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Science & Technology

PART - II

CRISP, CONCISE & COMPLETE

For UPSC CSE
PRELIMS 2025

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CURRENT AFFAIRS – SCIENCE & TECHNOLOGY PART II

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Day 71

Topic 771

771. Black Hole Triple

- **Neutron stars or Black Hole** are formed **when a massive star explodes and run out of fuel** and **collapses**.

If star is-

1. **Small size-Black dwarf** (in the end)
2. **Medium size-Neutron star** (in the end)
3. **Large size-Black hole** ((in the end)

Neutron star vs Black Hole

- A **neutron star is about 1.4-2 times** the mass of **the Sun** while the other **Black Hole** is **much more massive.**
- **A neutron star** has a surface and a **Black Hole does not.**
- Black Hole is **still collapsing.**
- Black Hole has such a **high density** and **gravity** is so strong that **not even light can escape.**

Current news?

- Scientists have discovered a **"black hole triple"** in space for **the first time**.

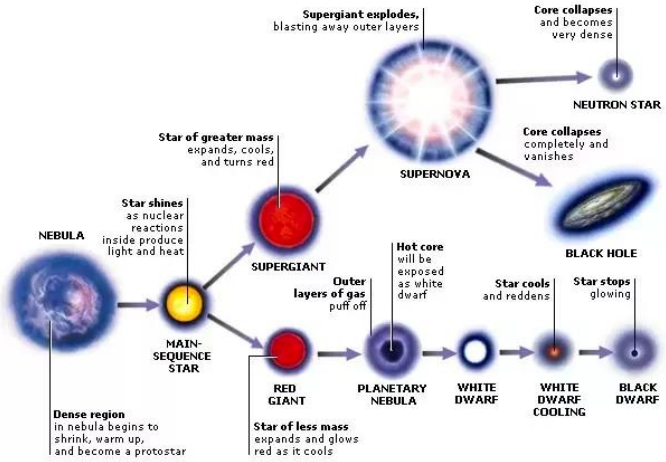
What is "black hole triple"?

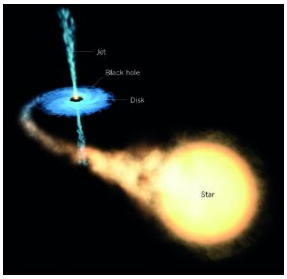
- A "black hole triple" is a system in space that contains **three objects**, with a **black hole at the center** and **two other objects**—**usually stars**—around it.

Why "black hole triple" is unique?

- This configuration creates an **unusual dynamic** because **black holes** are usually found in **binary systems** with only **one companion star** or **object.**

Explosion of a star is known as **Supernova.**





A binary system **black hole**

Q2315. With reference to the formation of stellar remnants, consider the following statements:
1. A black dwarf is the end state of a small-sized star after it cools completely.
2. Neutron stars are typically the remnants of medium-sized stars that have undergone a supernova.
3. Black holes result from the collapse of the largest stars after a supernova explosion.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: c

Sol: A black dwarf is the theoretical final stage of a white dwarf once it has cooled over trillions of years **(statement 1 — correct).**
Neutron stars are the compact remnants of stars about 1.4–2 solar masses, typically after a supernova explosion **(statement 2 — correct).**
Black holes form when massive stars collapse under their own gravity after a supernova **(statement 3 — correct).**

Q2316. Consider the following statements regarding black holes and neutron stars:
1. Neutron stars have a defined surface, whereas black holes do not.
2. The gravitational pull of a black hole is so intense that even light cannot escape it.
3. A neutron star is generally more massive than a black hole.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 only
(d) 1, 2, and 3

Ans: a

Sol: Neutron stars do have a surface; black holes do not — they have an event horizon **(statement 1 — correct).**
Black holes have such intense gravity that not even light can escape **(statement 2 — correct).**
However, black holes are much more massive than neutron stars, not the other way around **(statement 3 — incorrect).**

Q2317. With reference to the recent astronomical discovery, consider the following statements:
1. A "black hole triple" refers to a system with three black holes orbiting each other.
2. In the discovered system, the black hole lies at the center while the other two bodies are stars.
3. Black holes are more commonly found in binary systems rather than in triple systems.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All three

Ans: b

Sol: A "black hole triple" refers to a system with one black hole and two companion objects (usually stars), not three black holes **(statement 1 — incorrect).**
The newly discovered system has a central black hole with two stellar companions **(statement 2 — correct).**
Most black holes are found in binary systems, making the triple system rare **(statement 3 — correct).**

Topic 772

772. Tardigrades Extreme Resilience

Tardigrades

- These are **microscopic eight-legged creatures without a backbone**.
- Tardigrades are an **ancient species.**
- Molecular dating suggests Tardigrades originated at least **600 million years ago.**

Genetic Adaptations:

- Tardigrades have **unique genes** that allow them to **withstand extreme conditions**, including **dehydration, freezing,** and high levels of **radiation.**
- They have adapted into more than **1,300 species,** each evolving to **survive various harsh environments.**

Horizontal Gene Transfer

- Some of their **resilience is attributed** to **"horizontal gene transfer" (HGT),** where tardigrades **incorporate genes from bacteria, plants, and fungi into their DNA**, helping them adapt to extreme conditions.

Current news?

- Medical science is **interested in studying Tardigrades** and incorporate their **approach of Horizontal Gene Transfer** in **humans too.**

Tardigrade Genes can help in-

1. **Medical Research**
2. **Space Exploration**
3. **Agriculture**


A false-colour image of a tardigrade. FILE PHOTO/KSL

Tardigrades, also known as **water bears**, are one of the **most resilient organisms**, **surviving extreme environments** like deep-sea vents, deserts, and even outer space.

