**NDA PREPARATION MATERIAL**

**GAT– GEOGRAPHY**

**TOPIC 1**

# MOTIONS OF THE EARTH, LATITUDE, LONGITUDE AND HEAT ZONES OF THE EARTH

**Motions of the Earth**: The earth has two main motions: (i) Rotation and (ii) Revolution.

The axis of the earth, which is an imaginary line, makes an angle of 66 ½ ° with its orbital plane. The plane formed by the orbit is known as the orbital plane. The earth receives light from the sun. Due to the spherical shape of the earth, only half of it gets light from the sun at a time. The portion facing the sun experiences day while the other half away from the sun experiences night. The circle that divides the day from night on the globe is called the circle of illumination. This circle does not coincide with the axis.

**Rotation**: The earth rotates around its axis. The axis is an imaginary line passing through the centre of the earth. The earth completes one rotation in 23 hours, 56 minutes, 4.09 seconds to be exact. The earth rotates from west to east. The period of rotation is known as the earth day.

Effects of the Rotation of the Earth

(i) Causation of day and night

(ii) A difference of 1 hour between two meridians which are 15° apart.

(iii) Deflection of ocean currents and winds.

(iv) Rise and fall of tides every day.

**Revolution:** It is earth's motion in its elliptical orbit around the sun. One revolution is completed in 365 ¼ days, resulting in one extra day every fourth year. The year, consisting of 366 days is called a "leap year" having 29 days in the month of February. A year is usually divided into summer, winter, spring and autumn seasons. Seasons change due to the change in the position of the earth around the sun.

**On 21st June**, the Northern Hemisphere is tilted towards the sun. The rays of the sun fall directly on the Tropic of Cancer. As a result, these areas receive more heat. The areas near the poles receive less heat as the rays of the sun are slanting. The North Pole is inclined towards the sun and the places beyond the Arctic Circle experience continuous daylight for about six months. Since a large portion of the Northern Hemisphere is getting light from the sun, it is summer in the regions north of the equator. The longest day and the shortest night at these places occur on 21st June. At this time in the Southern Hemisphere all these conditions are reversed. It is winter season there. The nights are longer than the days. This position of the earth is called the **Summer Solstice**.

On 22nd December, the Tropic of Capricorn receives direct rays of the sun as the South Pole tilts towards it. As the sun's rays fall vertically at the Tropic of Capricorn (23 ½ ° S), a larger portion of the Southern Hemisphere gets light. Therefore, it is summer in the Southern Hemisphere with longer days and shorter nights. The reverse happens in the Northern Hemisphere. This position of the earth is called the **Winter Solstice**.

**On 21st March and September 23rd**, direct rays of the sun fall on the equator. At this position, neither of the poles is tilted towards the sun; so, the whole earth experiences equal days and equal nights. This is called an **equinox**.

On 23rd September, it is autumn season in the Northern Hemisphere and spring season in the Southern Hemisphere. The opposite is the case on 21st March, when it is spring in the Northern Hemisphere and autumn in the Southern Hemisphere. Thus, we find that there are days and nights and changes in the seasons because of the rotation and revolution of the earth respectively.

**Perihelion**: The position of the earth when it is at its nearest point to the sun. The earth reaches its perihelion on about 3rd January at a distance of about 147 million km from the sun.

**Aphelion**: The position of the earth when it is at its greatest distance from the sun. The earth reaches its aphelion on 4th July when it is at a distance of 152 million km from the sun.

**Perigee**: The point in the orbit of the moon when it is nearest to the earth.

**Apogee**: The point in the orbit of the moon when it is farthest from the earth.

**Eclipses**

An eclipse, solar or lunar occurs when the shadow of another body obscures the light from a celestial body. Eclipse occurs when the sun, moon and earth are in a straight line. A 'solar eclipse' occurs between sunrise and sunset at new moon when the moon lies between the sun and the earth. The 'lunar eclipse' takes place when the earth comes in between the sun and the moon so that the shadow of the earth is cast on the moon. A lunar eclipse takes place on a full moon. Generally a total of seven eclipses, including solar and lunar, take place every year.

**Latitude**: Latitude of a place on the earth is the angular distance of the place from the equator. 1° of latitude is approximately equal to 111 km.

