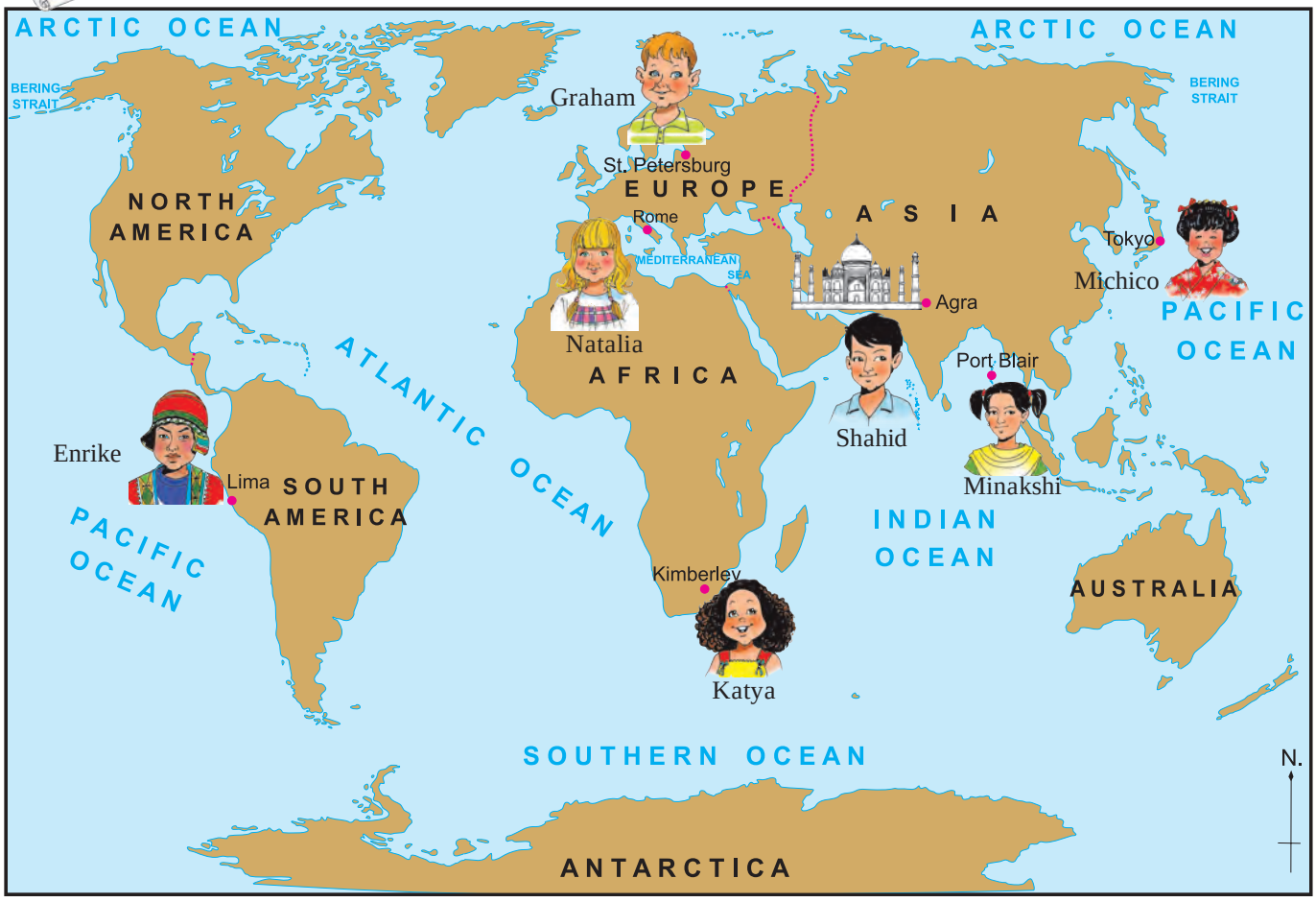


Figure 1.1 : World

Observe figure 1.1 and answer the following questions:

- Which places are shown on the map?
- In which city is the Taj Mahal located?
- In which continent is the Taj Mahal located?
- In which direction is the Taj Mahal located for Graham in St. Petersburg, for Katya in Kimberley, for Michico in Tokyo and Minakshi in Port Blair?
- Shahid in Agra is specifying the directions in which the others live. How will he express them?
- In what direction will Natalia in Rome and Enrike in Lima say the other child lives? Will their answers be the same?