Q2318. With reference to Tardigrades, consider the following statements:
1. Tardigrades are invertebrate microorganisms known for their ability to survive extreme environments.
2. They have evolved through vertical gene transfer, which explains their resilience.
3. Tardigrades have been found to survive in outer space, deep-sea vents, and deserts.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is correct: Tardigrades are microscopic, eight-legged invertebrates known for their extreme survival abilities.
Statement 2 is incorrect: Their resilience is partly due to horizontal gene transfer (HGT), not vertical gene transfer.
Statement 3 is correct: Tardigrades have survived in harsh environments like outer space, deep-sea vents, and deserts.

Q2319. Consider the following statements regarding Tardigrades:
1. They are estimated to have originated at least 600 million years ago.
2. There are fewer than 500 known species of Tardigrades due to their highly specific habitats.
3. Tardigrades possess unique genes that help them withstand dehydration and high radiation.
Which of the above statements is/are correct?
(a) 1 and 3 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) All three

Ans: a

Sol: Statement 1 is correct: Molecular dating places their origin at least 600 million years ago.
Statement 2 is incorrect: Over 1,300 species of tardigrades have been identified.
Statement 3 is correct: Their unique genes allow survival in extreme conditions such as dehydration and radiation.

Q2320. Why is medical science interested in the study of Tardigrades?
(a) They produce antibiotics effective against multidrug-resistant bacteria.
(b) Their genome may help in understanding human cancer pathways.
(c) Their method of horizontal gene transfer may be useful in genetic engineering for resilience.
(d) They are believed to hold the key to creating artificial organs.

Ans: c

Sol: Tardigrades exhibit horizontal gene transfer, incorporating genes from bacteria, fungi, and plants, which contributes to their resilience.
Medical science and space research are exploring how such genetic traits could be applied to improve human survival and health.

Topic 773

773. Solar Cycle

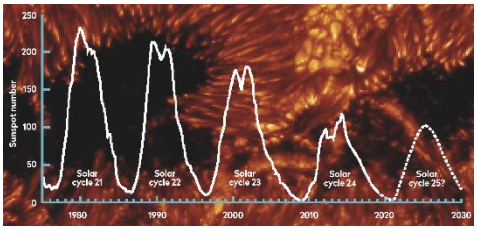
- Like a **bar magnet**, the **Sun** also has a **magnetic field** with **north and south poles.**
- In the **Sun** the **magnetic field** exists due to the **constant movement** of **electrically charged particles**.
- Every **11 years** or so, the Sun's **magnetic field completely flips**, meaning its **north and south** poles **switch places.**
- This periodic change is known as the **solar cycle**.
- The **solar cycle affects** activity on the **surface of the Sun**.
- For instance, the Sun is at its **most active** when the **magnetic field flips**.
- This phase is called the **solar maximum**.
- **After the flip**, the **star calms** down until it reaches the solar minimum, and a **new cycle begins**.

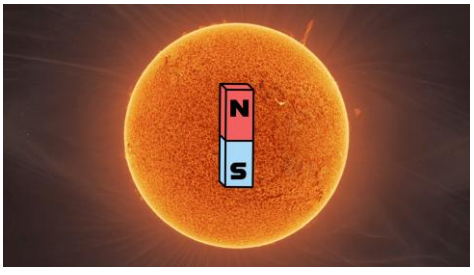
Current news?

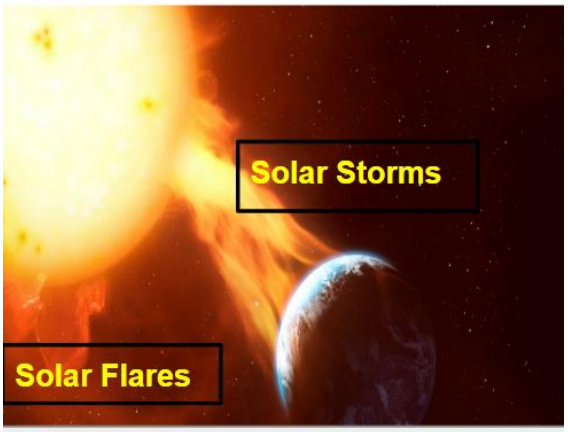
- The **present solar activity** is on its peak called '**Solar maxima'.**
- So, it is the **best window (2023-25**) to study solar flares.
- The next possible **intense solar activity** will not be **before 2035-2036.**

Recent solar missions

1. **Aditya L1, India: Launched on September 2, 2023**
2. **Proba-3, European Space Agency: Launched on December 4, 2024**
3. **PUNCH mission-a NASA mission** that studies the **Sun's corona and solar wind (create 3D image of Sun's Corona)**







Solar Flares also known as **Coronal mass ejection (CME)** relatively **intense, localized emission** of **electromagnetic radiation** and **charged particles(plasma)** from **the Sun's atmosphere.**

Q2321. With reference to the Solar Cycle, consider the following statements:
1. The Sun's magnetic field flips approximately every 11 years, marking a new solar cycle.
2. Solar maximum occurs when solar activity is at its lowest.
3. The solar minimum follows the flipping of the magnetic poles.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is correct: The solar cycle spans around 11 years, during which the magnetic poles flip.
Statement 2 is incorrect: The solar maximum is when solar activity is at its peak, not the lowest.
Statement 3 is correct: After the magnetic flip and solar maximum, the Sun moves toward a solar minimum.