**Parallels of Latitude**: They are circles drawn on the globe parallel to the equator. All the places. on a parallel of latitude will have the same latitudinal angle.

**Important Parallels of Latitude**

1. Equator 0°

2. Tropic of Cancer 23 ½ °N

3. Tropic of Capricorn 23 ½ °S.

4. Arctic circle 66 ½ °N.

5. Antarctic circle 66 ½ °S

**Heat Zones of the Earth**

The mid-day sun is exactly overhead at least once a year on all latitudes in between the Tropic of Cancer and the Tropic of Capricorn. This area, therefore, receives the maximum heat and is called the **Torrid Zone.**

The mid-day sun never shines overhead on any latitude beyond the Tropic of Cancer and the Tropic of Capricorn. The angle of the sun's rays goes on decreasing towards the poles. As such, the areas bounded by the Tropic of Cancer and the Arctic Circle in the Northern Hemisphere, and the Tropic of Capricorn and the Antarctic Circle in the Southern Hemisphere, have moderate temperatures. These are, therefore, called **Temperate Zones**.

Areas lying between the Arctic Circle and the North Pole in the Northern Hemisphere and the Antarctic Circle and the South Pole in the Southern Hemisphere, are very cold. It is because here the sun does not rise much above the horizon. Therefore, its rays are always slanting. These are, therefore, called **Frigid Zones**.

**Effects of the Revolution of the Earth**

(I) Change of seasons.

(ii) Variation in the lengths of day and night at different times of the year.

(iii) Shifting of wind belts.

(iv) Determination of latitudes.

**Great Circles**: Any circle which divides a globe into hemispheres is a great circle. The equator is a great circle and Greenwich meridian together with meridian 180° make another great circle. The number of great circle is limitless. Great circle can extend in any direction: east to west, north to south, north east to south west, and so on. Great circles are of equal length.

**Longitude**: The longitude shows the distance of a point east or west of the Prime Meridian which is at 0° and passes through Greenwich, near London. For each degree of longitude there is a difference of four minutes in time.

**Longitude and Time**: The best means of measuring time is by the movement of the earth and the moon. The sun regularly rises and sets every day, and naturally, it is the best time keeper throughout the world.

When the Prime Meridian has the sun at the highest point in the sky, all the places along this meridian will have mid-day or noon. As the earth rotates from west to east, those places east of Greenwich will be ahead of Greenwich time and those to the west will be behind it. The rate of difference can be calculated as follows. The earth rotates 360° in about 24 hours, which means 15° an hour or 1° in four minutes. Thus, when it is 12 noon at Greenwich, the time at 15° east of Greenwich will be 15 x 4 = 60 minutes, i.e., 1 hour ahead of Greenwich time, which means 1 p.m. But at 15° west of Greenwich, the time will be behind Greenwich time by one hour, i.e., it will be 11.00 a.m. Similarly, at 180°, it will be midnight when it is 12 noon at Greenwich.

**Greenwich Mean Time**: The local time at Greenwich or any place on the Prime Meridian. All meridians to the east of Greenwich meridian have sunrise before that meridian. Local times along these meridians are therefore ahead of G.M.T. Meridians to the west of Greenwich meridian have sunrise after this meridian and therefore their local times are behind G.M.T.

**Standard Time**: A particular meridian of longitude passing through a country is chosen as the reference meridian. The local time along this meridian, calculated with respect to Greenwich Mean Time in terms of its longitude is taken as the Standard Time for that country.

**Why do we have standard time?**

The local times of places which are on different meridians are bound to differ. For example, it will be difficult to prepare a time-table for trains which cross several longitudes. In India, for instance, there will be a difference of about 1 hour and 45 minutes in the local times of Dwarka in Gujarat and Dibrugarh in Assam. It is, therefore, necessary to adopt the local time of some central meridian of a country as the standard time for the country.

**Indian Standard Time**: Time along 82½° E meridians, calculated with respect to G.M.T. India, for being a large country, is unusual in having a single time zone all over the country. It is 5 ½ hours ahead of G.M.T.

**International Date Line**: An imaginary zigzag line on the globe, approximately along the 180° meridian of longitude. When a person crosses this line from East to West, he gains one day and when he crosses from West to East, he loses one day.