Graham, Katya, Michico, Natalia, Minakshi, Shahid and Enrike have answered the above questions differently using directions and subdirections. The Taj Mahal is located at one and the same place and that is Agra. However, when each one of the children told the direction from their respective places, their answers were different. This means that the use of directions alone does not help us to accurately describe the location of a place. That is why, it became necessary to find a new system to state the precise location of any place on the earth.

Let us see what it is!

Think a little!

Observe the globe in your school. Think about the following questions and then discuss them.

- There are some vertical and horizontal lines on the globe. Which of these lines are more in number?
- What labels do these lines have? What similarities and differences do you see in the labels?
- Will it be possible to actually draw such lines on the earth?

Explanation

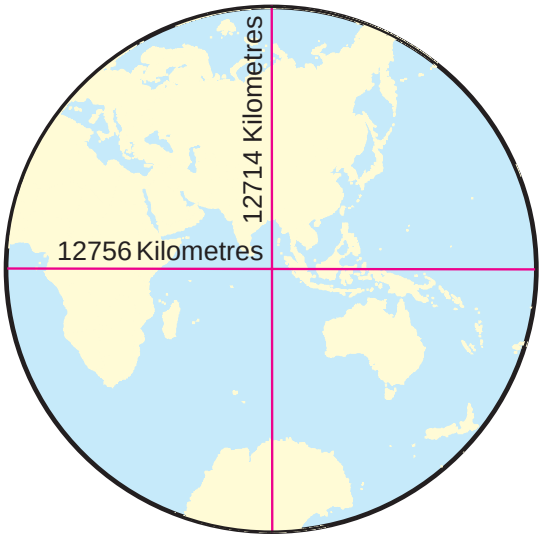


Figure 1.2 : Earth's Size

Figure 1.2 shows the lengths of the east-west and north-south diameters of the earth. This will give you some idea about the size of the earth. Oceanic waters, uneven nature of the land, forests, innumerable islands of different sizes, and buildings make it impossible to actually draw such lines on the earth. In order to overcome this difficulty, geographers developed a miniature model of the earth in the form of a globe. This can be used to determine locations on the earth. One can actually draw horizontal and vertical lines on a globe though not on the earth. Thus, they are imaginary lines on the earth.

⁎ Angular Distance

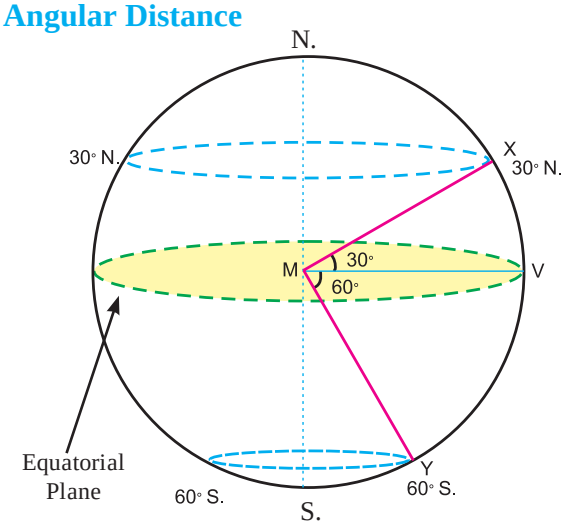


Figure 1.3 : Angular Distance – 1

The location of any place on the earth is determined with reference to the centre of the earth. In order to do it, we consider a straight line joining the point on the surface and the centre of the earth. At the centre, it makes an angle with the plane of the equator. The measure of this angle is used in determining the locations. For example, in figure 1.3, the measure of angle XMV is 30°. That is, its angular distance from the equator is 30°. Look at the figure and tell the angular distance of 'Y' from the equator.