Q2322. Consider the following pairs:
Solar Missions — Primary Objective
1. Aditya L1 — Study Earth's magnetosphere
2. Proba-3 — Study the Sun's corona using spacecraft formation
3. PUNCH — Create a 3D image of the Sun's corona and study solar wind
How many of the above pair(s) is/are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Pair 1 is incorrect: Aditya L1 is meant to study the Sun's outer layers, including the corona, solar flares, and solar wind, not Earth's magnetosphere.
Pair 2 is correct: Proba-3, an ESA mission, uses formation flying to study the Sun's corona.
Pair 3 is correct: PUNCH (NASA) aims to create a 3D image of the corona and study solar wind.

Q2323. Which of the following statements correctly explains the current phase of solar activity?
(a) The Sun is in its solar minimum, making it an ideal time to study sunspots.
(b) The Sun is in solar maximum, making it an ideal period for studying solar flares.
(c) The magnetic poles of the Sun are stable and aligned with Earth's poles.
(d) The next solar maximum is expected around 2026–27.

Ans: b

Sol: As per current data, the Sun is in solar maximum during 2023–25, which is the peak of solar activity, ideal for studying solar flares and coronal mass ejections.
The next solar maximum will likely be around 2035–36, not 2026–27.

Topic 774

774. Proba 3 Mission

- **developed** by the **European Space Agency (ESA)**.
- Launched by **ISRO**.
- The **PSLV-C59 rocket** successfully **launched the PROBA-3** mission for the **European Space Agency** (ESA) from the Satish Dhawan Space Centre, Sriharikota.

Orbit

- The satellites will be placed in a **highly elliptical orbit.**

Aim

- **Advanced solar observation**.

- It is an innovative endeavor aimed at demonstrating **high-precision formation flying**.

What is high-precision formation flying?

- Proba-3 consists of **two small satellites**

a. the **Coronagraph Spacecraft (CSC)**
b. the **Occulter Spacecraft (OSC)**

- They will **fly in a precise formation** approximately **150 meters apart.**
- This configuration will function as a **single, large instrument in space.**

How they will do advanced solar observation?

- By positioning the **OSC to block the Sun's direct light**, the **CSC's** will capture **detailed images of the Sun's faint corona** (the outer atmosphere) which is typically **obscured by the Sun's brightness**.
- This setup allows for **continuous observation** of the corona, providing **valuable data for solar research.**

Q2324. With reference to the Proba-3 mission, consider the following statements:
1. It is a joint mission developed by ISRO and the European Space Agency (ESA).
2. The satellites of Proba-3 are placed in a highly elliptical orbit.
3. The mission aims to demonstrate high-precision formation flying for advanced solar observation.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is incorrect: The mission was developed solely by ESA but launched by ISRO using PSLV-C59.

Statement 2 is correct: The satellites were indeed placed in a highly elliptical orbit.
Statement 3 is correct: A primary aim is to demonstrate high-precision formation flying for advanced solar observation.

Q2325. Which of the following best explains "high-precision formation flying" as demonstrated by Proba-3?
(a) A spacecraft flying through multiple solar flares to study magnetic storms.
(b) A constellation of satellites communicating through laser pulses.
(c) Two spacecraft maintaining a fixed relative distance to function as a single large instrument.
(d) A single satellite launching mini-satellites into different orbits for varied solar measurements.

Ans: c

Sol: Proba-3 consists of two spacecraft — the Coronagraph Spacecraft (CSC) and the Occulter Spacecraft (OSC) — that maintain a precise 150-meter distance to block the Sun's glare and observe its faint outer corona.

Q2326. Consider the following pairs:
Component — Function in Proba-3
1. Coronagraph Spacecraft (CSC) — Captures detailed images of the Sun's corona
2. Occulter Spacecraft (OSC) — Blocks the direct sunlight to allow corona observation
3. PSLV-C59 — Used to maneuver the Proba-3 satellites into geostationary orbit
How many of the above pair(s) is/are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Pair 1 is correct: The CSC takes detailed images of the Sun's corona.
Pair 2 is correct: The OSC blocks direct sunlight, enabling corona observation.
Pair 3 is incorrect: PSLV-C59 launched the mission but did not place it in geostationary orbit; the satellites were placed in a highly elliptical orbit.

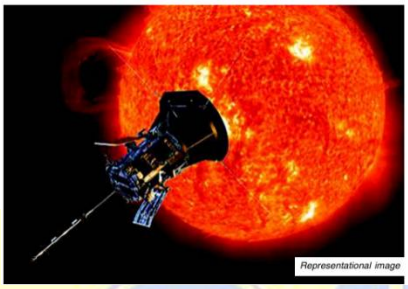
Topic 775

775. Parker Solar Probe

- Launched in **2018** by **NASA.**
- Aims to **study the Sun,** mainly its **outer atmosphere** and **solar wind.**

Current news?

- NASA's Parker Solar Probe **made history** on December 24 by **flying closer to the Sun than any spacecraft ever,** reaching just 6.1 million km from the **Sun's outer atmosphere.**
- This was the **first of three final approaches** to the Sun, part of the probe's plan to gather groundbreaking data from the Sun.