**Solar Day**: It is the time interval between successive crossings of the sun across the meridian of the celestial sphere of any fixed place in the same direction. This is equal to 24 hours.

**Sidereal Day**: The period of rotation of the earth about its axis. This is calculated with respect to any fixed star. It is 4 minutes less than 24 hours.

**Solar Year (Tropical year):** It is the average interval between successive returns of the sun in its apparent motion along the ecliptic to a fixed position on the celestial sphere of any fixed place. This is equal to 365.24 mean solar days.

**Sidereal Year**: The period of revolution of the earth around the sun. It is calculated with reference to any fixed star: It is approximately equal to 365.26 days. To account for 1/4 of a day in a year, the leap year system is adopted in the Gregorian calendar. To account for the excess of 11 minutes in a year, the centurial year is considered a leap year only when it is divisible by 400.

Multiple choice questions:

1. When the earth is nearest to the sun in its orbit, it is said to be in:
a) Equinox
b) Perihelion
c) Aphelion
d) Apogee
2. In the northern hemisphere the shortest day falls on:
a) March 21
b) September 22
c) December 24
d) September 24
3. What is the International Date Line?
a) It is the Equator
b) It is the 90 degree Longitude
c) It is Prime Meridian
d) It is the 180 degree Longitude
4. The longitude of a place is 100°E. It is 4.00 PM on June 22, according to local time. What will be the time and date at another place B situated at 60°E?
a) 3.00 PM, June 22
b) 5.00 PM, June 22
c) 2.00 PM, June 23
d) 1.20 PM, June 22
5. The maximum difference in spacing between two consecutive longitude would be noticed
a) On the equator
b) At the Poles
c) On the Tropic of Cancer
d) On the Arctic Circle
6. What is the longitude of a place if it is 9.00 PM on June 20 while the time at Greenwich is 2.00 AM on June 21.

a) 60° W
b) 75° W
c) 60° E
d) 75° E

7. It is 10:00 PM on June 21 (Monday) at 70°E. What will be the time and date at 170°E?
a) June 22, 10:00 Am
b) June 22, 01:00 PM
c) June 22, 04:40 AM
d) June 21, 03:30 AM

8. The velocity of earth's rotation at the equator is:
a) 1,038 mph
b) 1,298 mph
c) 6,524 mph
d) 16,448 mph

9. The International Date Line is located in the
a) Indian Ocean
b) Pacific Ocean
c) Atlantic Ocean
d) Arctic Ocean

10. At what speed earth is rotating near the equator:
a) 2,600 KM/ Hour
b) 2,000 KM/ Hour
c) 1,700 KM/ Hour
d) 1,000 KM/ Hour

11. There are 24 hours of darkness at the Antarctic Circle and beyond on:
a) 21st March
b) 21st June
c) 23rd September
d) 22nd December

12. The whole World experiences 12 hours of daylight and 12 hours of darkness during:
a) The summer solstice
b) The winter solstice
c) A leap year
d) The spring and autumn equinox

13. At around 40 degree North and South latitudes the rotational speed of the earth is about:
a) 1,280 KM/ Hour
b) 2,120 KM/ Hour
c) 3,120 KM/ Hour
d) 820 KM/ Hour

14. When the earth is nearest to the sun in its orbit, it is said to be in:
a) Equinox
b) Perihelion
c) Aphelion
d) Apogee

15. What is the International Date Line?
a) It is the Equator
b) It is the 90 degree Longitude
c) It is Prime Meridian
d) It is the 180 degree Longitude

16. The longitude of a place is 100°E. It is 4:00 PM on June 22, according to local time. What will be the time and date at another place B situated at 60°E?

a) 3:00 Pm. June 22
b) 5:00 PM, June 22
c) 2:00 PM. June 23
d) 1:20 PM, June 22

17. The maximum difference in spacing between two consecutive longitudes would be noticed:

a) On the equator
b) At the poles
c) On the tropic of Cancer
d) On the Arctic Circle

18. What is the longitude of a place if it is 9:00 PM on June 20 while the time at Greenwich is 2:00 AM on June 21?

a) 60° W
b) 75° W
c) 60° E
d) 75° E

19. How much time Sun takes to cross one degree of Longitude in the torrid region?

a) 60 Minutes
b) 14 Minutes
c) 04 Hours
d) 240 Seconds

20. The whole World experiences 12 hours of daylight and 12 hours of darkness during:

a) The summer solstice
b) The winter solstice
c) A leap year
d) The spring and autumn equinox

