GN01 — Physical Geography: Universe & Earth

📖 GN01 · NDA General Ability Test — Geography

★ Foundation Chapter — 2–3 Questions

Geography begins where everything begins — in space. Before you can understand why India has monsoons, why some regions are deserts, or why rivers flow the way they do, you need to understand Earth's position in the solar system and how it moves. This chapter gives you that foundation. In the NDA exam, questions from this chapter are direct and factual — they test whether you know the solar system's key facts, Earth's movements, and the coordinate system used to locate any point on Earth.

🌎 **NDA Focus:** Hottest planet = Venus (not Mercury); largest planet = Jupiter; smallest = Mercury; Venus = retrograde rotation; Tropic of Cancer passes through 8 Indian states; IST = GMT + 5½ hours; Earth's axis tilts at 23½° — this tilt causes seasons. These direct facts appear in NDA papers every year.

PART 1 — THE UNIVERSE & SOLAR SYSTEM

1. Origin of the Universe

The universe is estimated to be about **13.8 billion years old**. Three theories explain its origin:

- **Big Bang Theory** (most accepted): All matter was concentrated in a single point of infinite density. A massive explosion (Big Bang) caused matter to fly outward, gradually cooling and forming galaxies, stars, and planets. Edwin Hubble observed that galaxies are moving away from each other — proof of an expanding universe.
- **Steady State Theory**: The universe has always existed in the same state; matter is continuously created as the universe expands. Now largely discredited.
- **Nebular Hypothesis**: The solar system formed from a rotating cloud of gas and dust (nebula) that condensed under gravity. Used to explain individual star system formation.

Why it matters for NDA: *The Big Bang theory and Nebular Hypothesis are directly asked in NDA. Remember: Big Bang explains the universe; Nebular Hypothesis explains solar system formation. The two are often confused in MCQs.*

2. The Solar System

Our solar system consists of the Sun, 8 planets, their moons, asteroids (in the asteroid belt between Mars and Jupiter), comets, and dwarf planets (Pluto, Eris, Ceres). The solar system is part of the **Milky Way Galaxy**, which contains over 200 billion stars.

The Eight Planets — Ordered from Sun

Remember: **My Very Educated Mother Just Showed Us Neptune** (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune)

The four inner planets (Mercury–Mars) are **Terrestrial** — rocky, dense, small, slow rotation. The four outer planets (Jupiter–Neptune) are **Gaseous/Jovian** — mostly gas/ice, large, fast rotation, many moons.

Planet	Type	Key Feature	NDA Fact
Mercury	Terrestrial	Closest to Sun; no atmosphere; extreme temperature swings	Smallest planet; no moon
Venus	Terrestrial	Hottest planet (greenhouse effect); rotates east to west (retrograde)	Brightest object after Sun and Moon; 'Morning/Evening Star'
Earth	Terrestrial	Only planet with life; 71% water; one natural satellite (Moon)	Third from Sun; perfect distance — Goldilocks zone
Mars	Terrestrial	Red colour due to iron oxide; two moons (Phobos, Deimos)	Olympus Mons = tallest volcano in solar system
Jupiter	Gaseous	Largest planet; Great Red Spot = giant storm; 95 moons	More moons than any planet; fastest rotation (~10 hrs)
Saturn	Gaseous	Ring system (ice and rock); least dense planet	Floats on water (density < water)
Uranus	Gaseous	Rotates on its side (98° tilt); coldest planet (−224°C)	Ice giant; rotates east to west like Venus

Neptune	Gaseous	Farthest from Sun; strongest winds in solar system	Triton orbits backward (retrograde moon)

> 💡 **NDA Trap — Hottest Planet:** The common mistake is choosing Mercury as the hottest because it's closest to the Sun. But **Venus** is hotter (462°C average) because its thick CO_2 atmosphere creates an extreme greenhouse effect. Mercury has no atmosphere, so heat escapes. Always remember: Venus = hottest.

Important Solar System Facts

- **Sun:** Star at the centre; 109× diameter of Earth; made of hydrogen (73%) and helium (25%); surface temperature ~5,500°C; core ~15 million°C; light takes 8 minutes 20 seconds to reach Earth
- **Asteroids:** Rocky bodies between Mars and Jupiter (Asteroid Belt); occasionally fall to Earth as meteorites
- **Comets:** Made of ice, dust and gases; develop a tail (coma) when near the Sun; Halley's Comet visible every 75–76 years (last seen 1986; next ~2061)
- **Moon:** Earth's natural satellite; distance ~384,400 km; no atmosphere; surface has craters (maria = dark basaltic plains)

PART 2 — EARTH'S MOVEMENTS

3. Earth's Two Movements

Earth has two simultaneous motions: rotation (spinning on its own axis) and revolution (orbiting the Sun). Both are equally important for NDA. The key is to connect each movement to its consequences — NDA tests this connection directly.