Figure 1.3 shows another plane. It passes through X. It is parallel to the plane of the equator. Observe figure 1.3 and see how it meets the surface of the earth. Note that it forms a circle on the surface. Any point on this circle and the equatorial plane form an angle of 30° at the centre of the earth.

Do it yourself !

Use figure 1.4 for the following:

- In the upper portion of the circle, at the centre X, draw angles of 20°, $V_1X\ K_1$ and $V_2X\ K_2$; K_1 and K_2 being the points on the circle. Draw an ellipse joining K_1 and K_2.
- In the lower half of the circle, mark angles of 60° and name the points on the circle as P_1 and P_2.
- Draw an ellipse joining P_1 and P_2.

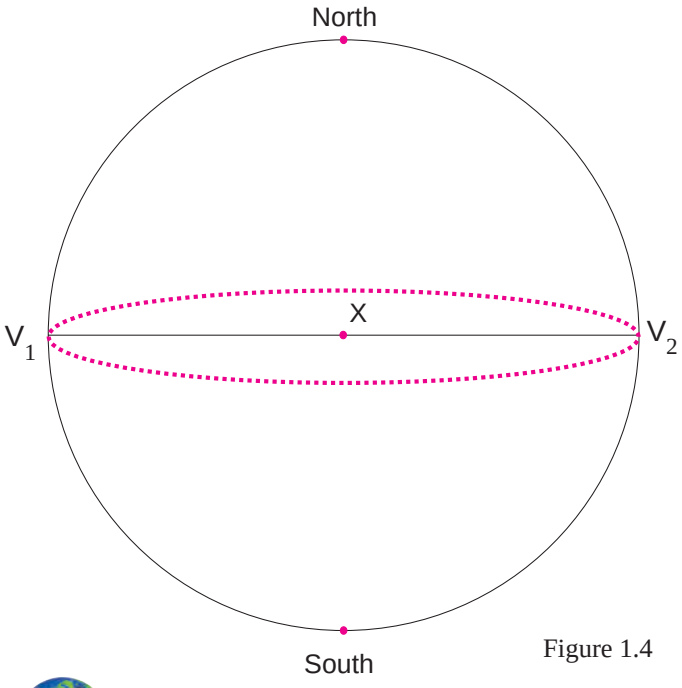


Figure 1.4

Can you tell?

- Are the distances between K_1 K_2 and P_1 P_2 the same?
- Compare the distances XK_1 and XP_2. Are these distances the same or are they different?
- Now compare the ellipses you have drawn.
- Which is the larger ellipse? Why?

Explanation

⁎ Parallels of Latitude

You must have realized that the ellipse drawn by joining the 20° points is larger than the ellipse that joins the 60° points. However, the distances X K_1 and X P_2 are the same. This is because we are dealing with a sphere.

Note that though these lines appear to be ellipses in the diagram, on the globe they are circles. The circles thus created at some angular distance from the centre of the earth are parallel to one another. Hence, they are called parallels of these latitudes . The values of parallels are angular measures expressed in degrees.