21. Which force results in the deflection of winds on the earth surface?

a) Revolution of earth
b) Centrifugal force
c) Coriolis force
d) Gravitational force

22. The longitude of a place is 100°E. It is 4.00 PM on June 22, according to local time. What will be the time and date at another place B situated at 60°E?

a) 3.00 PM, June 22
b) 5.00 PM, June 22
c) 2.00 PM, June 23
d) 1.20 PM, June 22

23. Generally how many solar and lunar eclipses take place in a year:

a) Seven
b) Ten
c) Two
d) Four

24. Which one of the following is not the effect of earth's revolution?

a) Change of Season
b) Shifting of wind belts
c) Duration of days and nights.
d) Occurrence of day and night

25. Which of the following statements regarding the duration of day and night is correct?
a) Difference is least near the equator and progressively increases away from it
b) Difference is maximum at the equator and progressively decreases away from it
c) Difference is least at the tropics and progressively increases towards the equator and poles
d) Difference is maximum at the tropics and progressively decreases towards the equator and poles
26. Which one of the following statements is not correct?
a) Solar noon occurs simultaneously at locations with the same longitude
b) One meridian, which is directly under the sun, experiences solar noon at a given time
c) Places having same longitude experience solar noon at different times
d) Solar noon occurs at different times at locations with the same latitude
27. The circle of illumination divides earth into two hemispheres known as:
a) East and West
b)North and South
c) Day and Night
d) Summer and Winter
28. The Coriollis effect is produced by:
a) Pressure difference
b) Earth's revolution
c) Earth's rotation
d) Earth's rotation and revolution
29. To a perpendicular to the plane of Ecliptic, earth's axis of rotation makes an angle of 23 ½ ° had this angle been 0°, which one among the following would result?
a) There would have been no season
b) The length of the day and night would have been the same throughout the year
c) The length of the day and night would have been the same all over the earth
d) All of the above
30. Which one of the following statements is not correct?
(a) Temperatures decreases from the equator to poles
(b) Temperatures in equatorial regions change substantially from January to July
(c) Large land masses located in the subarctic and arctic zones develop centers of extremely low temperature in winters
(d) Highlands are always colder than surrounding low lands.
31. Which of the following statements in the context of northern hemisphere is/ are correct?
1. Vernal equinox occurs on March 21.
2. Summer solstice occurs on December 22.
3. Autumnal equinox occurs on September 23.
4. Winter solstice on June 21.
Select the correct answer using the code given below:
(a) 1 only
(b) 1 and 3 only
(c) 2 and 4 only
(d) 1, 2 and 3 only
32. Sunrise in eastern Arunachal Pradesh would be about how many hours before the sunrise in western Gujarat?
(a) One hour
(b) Two hours
(c) Three hours
(d) Four hours
33. Earth revolves around the sun in every

(a) 362 days
(b) 364 days
(c) 365 1/2 days
(d) 365 1/4 days
34. Indian standard time is the local time of
(a) Chennai
(b) Allahabad
(c) Calcutta
(d) Chennai
35. **'Indian Standard Meridian' passes through the states of UP, MP:**
(a) AP and Karnataka
(b) AP and Tamil Nadu
(c) Karnataka and Tamil Nadu
(d) Orissa and AP
36. **If the usual rule of calculation of time were applied for the extremes of Gujrat and Arunachal Pradesh, then approximately time:**
(a) At Gujarat would be ahead of that at Arunachal Pradesh by about 3 hours
(b) At Gujarat would be ahead of that at Arunachal Pradesh by about 2 hours
(c) At Arunachal Pradesh would be ahead of that at Gujarat by about 3 hours
(d) At Arunachal Pradesh would be ahead of that at Gujarat by about 2 hours
37. **One degree of the circumference of the earth measures (approx)**
(a) 100 km
(b) 111 km
(c) 151 km
(d) 175 km
38. **What is the approximate equatorial circumference of the earth?**
(a) 30,000 km
(b) 35,000 km
(c) 40,000 km
(d) 45,000 km
39. **Vernal Equinox occurs on?**
(a) Feb 15
(b) Feb 21
(c) March 15
(d) March 20
40. The longest circle which can be drawn on the earth surface passes through the
(a) Circle of Arctic
(b) Equator
(c) Tropic of Cancer
(d) Tropic of Capricorn
41. The imaginary line on the earth's surface that closely follows the 180 degree Meridian is
(a) Prime meridian
(b) Equator
(c) International Date Line
(d) Tropic of Cancer
42. The minimum distance between the sun and the earth occurs on-
(a) December 22
(b) September 22
(c) June 21
(d) January 3
43. On the day the sun is nearest to the earth, the earth is said to be in-
(a) Aphelion