Movement	Period	Direction	Consequences
Rotation (spinning on axis)	23 hrs 56 min (1 sidereal day)	West to East (anticlockwise from North Pole)	Day and Night; Rising and setting of Sun; Coriolis effect (winds deflect right in NH, left in SH); Tides
Revolution (orbit around Sun)	365¼ days (1 sidereal year)	West to East (anticlockwise from North Pole)	Seasons (Spring, Summer, Autumn, Winter); Solstices & Equinoxes; Varying length of day and night; Leap year every 4 years (extra ¼ day)

Earth's Axial Tilt — The Cause of Seasons

Earth's axis is tilted at **23½° from the vertical** (or 66½° from the orbital plane). This tilt is *constant in direction* — Earth always points toward Polaris (North Star). As Earth revolves around the Sun, different hemispheres receive more direct sunlight at different times of year. This causes seasons.

🌞 Solstices (Extreme Sun Position)

- **Summer Solstice (21 June):** Sun directly over Tropic of Cancer (23½°N). Longest day in NH. Shortest day in SH. Arctic Circle has 24-hr daylight.
- **Winter Solstice (22 Dec):** Sun directly over Tropic of Capricorn (23½°S). Shortest day in NH. Longest day in SH. Antarctic Circle has 24-hr daylight.

🪶 Equinoxes (Equal Day and Night)

- **Spring Equinox (21 March):** Sun directly over Equator. All places on Earth have 12 hours day and 12 hours night.
- **Autumn Equinox (23 Sept):** Sun directly over Equator again. Same effect as Spring Equinox.
- At the Equator: every day of the year is an equinox — always 12 hours day/night.

PART 3 — LATITUDES, LONGITUDES & TIME

4. The Coordinate System

Latitude and longitude form a grid system that allows us to identify the exact position of any point on Earth. Every NDA paper has at least one question on this — either asking about a specific parallel's significance or calculating time differences between locations.

Important Parallels and Meridians

Parallel / Meridian	Degree	Significance
Equator	0°	Divides Earth into Northern and Southern hemispheres; receives direct sunlight throughout year; 12 hours day = 12 hours night always
Tropic of	23½°	Sun is directly overhead on Summer Solstice (21 June); northern boundary of tropics; passes through India (Mizoram, Tripura, Manipur, West Bengal, Jharkhand,

Cancer	N	Chhattisgarh, Madhya Pradesh, Rajasthan, Gujarat)
Tropic of Capricorn	23½° S	Sun is directly overhead on Winter Solstice (22 December); southern boundary of tropics
Arctic Circle	66½° N	Northern boundary of the Temperate Zone; midnight sun in summer; polar night in winter
Antarctic Circle	66½° S	Southern boundary of the Temperate Zone; same phenomena as Arctic Circle but opposite season
Prime Meridian (Greenwich)	0°	Reference for all longitudes; passes through Greenwich, London; separates Eastern and Western hemispheres
International Date Line	180°	Where the calendar date changes; bends around island groups to avoid splitting countries

Time Zones and IST

How Time Zones Work:
Earth rotates 360° in 24 hours → 15° per hour → 1° per 4 minutes.
Each 15° of longitude = 1 hour difference. Places east of Prime Meridian are ahead (+); places west are behind (−).

India's Standard Time (IST):
India's standard meridian = **82½°E** (passes through Mirzapur, Uttar Pradesh).
IST = GMT + 5 hours 30 minutes = GMT + 5½ hours
(82.5° ÷ 15° = 5.5 hours)

Why India has one time zone: India spans from 68°E to 97°E (about 29° = nearly 2 hours difference). But for administrative convenience, one standard time is used for the entire country. North-east states experience sunrise much earlier than western states.

PART 4 — ECLIPSES

5. Solar and Lunar Eclipses

Solar Eclipse

Lunar Eclipse

- Moon comes between Earth and Sun
- Moon's shadow falls on Earth
- Occurs only on **New Moon (Amavasya)**
- Total solar eclipse: Moon completely covers Sun — only corona visible
- Annular eclipse: Moon is farther from Earth; appears smaller; ring of Sun visible
- Partial eclipse: only part of Sun covered
- Visible only from a narrow strip of Earth

- Earth comes between Sun and Moon
- Earth's shadow falls on Moon
- Occurs only on **Full Moon (Purnima)**
- Total lunar eclipse: Moon enters Earth's umbra; appears red ("Blood Moon" due to refracted sunlight)
- Partial eclipse: only part of Moon in shadow
- Visible from the entire night side of Earth (larger area than solar eclipse)

Moving forward: *Now that you understand Earth's position, movements and coordinate system, Chapter GN02 builds directly on this — exploring what Earth is made of inside, how its surface is shaped, and why earthquakes and volcanoes occur. The deeper you understand Earth's structure, the better you will understand everything that happens on its surface.*

📝 NDA PYQs — Universe & Earth

Q1. Which is the hottest planet in our solar system? NDA PYQ

(a) Mercury (b) Venus (c) Mars (d) Jupiter

✓ Answer: (b) Venus

Venus is the hottest planet (average surface temperature ~462°C), not Mercury. Although Mercury is closest to the Sun, it has no atmosphere to trap heat — temperatures swing from 430°C (day) to -180°C (night). Venus has a thick CO_2 atmosphere creating an extreme greenhouse effect that traps all heat. This is one of the most repeated NDA geography misconceptions — always verify your answer before marking.