Q2327. With reference to the Parker Solar Probe, consider the following statements:
1. It was launched by NASA in 2018 to study the Sun's outer atmosphere and solar wind.
2. In December 2023, it became the first spacecraft to enter the core of the Sun.
3. It has flown closer to the Sun than any other spacecraft in history.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is correct: The Parker Solar Probe was launched by NASA in 2018 to study the Sun's outer atmosphere and solar wind.
Statement 2 is incorrect: While it approached the Sun's outer atmosphere (corona), it did not enter the Sun's core, which is not possible with current technology.
Statement 3 is correct: On December 24, 2024, the probe flew just 6.1 million km from the Sun's outer atmosphere — the closest any spacecraft has ever come.

Q2328. Which of the following statements best explains the scientific objective of NASA's Parker Solar Probe?
(a) To land on the Sun's surface and collect solar material samples.
(b) To observe solar flares from Earth's orbit and relay space weather alerts.
(c) To study the structure and dynamics of the Sun's corona and origin of solar wind.
(d) To deploy solar-powered satellites for interstellar communication.

Ans: c

Sol: The Parker Solar Probe's main mission is to gather data on the corona (outer atmosphere) and solar wind, which affect space weather and magnetic storms on Earth.

Q2329. Consider the following pairs:
Milestone — Parker Solar Probe Achievement
1. Closest approach to the Sun — December 24, 2024
2. Launch date — 2018
3. Final phase of mission — Includes three flybys within 10 million km of the Sun
How many of the above pair(s) is/are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Pair 1 is correct: On December 24, 2024, it made a historic closest approach to the Sun (~6.1 million km).
Pair 2 is correct: The launch year was 2018.
Pair 3 is incorrect: The final three flybys are planned to go even closer than 10 million km, making 6.1 million km already inside that threshold.

Topic 776

776. Lignosat

- It is the world's **first wood-panelled satellite.**

- It has been **developed by Kyoto University of Japan.**
- LignoSat is a **cube shaped** satellite that measures just **4 inches** (10 centimeters) on each side, and weighs **900 grams**.
- LignoSat aims to **test the durability of wood** in **extreme temperatures** as scientists seek to **reduce the use of aluminium** and **metals in spacecraft.**
- By substituting **magnolia wood for aluminium**, the satellite **wouldn't introduce damaging pollutants** into the **atmosphere** when it **falls back to Earth.**

Current news?

- LignoSat, arrived at the **International Space Station (ISS) on November 5** aboard a **SpaceX Dragon cargo capsule.**
- **After a month**, it was **released into orbit** above the Earth, where it will remain in orbit for six months.

Q2330. With reference to LignoSat, consider the following statements:
1. LignoSat is the world's first wood-based satellite developed by a European space agency.
2. It was launched to study the performance of wood in outer space conditions.
3. The primary aim is to reduce atmospheric pollution during satellite re-entry by using biodegradable materials.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is incorrect: LignoSat was developed by Kyoto University of Japan, not a European agency.
Statement 2 is correct: It aims to test wood's durability in space (extreme temperatures, vacuum, etc.).
Statement 3 is correct: Using magnolia wood instead of metals like aluminium would reduce pollution on re-entry.

Q2331. Which of the following statements regarding the physical characteristics of LignoSat is/are correct?
1. It is cube-shaped and measures about 10 centimeters on each side.
2. It weighs less than one kilogram.
3. It uses teak wood for its outer surface due to its extreme hardness.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is correct: It is a cube-shaped satellite, each side 10 cm.
Statement 2 is correct: It weighs around 900 grams, which is less than 1 kg.
Statement 3 is incorrect: LignoSat uses magnolia wood, not teak wood.

Q2332. Consider the following statements about LignoSat's journey and deployment:
1. LignoSat was delivered to the International Space Station (ISS) aboard a SpaceX Dragon cargo capsule.
2. After arrival at the ISS, it was immediately released into Earth orbit for a full year-long mission.
3. The satellite will remain in orbit for six months to monitor material endurance in space.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans: b

Sol: Statement 1 is correct: It arrived at the ISS on November 5 via a SpaceX Dragon capsule.
Statement 2 is incorrect: It was not immediately released and the mission is six months, not a year.
Statement 3 is correct: LignoSat is scheduled to orbit Earth for six months.

Topic 777

777. Ground Station as a Service (GSaaS)

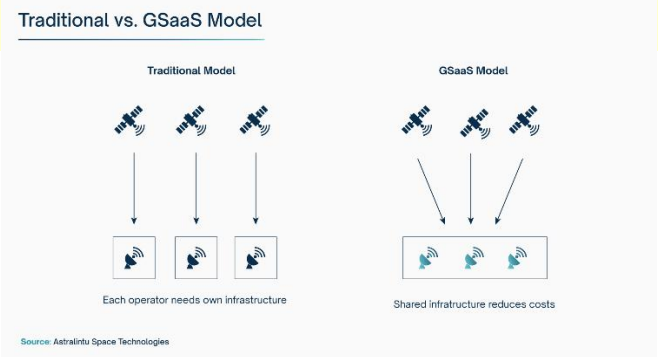
- It is a **model in the space industry** that provides **on-demand access to ground station** infrastructure for **satellite operators and space missions**.
- **Instead of building** and maintaining their **own ground stations**, **satellite operators** can use **shared facilities** and services offered by **GSaaS providers**.
- This approach **optimizes costs**, increases efficiency, and simplifies operations.

How GSaaS Works?

- Ground stations are **facilities equipped with antennas** and **communication systems** that **connect satellites** in orbit with systems on Earth.
- They facilitate tasks like **data reception, tracking, and command** of satellites.

Current news?