(b) Apogee
(c) Perihelion
(d) Perigee
44. The earth is at its maximum distance from the sun on
(a) January 30
(b) September 22
(c) December 22
(d) July 4
45. The rate of rotation of the earth on its axis is highest on
(a) January 3
(b) December 22
(c) July 4
(d) Never changes
46. Which of the statements does not prove the sphericity of the earth?
(a) If the earth were flat one would come across some sharp edges
(b) The shadow of the earth at the time of solar eclipse is circular
(c) The sunrise is not visible from all places at the same time
(d) The altitude of the stars from various point on the earth's surface varies
47. The difference in the duration of day and night increases as one move from _____ to _____.
(a) Equator to Pole
(b) Pole to Equator
(c) Tropic of Cancer to Equator
(d) Tropic of Cancer to Tropic of Capricorn
48. Which of the following is wrong?
(a) The sun never shines vertically beyond the tropics
(b) At the pole there is light for half the year
(c) The sun never shines vertically over the tropic of cancer at the time of the winter solistice
(d) When the sun shines vertically over the equator, it is called an equinox
49. Equinoxes occur on-
(a) January 4 and September 22
(b) December 22 and June 21
(c) March 21 and September 23
(d) March 21 and December 22
50. The South Pole experiences continuous light at the time of
(a) Winter Solistice
(b) Vernal Equinox
(c) Autumn Equinox
(d) Summer Solistice
51. To travel by the shortest route one should follow-
(a) The winds
(b) The rivers
(c) The latitudes
(d) The longitudes
52. A day is added when one crosses
(a) The equator from north to south
(b) 180 degree longitude from east to west
(c) 10 degree longitude from west to east

(d) The equator from south to north
53. A day is subtracted when one crosses
(a) The equator from south to north
(b) The equator from north to south
(c) 180 degree longitude from east to west
(d) 180 degree longitude from west to east
54. The longitude on which the Indian Standard Time (IST) is based is
(a) 80°30'E
(b) 81°32'E
(c) 82°30'E
(d) 85°30'E
55. For each degree of longitude there is a time difference of
(a) 2 minutes
(b) 3 minutes
(c) 3 minutes 25 sec
(d) 4 minutes
56. Indian Standard Time (ISD) is
(a) 5 ½ hours ahead of Greenwich Mean Time (GMT)
(b) 4 ½ hours ahead Greenwich Mean Time (GMT)
(c) 5 ½ hours behind Greenwich Mean Time (GMT)
(d) 4 ½ hours behind Greenwich Mean Time (GMT)
57. The distance the earth covers in one complete revolution around the sun
(a) 240 million Kms
(b) 840 million Kms
(c) 940 million Kms
(d) 740 million Kms
58. What will happen if the earth stops its rotation on its axis?
(a) There will be no seasons on the earth
(b) There will be no day and night as it is now
(c) The earth will be very hot plane like mercury
(d) None of these
59. Which of the following statements regarding the movement of the planets round the sun is false?
(a) The speed of movement of the planets is not constant
(b) Speed is maximum when the planets are nearer to the sun
(c) Speed is maximum when the planets are farther from the sun
(d) Speed is less when the planets are farther from the sun
60. The earth without rotational movement would result into
1. No sun- rise and sun- set
2. No occurrence of day and night cycle
3. Only one season

Select the correct answer using the code given below
(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

61. If 82°30' east longitude (Allahabad) shows 06:00 am of Sunday (local time), what would be the local time of Florida (USA) located on 82° west longitude?
(a) 06:58 pm of Saturday
(b) 07:02 pm of Sunday
(c) 06:58 am of Sunday
(d) 07:02 am of Saturday