Q2. The Tropic of Cancer passes through how many Indian states? NDA PYQ

(a) 6 (b) 7 (c) 8 (d) 9

✓ Answer: (c) 8 states

The Tropic of Cancer (23½°N) passes through **8 Indian states**: Gujarat, Rajasthan, Madhya Pradesh, Chhattisgarh, Jharkhand, West Bengal, Tripura, and Mizoram. A useful mnemonic: *Gujarat Rajasthan Mera Chhattisgarh Jharkhand West Bengal Tripura Mizoram* (GM CR JW TM). NDA asks this directly. Note: It does not pass through Manipur — a common confusion.

Q3. If it is 12:00 noon at Greenwich, what is the Indian Standard Time?

NDA PYQ

(a) 05:30 AM (b) 05:30 PM (c) 06:30 PM (d) 06:30 AM

✓ Answer: (b) 05:30 PM

IST = GMT + 5 hours 30 minutes. India's standard meridian is 82½°E. Since India is east of Greenwich, it is ahead in time. 12:00 noon + 5:30 hours = **5:30 PM IST**. This calculation appears in NDA nearly every year — either as a direct time calculation or as a question about India's standard meridian.

Q4. Summer Solstice in the Northern Hemisphere occurs on: NDA PYQ

(a) 21 March (b) 23 September (c) 21 June (d) 22 December

✓ Answer: (c) 21 June

On **21 June**, the Sun is directly overhead at the Tropic of Cancer (23½°N). This gives the Northern Hemisphere its longest day of the year — Summer Solstice for the NH. The same day is Winter Solstice for the Southern Hemisphere. Remember: 21 March = Spring Equinox; 21 June = NH Summer Solstice; 23 September = Autumn Equinox; 22 December = NH Winter Solstice.

Q5. A lunar eclipse occurs when: Tricky

(a) Moon comes between Earth and Sun (b) Earth comes between Sun and Moon

(c) Sun comes between Earth and Moon (d) Moon moves away from its orbit

✓ Answer: (b) Earth comes between Sun and Moon

Lunar eclipse: Earth is between the Sun and Moon — Earth's shadow falls on the Moon. This happens only on **Full Moon (Purnima)**. Solar eclipse: Moon is between Earth and Sun — Moon's shadow falls on Earth. This happens only on **New Moon (Amavasya)**. The

trick is that a lunar eclipse can be seen from the entire night side of Earth, while a solar eclipse is visible only from a narrow path. NDA tests this confusion between solar and lunar eclipse conditions.

🧠 Quick Memory Chart — GN01

🌏 Solar System

- Hottest: **Venus** (not Mercury!)
- Largest: **Jupiter**
- Smallest: **Mercury**
- Closest to Sun: Mercury; Farthest: Neptune
- Retrograde rotation: Venus, Uranus

🌞 Earth's Movements

- Rotation (west→east): Day & Night, Coriolis
- Revolution (365¼ days): Seasons, solstices
- Axial tilt: **23½°** (cause of seasons)
- 21 June: NH Summer Solstice
- 22 Dec: NH Winter Solstice; Equinoxes: 21 Mar, 23 Sep

🕰 Latitudes & Time

- Tropic of Cancer: **8 Indian states**
- IST = GMT + 5½ hrs (82½°E)
- 15° longitude = 1 hour time difference
- Solar eclipse: New Moon; Lunar: Full Moon
- Milky Way has 200+ billion stars

📝 Practice Exercise

E1. Which planet has the most moons in our solar system?

(a) Saturn (b) Jupiter (c) Uranus (d) Neptune

E2. The International Date Line roughly follows which meridian?

(a) 90°E (b) 0° (Prime Meridian) (c) 180° (d) 90°W

E3. At which location on Earth are day and night ALWAYS equal throughout the year?

(a) Tropic of Cancer (b) Arctic Circle (c) Equator (d) Prime Meridian

E4. Halley's Comet is visible approximately every:

(a) 25 years (b) 50 years (c) 76 years (d) 100 years

Answers:

E1 → (b) Jupiter [currently 95 confirmed moons; Saturn has 146 but Jupiter held the record longer — verify current count in exam] | E2 → (c) 180° [bends around island groups to avoid date change within a country] | E3 → (c) Equator [at 0° latitude, solar energy is received equally year-round; always 12 hrs day, 12 hrs night] | E4 → (c) 76 years [last seen 1986; next visible ~2061]