- IN-SPACe is **exploring private sector participation** in **ground station as a service (GSaaS)** market.
- **IN-SPACe** (Indian National Space Promotion and Authorization Center) is a **government organization** established under the **Department of Space (DoS)** in India with **aim of promoting private sector participation** in **space segment.**



Q2333. With reference to the concept of Ground Station as a Service (GSaaS), consider the following statements:

1. GSaaS allows satellite operators to use shared ground station infrastructure rather than building their own.
2. It enables satellite operators to communicate with satellites in orbit through remote data centers, bypassing traditional antenna-based facilities.
3. GSaaS helps reduce costs and improve operational efficiency for space missions.

How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is correct: GSaaS allows shared access to existing ground station infrastructure.
Statement 2 is incorrect: GSaaS still relies on antenna-based ground stations, not solely remote data centers.
Statement 3 is correct: It is a cost-effective and efficient model for satellite communication.

Q2334. Consider the following statements regarding Ground Station as a Service (GSaaS):
1. Ground stations are responsible for receiving data from satellites and sending commands to them.
2. The GSaaS model is especially beneficial for startups and small satellite operators.
3. IN-SPACe is the nodal body exploring GSaaS models in India through private sector engagement.

How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: c

Sol: Statement 1 is correct: Ground stations receive data and transmit commands to satellites.
Statement 2 is correct: GSaaS is particularly useful for small operators who can't afford dedicated infrastructure.
Statement 3 is correct: IN-SPACe, under DoS, is encouraging private participation in the GSaaS market.

Q2335. Which of the following is/are functions of ground stations in the GSaaS model?
1. Telemetry and command services
2. Real-time data downlink from satellites
3. Manufacturing of satellite payloads
4. Satellite tracking across orbits
How many of the above function(s) is/are correct?
(a) Only one
(b) Only two
(c) Only three
(d) All four

Ans: c

Sol: Statements 1, 2, and 4 are correct: These are key functions of a ground station.
Statement 3 is incorrect: Payload manufacturing is not a function of ground stations or GSaaS providers.

Topic 778

778. Discovery of x-rays

Different types of Electromagnetic radiations

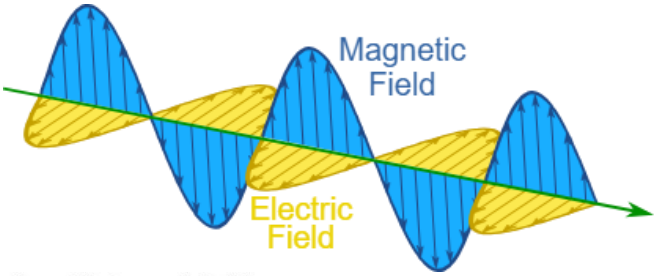
- Electromagnetic fields are a **combination of invisible electric** and **magnetic fields.**
- They are **present everywhere** in the environment

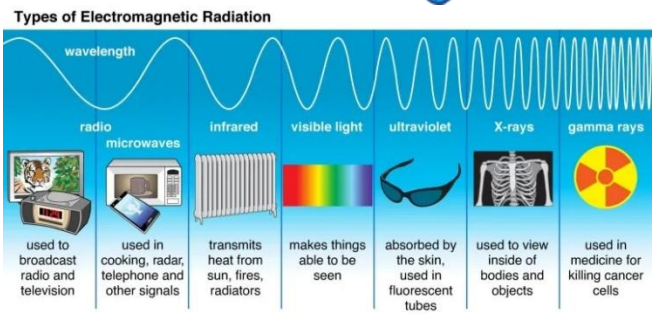
Sources

1. **Natural Sources**
- **Electric charges** in the **atmosphere** associated with **thunderstorms**.
- The **Earth's magnetic field** -used by **birds and fish for navigation.**
2. **Human-made sources**
- **Medical equipment** using static fields **(e.g. MRI)**, **electric appliances** and various **wireless, telecommunications.**

How X-Rays were discovered?

- **Wilhelm Röntgen's discovered X-Rays in 1895** while working in his laboratory at the University of Würzburg in **Germany.**
- The discovery **revolutionised** the **field of medicine forever**.
- The discovery **earned** him the **first ever Nobel Prize in Physics in 1901.**





Wave Type	Wavelength Range	Key Uses
Radio Waves	> 1 mm	Communication, navigation, astronomy
Microwaves	1 mm to 1 m	Cooking, radar, communication
Infrared Waves	700 nm to 1 mm	Thermal imaging, remote controls
Visible Light	400 nm to 700 nm	Illumination, vision, photography
Ultraviolet Rays	10 nm to 400 nm	Sterilization, medicine, security
X-Rays	0.01 nm to 10 nm	Medical imaging, security, industry
Gamma Rays	< 0.01 nm	Cancer treatment, sterilization

Q2336. With reference to the discovery of X-rays, consider the following statements:
1. Wilhelm Röntgen discovered X-rays while working at the University of Heidelberg in Germany.
2. X-rays are a type of electromagnetic radiation that revolutionized the field of medicine.
3. Wilhelm Röntgen was awarded the first-ever Nobel Prize in Physics for his discovery of X-rays.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is incorrect: Röntgen discovered X-rays at the University of Würzburg, not Heidelberg.
Statement 2 is correct: X-rays are electromagnetic radiation and had a transformative impact on medical diagnostics.
Statement 3 is correct: Röntgen received the first Nobel Prize in Physics in 1901.