The degrees of the parallels are measured from

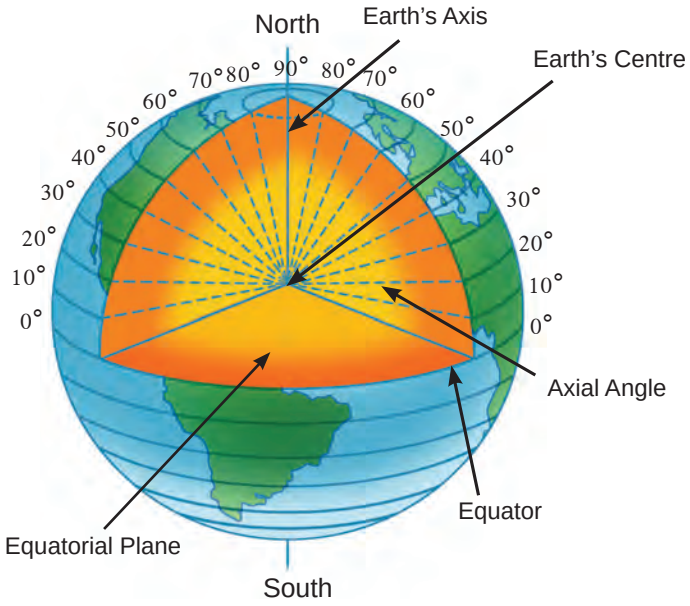


Figure 1.5 : Parallels of Latitude

the equator as shown in figure 1.5. That is why, the equator is considered as 0° parallel. It is the largest parallel, and also a great circle. The angular distance of other parallels towards north and south goes on increasing away from the equator.

Use your brain power!

Explain the meaning of the term equator.

The equator bisects the earth into north and south parts. The one to the north is called the northern hemisphere while the one to the south is called the southern hemisphere . Towards the north and south of the equator, parallels of latitude progressively become smaller and smaller. On the globe (and also on the earth), at the north and south ends of the earth's axis, they appear as points. These are called the North Pole and the South Pole respectively.

While mentioning the value of a parallel, it is necessary to mention whether it is in the northern or southern hemisphere. The parallels from the northern hemisphere are referred to as 5°N, 15°N, 30°N, 50°N whereas the parallels from the southern hemisphere are referred to as 5°S, 15°S, 30°S, 50°S.

