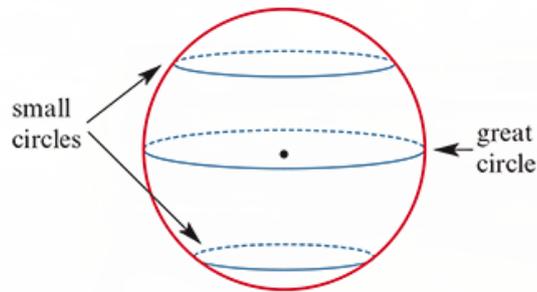*The earth can be approximated as a sphere with a radius of 6,400 km.*

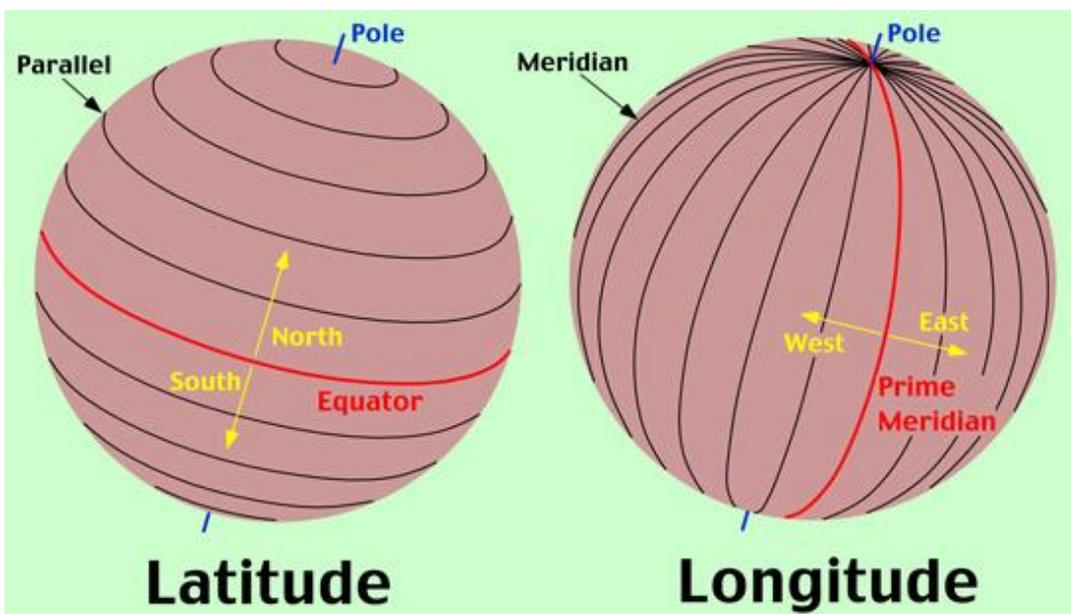# GREAT CIRCLES and SMALL CIRCLES on a SPHERE

A **great circle** on a sphere has the same diameter as the sphere itself. The centre of a great circle is the centre of the sphere.

The **equator** is a great circle.

A small circle has a diameter less than the sphere's diameter, and the centre of a small circle is NOT the centre of the sphere.

CIRCLES of LATITUDE and LONGITUDE

Parallels of **latitude** are small circles that lie in an orientation parallel to the equator.

The **meridians** of **longitude** are half great circles that pass through the north and south poles.