Q2337. Consider the following statements regarding electromagnetic radiation and its sources:
1. The Earth's magnetic field is a natural source of electromagnetic radiation and is used by certain animals for navigation.
2. MRI machines operate using high-frequency radio waves and are a human-made source of electromagnetic fields.
3. Thunderstorms can generate electric charges, which are a natural source of electromagnetic radiation.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None
Ans: c

Sol: All three statements correctly identify natural and artificial sources of electromagnetic radiation, including their biological and technological relevance.

Q2338. Which of the following are correctly matched?

Type of Source	Example
Natural Source	Electric charges during thunderstorms
Natural Source	Earth's magnetic field guiding migratory birds
Human-made Source	Wireless communication systems
Human-made Source	Natural background radiation from cosmic rays

How many of the above pair(s) is/are correctly matched?
(a) Only one
(b) Only two
(c) Only three
(d) All four

Ans: c

Sol: The first three pairs are correctly matched. Fourth pair is incorrect: Cosmic rays are a natural, not human-made, source of radiation.

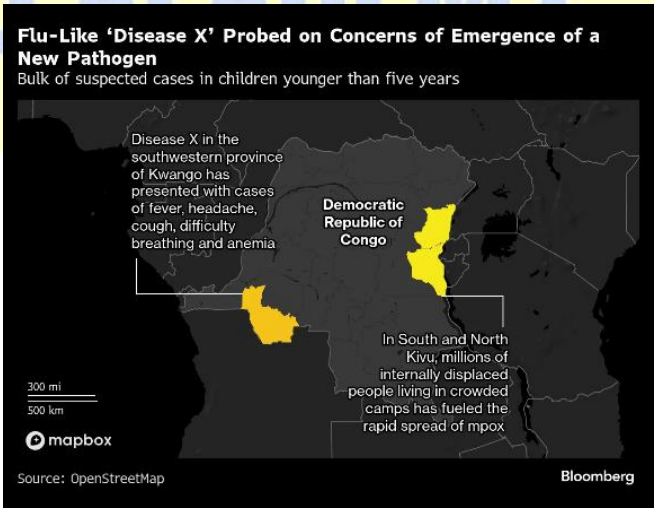
Topic 779

779. Disease X

- Disease X represents a **hypothetical disease** that can become **global health threat**.
- Coined by the World Health Organization **(WHO)** after the **West African Ebola epidemic (2014–2016)**.
- As per WHO Disease X would be **caused by pathogens** like **viruses, bacteria, parasites etc.**
- WHO called them **"known unknowns"**(we know about them but **lack specifics**).
- **COVID-19** is widely regarded as the **first instance of a real Disease X** after the **WHO introduced** the **concept in 2018.**

Challenges in prediction of Disease X

1. The vast number of **undiscovered pathogens**
2. **Zoonotic spillovers** driven by **human encroachment**
3. **Climate change** altering disease dynamics due to impact on **vectors** like **mosquitoes and sandflies etc**
4. **Risks** from **antimicrobial resistance**
5. **Bioterrorism, and accidental lab leaks.**



Current example-

- Marburg virus disease (MVD), a **severe hemorrhagic fever and bleeding eye** caused by the **Marburg virus spread in Rwanda.**

Q2339. With reference to "Disease X", consider the following statements:
1. The term "Disease X" was coined by the World Health Organization after the COVID-19 pandemic.
2. Disease X represents a hypothetical illness that could arise from yet-unknown pathogens with epidemic or pandemic potential.
3. COVID-19 is widely regarded as the first real instance of Disease X.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is incorrect: The term "Disease X" was coined by WHO after the 2014–2016 West African Ebola outbreak, and before COVID-19 (in 2018).
Statements 2 and 3 are correct.

Q2340. Which of the following are listed by WHO as challenges in predicting or managing the emergence of Disease X?
1. Zoonotic spillovers from wildlife to humans
2. Climate change impacting the range of disease vectors
3. Enhanced detection of all known pathogens through next-gen diagnostics
4. Antimicrobial resistance and risks from bioterrorism
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) Only three
(d) All four

Ans: c

Sol: Statements 1, 2, and 4 are correct: All are valid challenges mentioned by WHO.
Statement 3 is incorrect: Enhanced detection would help in mitigating rather than complicating prediction.

Q2341. Consider the following pairs:

Concern	Description
Zoonotic spillovers	Pathogens jumping from animals to humans
Climate change	Alters habitats and increases disease vector activity
Antimicrobial resistance	Makes existing treatments ineffective
Disease X	Predictable disease caused by a known virus

How many of the above pair(s) is/are correctly matched?
(a) Only one
(b) Only two
(c) Only three
(d) All four

Ans: c

Sol: The first three pairs are correctly matched. Fourth pair is incorrect: Disease X refers to a hypothetical or unpredictable disease, not a predictable one.

Topic 780

780. India's first Hyperloop

- The Hyperloop train is like any other **normal train** with **two basic differences**.

1. The **bogey** carrying passengers **travel through tubes** from which most of the **air has been removed to reduce friction.**
2. Rather than using wheels like a train or car, the pods are designed to float **using magnetic levitation to reduce friction**.

- The Hyperloop concept was originally **popularised by Elon Musk in 2012.**

Current news?

- Recently, **IIT Madras** has completed a **410-meter Hyperloop test track.**
- **Hyperloop pods** are **designed** to reach **speeds of up to 1,100 kmph.**
- India's hyperloop project is a **joint initiative** of **Indian Railways, IIT-Madras' Avishkar Hyperloop team and TuTr** (incubated startup).