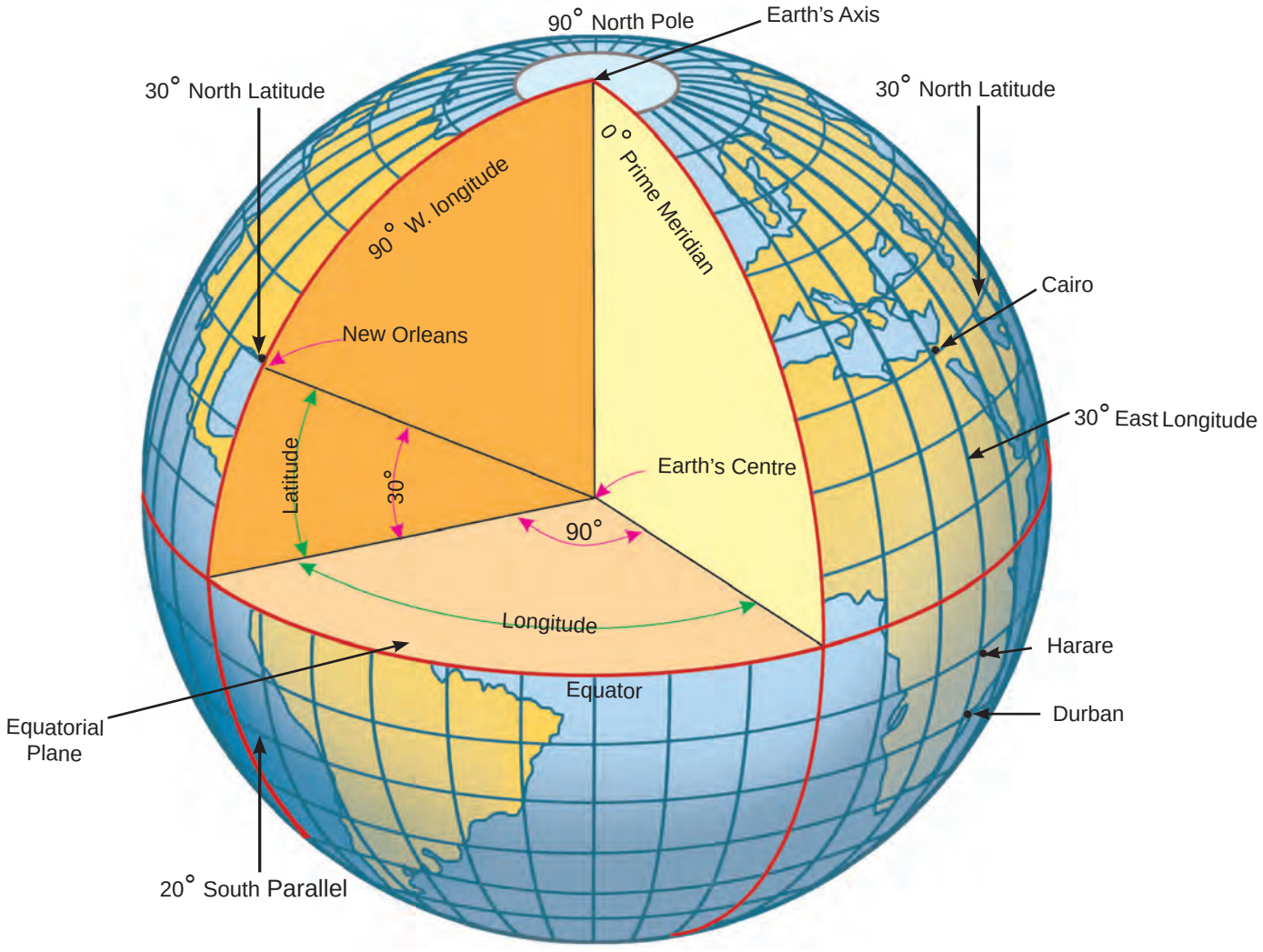


Figure 1.6 : Earth's Angular Measurements

A line joining all the places located to the north of the equator at an angular distance of 30° is 30° north parallel. Hence, all the places on this parallel will be at the same latitude, which is 30°N. New Orleans in North America, Cairo in Africa or Basra and Lhasa in Asia are all located on 30°N parallel. The same concept holds good for all other parallels. See figure 1.6.

One can draw 181 parallels on the earth at the interval of 1°.

- At 0°, that is, the equator.
- 90 parallels in the northern hemisphere –1°N to 90°N.
- 90 parallels in the southern hemisphere –1°S to 90°S.

Do it yourself !

- Take an orange and peel off its skin. You will see the segments inside and thin vertical lines on them.
- Carefully take out one segment. Observe the segment and the gap it has left in the orange. See figure 1.7
- See if the shape of the central and terminal portion of the segment is the same or different.
- See if the angle of the gap is the same at all points.
- Find how many segments are there in an orange.

Figure 1.7

- An orange is spherical, with a circular cross section. There are 360° in a circle. The earth being spherical, we consider 360° with respect to the earth as well.

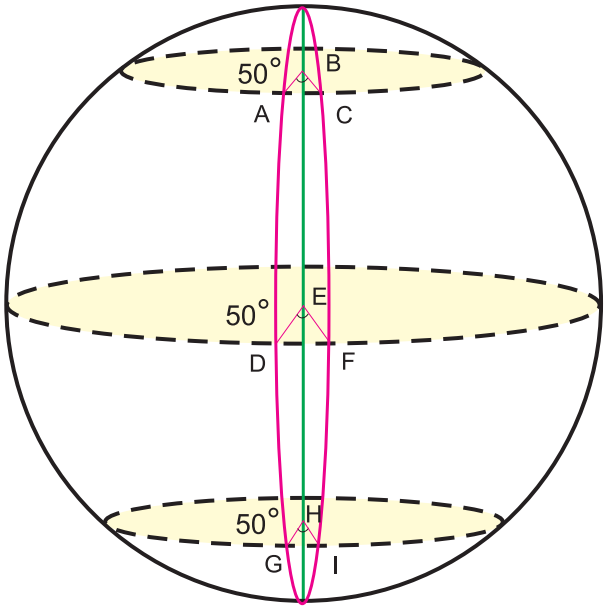


Figure 1.8 : Angular Distance – 2

In figure 1.8, ∠ABC, ∠DEF, ∠GHI have the same measure, 50°. However, the distances between A and C, D and F and G and I, are different when measured on the earth's surface. That is because the earth is spherical in shape.