Any position on the earth's surface can be specified by co-ordinates: (latitude, longitude). The meridians and the parallels of latitude cover the earth in a grid:
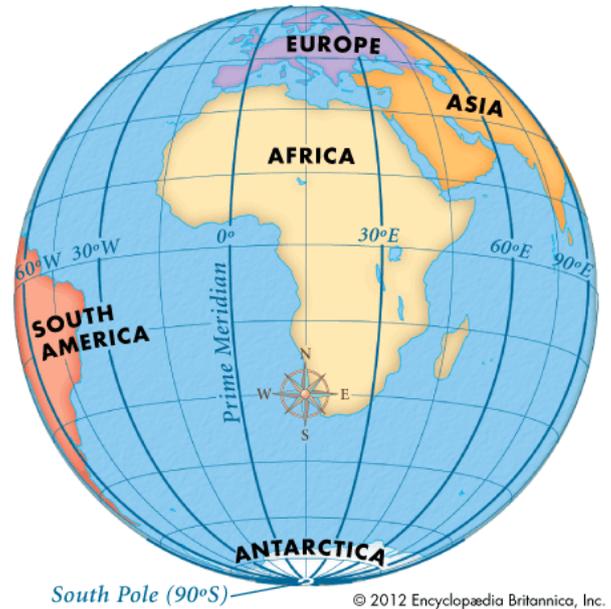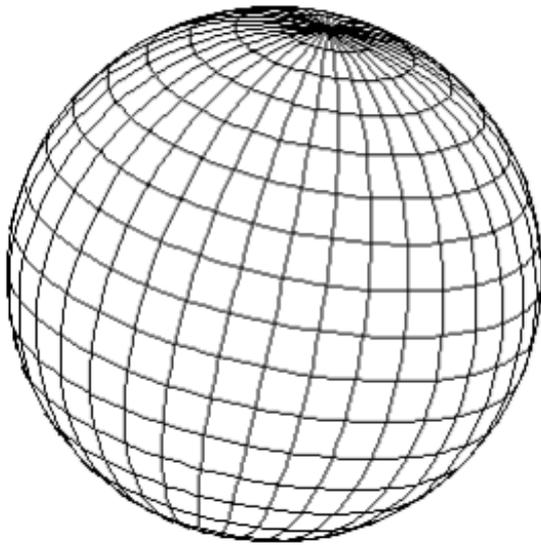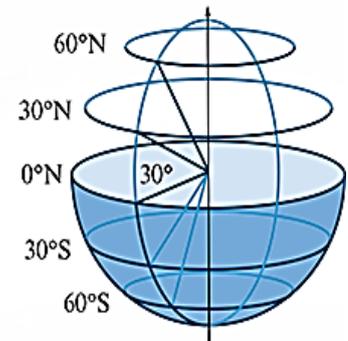

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Latitude

The blue lines in the diagram opposite are parallels of latitude. The latitude of a point on a sphere is the elevation of the point from the plane of the equator.

- The equator has latitude $0°N$.
- The North Pole has latitude $90°N$.
- The South Pole has latitude $90°S$.

In the diagram the latitudes $60°N$, $30°N$, $60°S$ and $30°S$ are shown.

In the diagram opposite, the Earth has been sliced in half along a great circle. The vertical line through the poles is perpendicular, or at $90°$, to the plane of the equator.

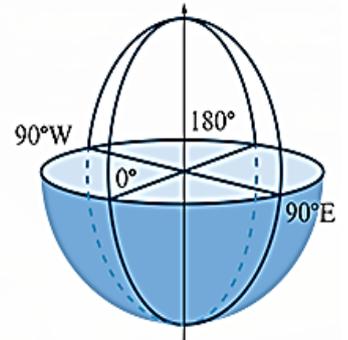If the earth is cut in half vertically the parallels of latitude would look like this:

South Pole
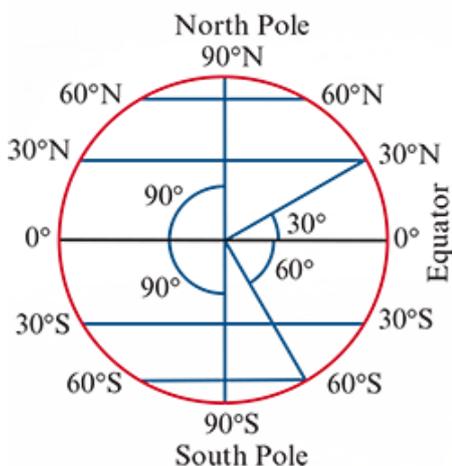
Longitude and the prime meridian

Lines of longitude are measured in degrees east or west of the *prime meridian* ($0°$).

The lines of longitude shown in the diagram opposite are $0°$, $90°E$, $180°$ and $90°W$. Note that you don't need to add E or W to the $0°$ or the $180°$.