Magnetic Levitation

Normal Train

Q2342. With reference to the concept of Hyperloop transportation, consider the following statements:
1. Hyperloop pods travel through low-pressure tubes to reduce air resistance.
2. The pods use wheels and diesel propulsion for movement.
3. Magnetic levitation is used to minimize contact friction during travel.

How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is correct: Low-pressure tubes reduce air resistance.
Statement 2 is incorrect: Hyperloop pods do not use wheels or diesel engines; they rely on electric propulsion and magnetic levitation.
Statement 3 is correct: Maglev (magnetic levitation) technology lifts the pod off the surface, eliminating rolling resistance and allowing smooth, fast movement.

Q2343. Consider the following pairs related to the development of India's first Hyperloop project:

Institution/Entity	Role in Hyperloop Project
IIT Madras	Developed a 410-metre Hyperloop test track
Indian Railways	National partner in the Hyperloop initiative
TuTr Hyperloop	Incubated startup collaborating on project implementation
ISRO	Designed the propulsion system for the Hyperloop pod

How many of the above pair(s) is/are correctly matched?
(a) Only one
(b) Only two
(c) Only three
(d) All four

Ans: c

Sol: All pairs except ISRO are correct. ISRO is not involved in the Hyperloop project.

Q2344. Which of the following statements is/are correct about the Hyperloop concept?
1. It was originally popularised by Elon Musk in 2012.
2. Hyperloop pods can potentially achieve speeds exceeding 1,000 kmph.
3. India's Hyperloop initiative is being led by IIT Bombay in partnership with BHEL.

Select the correct answer using the code below:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All three

Ans: a

Sol: Statements 1 and 2 are correct.
Statement 3 is incorrect: The project is led by IIT Madras, not IIT Bombay, and BHEL is not a partner.

Topic 781

781. GPS Spoofing

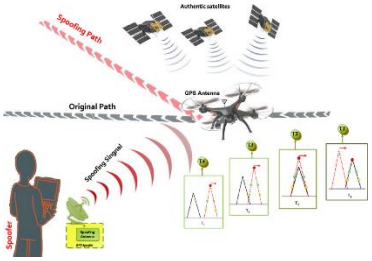
- **GPS spoofing**, also known as **GPS simulation**, refers to the practice of **manipulating or tricking** a **GPS receiver** by **broadcasting false GPS signals**.

How Does GPS Spoofing Work?

- It exploits the **inherent vulnerabilities** in the **GPS infrastructure** – the **weak signal strength of GPS satellites.**
- These **fake signals are stronger,** causing the receiver to **recognize them as authentic signals.**
- As a result, the **victim's GPS receiver ends** up processing these **counterfeit signals**, leading to **erroneous location information**.

Current news?

- **Instances of GPS spoofing** on passenger aircraft, including with **false signals**, are on the **rise over conflict zones** globally, including on **India's borders with Pakistan.**



Q2345. With reference to GPS spoofing, consider the following statements:
1. GPS spoofing involves sending counterfeit signals to a GPS receiver to mislead it about its actual location.
2. GPS spoofing takes advantage of the strong signal strength of GPS satellites to override real signals.
3. It is a form of cyberattack that can be used to manipulate civilian or military navigation systems.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is correct – GPS spoofing misleads devices using fake signals.
Statement 2 is incorrect – GPS spoofing exploits the weak signal strength of authentic GPS satellites.
Statement 3 is correct – It is a cyberattack with implications for both civilian and military systems.

Q2346. Which of the following statements correctly explains why GPS spoofing is possible?
(a) GPS signals are highly encrypted and cannot be decoded, allowing attackers to jam them.
(b) GPS satellites transmit signals with such high strength that they can be intercepted and rebroadcast.
(c) The low-power nature of GPS signals makes it possible for spoofers to override them with stronger, fake signals.
(d) GPS spoofing can only occur in the presence of internet connectivity in the targeted device.

Ans: c

Sol: Authentic GPS signals are weak by the time they reach Earth.
Spoofers broadcast stronger, fake signals that the receiver wrongly prioritizes.
This enables attackers to mislead the GPS system without needing internet access or satellite jamming.

Q2347. Consider the following statements regarding recent developments related to GPS spoofing:
1. Instances of GPS spoofing have been reported over international conflict zones.
2. India has reported no cases of GPS spoofing over its airspace or borders.

3. Passenger aircraft have recently been affected by GPS spoofing attacks.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All three

Ans: c

Sol: Statements 1 and 3 are correct – GPS spoofing incidents have been reported in conflict zones and have affected passenger aircraft.
Statement 2 is incorrect – India has witnessed rising instances of GPS spoofing near its borders with Pakistan.

Topic 782

782. 'Ghost particles' or Neutrinos

What are 'Ghost particles'?