Do it yourself !

Use figure 1.9 to do the following:

Let the line AM be 0°.

- Draw the line MB. Measure the angle it makes with the line AM and write it near B. Note the semicircle that passes through B and joins the North and South Poles. Trace it.
- Now join MC. Measure ∠AMC and write it next to C. Draw a semicircle that passes through 'C' and joins the North and South Poles.
- Draw a line that passes through point A at 0°, and joins the North and South Poles.

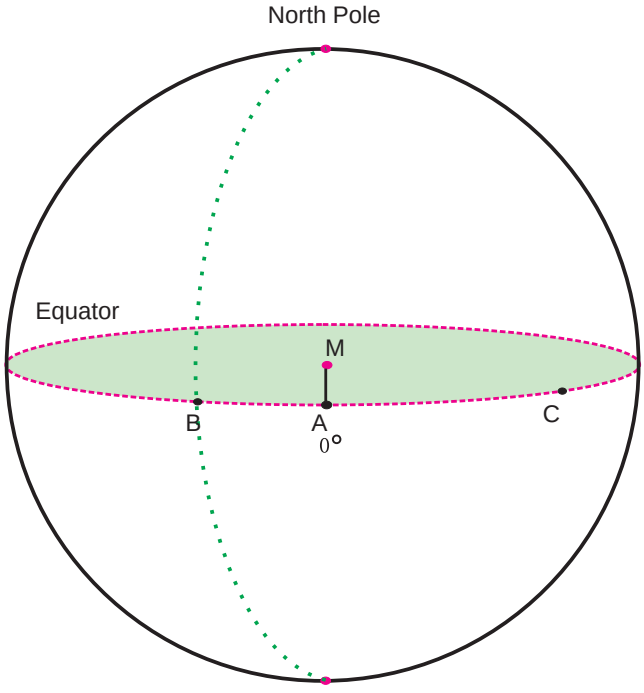


Figure 1.9

Explanation

⁎ Meridians of Longitude

You will realize that the lines drawn from points A, B and C make angles at M, the centre of the earth on the plane of the equator. Through these points, we can draw semicircles joining both the poles. Starting with point A, we can draw similar semicircles through points placed at each degree. These semicircles are known as meridians of longitude.

One of these meridians is considered to be 0°. It is known as the Prime Meridian. The angular distances of the other meridians from the Prime Meridian are measured in degrees and are called longitudes. You have done this in the activity based on figure 1.9. The 0° and 180° meridians lie opposite on the globe, forming a circle. This circle divides the earth in the eastern and western hemispheres. All meridians are equal in size.

Meridians in the eastern hemisphere are labelled as 10° E, 25° E, 135° E, etc. while in the western hemisphere they are labelled as 10° W, 25° W, 135° W etc.

30° E is the semicircle that joins all places at an angular distance of 30° from the Prime Meridian. Some of them are Cairo, Harare and Durban in Africa. See figure 1.6.

Though the earth is huge in size, we can tell the exact location of places on the earth using latitudes and longitudes. Note that the distance between two adjacent parallels is the same everywhere but the distance between two adjacent meridians is not the same everywhere. We can see this even on the segment of an orange. The distance between the meridians is the maximum on the equator and goes on reducing towards the Poles. At the Poles it is zero.

The distance between any two adjacent parallels is 111 km on the surface of the earth. The distance between two adjacent meridians is also 111 km on the equator. To locate the places within this distance of 111 km exactly, we need to divide the unit degree into smaller units. Degrees are divided into minutes, and minutes into seconds. Conventionally, latitudes and longitudes are expressed into degrees, minutes and seconds. Each degree is divided into 60 minutes and a minute into 60 seconds. These values are expressed using the symbols degrees (…°), minutes (…'), seconds (…").

In all, we can draw 360 meridians, each at a distance of 1°.

- 0° Prime Meridian
- 180° meridian
- 1° East to 179° East meridians. Thus, we have 179 meridians in the eastern hemisphere.
- 1° West to 179° West meridians. Thus, 179 meridians in the western hemisphere.