90°W 180° 0° 90°E

The prime meridian (Greenwich meridian) is the meridian that passes through Greenwich, London.

prime meridian   meridians

80°
60°
40°
20°
60° 40°
20°
0° 20° 40° 60° 80°
20°
40°
60°
equator
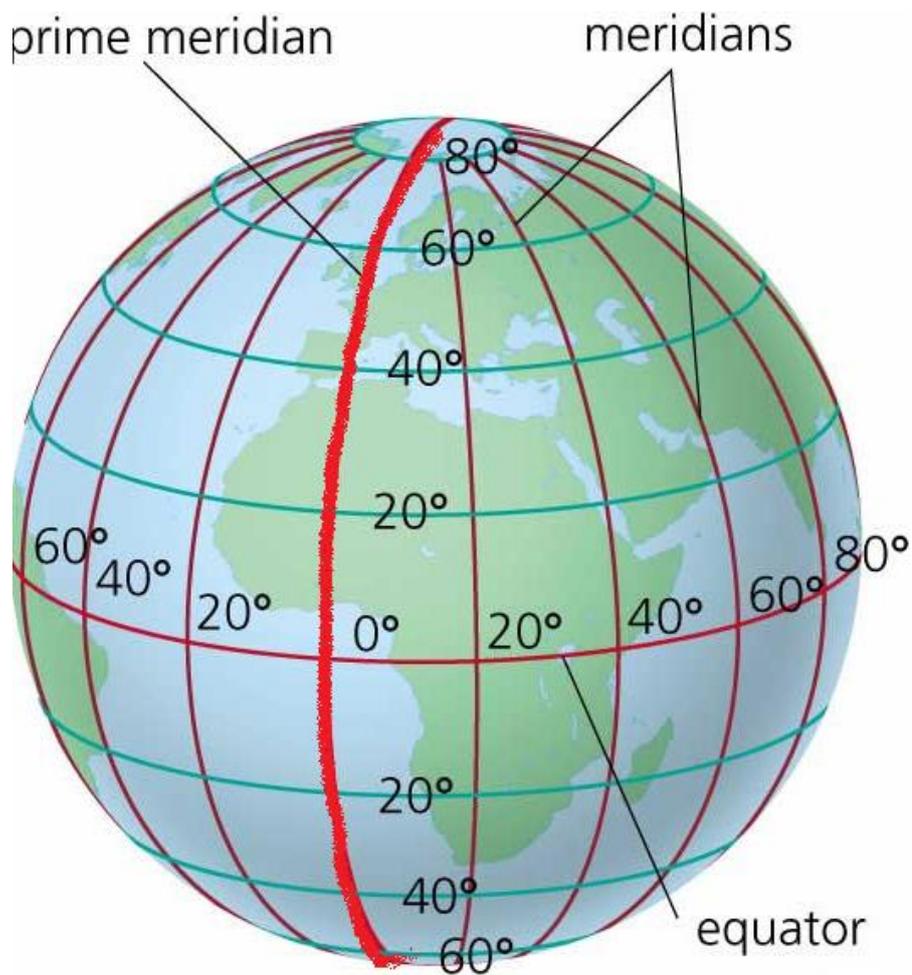
The co-ordinates of every point on the earth are always expressed as (Latitude N or S, Longitude E or W) . Latitude always goes first.

SHORTEST DISTANCE

On a flat surface, the shortest distance between two points is a straight line. On the curved surface of a sphere, the shortest distance between two points is the arc of a great circle.

On the earth, every great circle has a radius of 6,400 km.

EXAMPLE 1:

Beijing, China and Perth, Australia have coordinates (40°N, 116°E) and (32°S, 116°E) respectively. Calculate the shortest distance between Beijing and Perth, to the nearest kilometre, given that the Earth's radius is 6400 km. Give your answer to the nearest kilometre

NOTE: The longitude co-ordinate for both locations is the same, so they lie on the same meridian.

EXAMPLE 2:

Point A has longitude 30°W and latitude 0°

Point B has longitude 90°E and latitude 0°

Find the distance between the two points.

Give your answer to the nearest kilometre.

NOTE: The latitude of both locations is 0° so they both lie on the equator.