Think a little!

A game of reading the meridians on the world map is going on. Shaheen and Sanket are asking each other to locate places on specific meridians and are making notes of the same. Shaheen asks Sanket to locate Wrangel Island on 180° meridian. Sanket could locate the island in the map but both are confused while making a note of it. They are puzzled whether to write 180°E or 180°W? What would be the precise answer? Please help them. Can we use a similar logic with reference to 0° meridian as well?

Do you know?

The distance between any two consecutive meridians is different on different parallels. It is maximum on the equator and it is zero on both the Poles.

Equator – 111km.
Tropic of Cancer/Capricorn – 102 km.
Polar circles (Arctic / Antarctic) – 44 km
Poles (North / South) – 0 km

✻ The Graticule

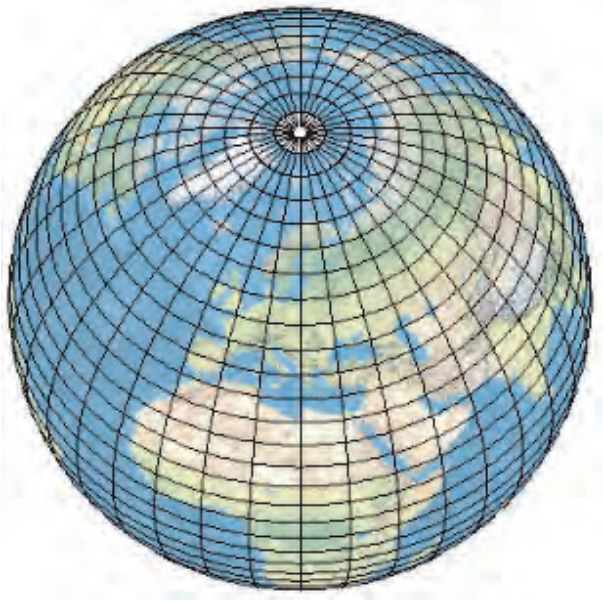


Figure 1.10 : The Graticule

The parallels and meridians on the globe form a net that is called a graticule. This facilitates determining the location of a place. See figure 1.10

Thus we use latitude and longitude for determining the locations on the earth. This method is being used even in today's modern age quite effectively. Geographical Information System (GIS), Global Positioning System (GPS) as also Google Maps, Wikimapia and Bhuvan of ISRO on the internet also make use of latitudes and longitudes. This technology is also available on mobile phones and motor cars.

Figure 1.11 : G.P.S. Instrument

Do you know?

Indian Regional Positioning System:

India has achieved self-reliance in Global Positioning Technology. With the help of IRNSS (Indian Regional Navigation Satellite System), locating any place in the Indian subcontinent is going to be easy. For this, India is launching its own series of 7 satellites. It will then be possible to locate any place in the region of South Asia and the Indian Ocean precisely.

Use your brain power!

How many parallels and meridians can be drawn on a globe at an interval of 10°?

I can do this!

- *Express the angular measures of latitude and longitude on a globe/map.*
- *Read parallels of latitude and meridians of longitude.*
- *Draw a graticule on a spherical object.*

Exercises

(A) Place a tick mark ✓ against the correct option.

(1) What term is used for the imaginary east-west horizontal lines on the earth?

Meridians ☐ International Date Line ☐
Parallels ☐

(2) What is the shape of the meridians?

Circular ☐ Semicircular ☐
Points ☐

(3) What do the parallels of latitude and meridians of longitude together form on the globe?

Angular distance ☐
Hemisphere ☐ Graticule ☐

(4) How many parallels are there in the northern hemisphere?

90 ☐ 89 ☐ 91 ☐

(5) Which circle forms the eastern and western hemispheres?

0° parallel and 180° meridian ☐
0° Prime Meridian and 180° meridian ☐
North and South Polar circles ☐

(6) Which circle appears as a point on the globe?

Equator ☐ North / South Pole ☐
Prime Meridian ☐

(7) How many places on the earth may be located on 45°N parallel?

one ☐ many ☐ two ☐

(B) Observe a globe and examine the following statements. Correct the wrong ones.

(1) Parallels of latitude lie parallel to the Prime Meridian.

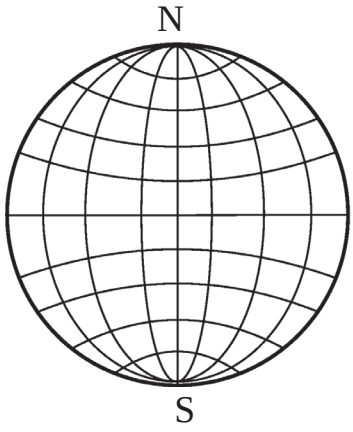
(2) All parallels of latitude converge at the equator.

(3) Parallels and meridians are imaginary lines.

(4) 8° 4' 65" is a north meridians.

(5) Meridians are parallel to each other.

(C) Find the correct graticule out of the following and put a tick mark ✓ against it.



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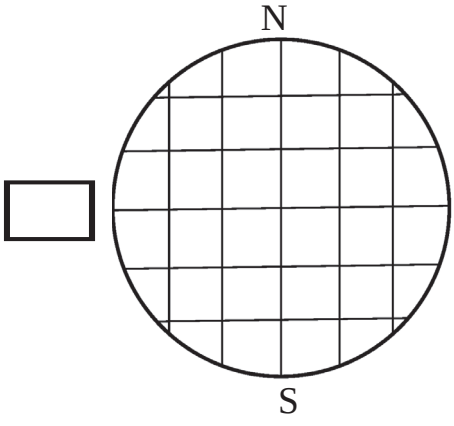

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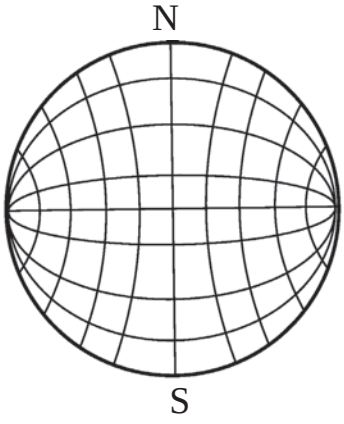

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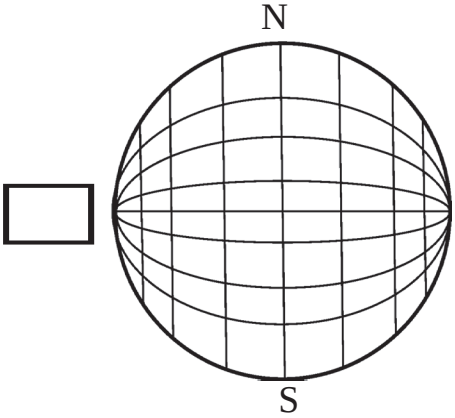

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(D) Answer the following :

(1) How will you express the latitude and longitude of the North Pole?

(2) How much is the angular distance between the Tropic of Cancer and Tropic of Capricorn?

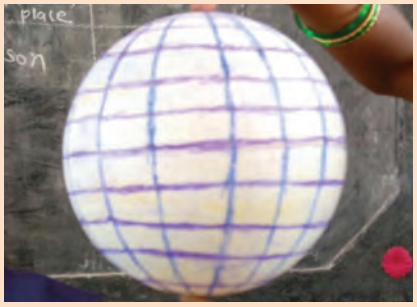
(3) Using a globe, write down the names of the countries through which the equator passes.

(4) Write down the main uses of the graticule.

(E) Complete the following table.

Characteristics	Parallels of latitude	Meridians of longitude
Shape		
Size	Size of each parallel is different.	
Distance		Distance between two meridians is larger on the equator and the same decreases towards the Poles.

Look at the photographs.



❊ Activity

Try to draw a graticule on a ball.

Graticule for special children.

Websites for reference

- http://www.kidsgeog.com
- http://www.youtube.com
- http://www.wikihow.com
- https://earth.google.com

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