- **Proton, neutron, and electron** are tiny particles **that make up atoms.**
- Similarly **neutrino** is also a **tiny elementary particle**, but it is **not part of the atom.**
- Such particles are found to **exist freely in nature.**
- Neutrino has a **very tiny mass**, **no charge.**
- It **interacts very weakly** with other matter particles.
- So weakly that **every second trillions of neutrinos fall on us** and pass through our bodies **unnoticed**.
- Thus they are also known as **'Ghost particles'**

Neutrino detectors

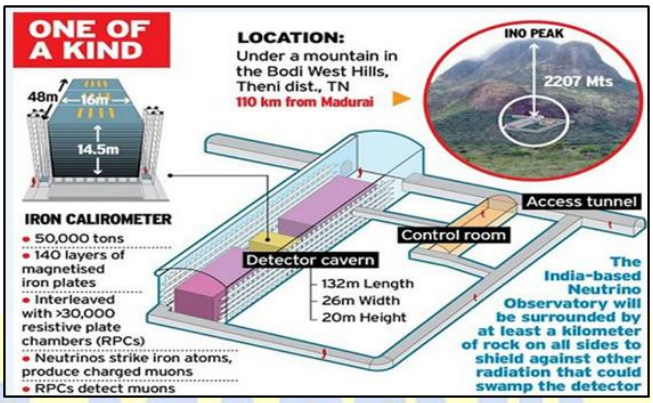
1. **IceCube Neutrino Observatory**
- The world's **largest neutrino detector**.
- It is **under the frozen ice** in the **Antarctic** rather than being in the water.

2. **Cubic Kilometre Neutrino Telescope (KM3NeT)**
- **two telescopes** to **detect high-energy neutrinos**, also known as ghost particles, **under the Mediterranean Sea.**
- detected the **most energetic neutrino recorded so far.**

3. **Indian Neutrino Observatory (INO)**
- approved in **2015**
- **1,200-metre-deep cave**.
- **Bodi West Hills region** of the **Theni district, Tamil Nadu.**

IceCube Neutrino Observatory

Cubic Kilometre Neutrino Telescope



Indian Neutrino Observatory (INO)

Q2348. With reference to neutrinos, also called 'ghost particles', consider the following statements:
1. Neutrinos are part of the atom like protons and neutrons.
2. Neutrinos carry no electric charge and interact weakly with matter.
3. Neutrinos have zero mass and can be detected using X-ray telescopes.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: a

Sol: Statement 1 is incorrect: Neutrinos are not part of the atom.
Statement 2 is correct: They are neutral and interact very weakly with matter.
Statement 3 is incorrect: Neutrinos have a tiny mass, not zero, and X-ray telescopes cannot detect them. Specialized neutrino detectors are used.

Q2349. Consider the following pairs:

Neutrino Detector	Location
IceCube Neutrino Observatory	Under Antarctic ice
KM3NeT (Cubic Kilometre Telescope)	Under the Atlantic Ocean
Indian Neutrino Observatory (INO)	Bodi Hills, Tamil Nadu

How many of the above pair(s) is/are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: IceCube is correctly matched (Antarctic ice).
KM3NeT is located under the Mediterranean Sea, not the Atlantic Ocean.
INO is correctly matched (Bodi West Hills, Tamil Nadu).

Q2350. Which of the following statements is/are correct regarding the Indian Neutrino Observatory (INO)?
1. It was approved in 2015 and is proposed to be built in a 1,200-metre-deep cave.
2. INO aims to study high-energy gamma rays from cosmic sources.
3. It is located in the Bodi West Hills region of Theni district in Tamil Nadu.
Select the correct answer using the code below:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All three

Ans: c

Sol: Statements 1 and 3 are correct.
Statement 2 is incorrect: INO is focused on neutrino physics, not gamma rays.

Topic 783

783. Neutrinoless Double Beta Decay experiment

- Neutrinos are the **second-most abundant subatomic particle** in the universe, **after photons**, the particles of light.
- They were **produced in copious amounts** during the **Big Bang event.**

Since then, they are **produced in-**

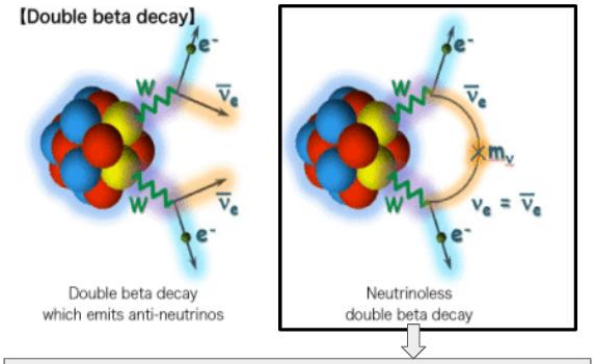
a. **radioactive decay**
b. when **massive stars explode**,
c. when **cosmic rays strike** the earth's **atmosphere**.

Particle and Antiparticles

- Most subatomic particles have **distinct anti-particles** (e.g., the electron's antiparticle is a positron).
- **Antiparticles** have the **same mass** as regular particles, but **opposite electric charge**.
- **Particles and antiparticles** were made in **equal amounts** after the **Big Bang.**

Biggest mystery in Physics-

- If **particles and antiparticles** were **made in equal amounts** after the **Big Bang**, **why is our universe** made mostly of **matter/Particles not anti-matter or anti-particles?**
- This **mystery can be solved** if it is proven that **Neutrinos** are their **own anti particles (Majorana particles).**
- This can be proved through **Neutrinoless Double Beta Decay experiment**



If **Neutrinoless Double Beta Decay (0νββ)** experiment is conducted **successfully**. It means that-

- **Anti Neutrinos annihilated Anti Neutrinos**.
- It means **Neutrinos** are their own **anti-particles**(Majorana particles).

Current news?

- **AMoRE**(Advanced Mo-based Rare Process Experiment) conducted in **South Korea.**
- It is a scientific experiment that is **searching** for **neutrinoless double beta decay (0νββ).**
- The experiment observed **3 kg of molybdenum-100** (Mo-100), a nucleus known to **undergo double beta decay.**

Recent Findings

- **No confirmed observation** of neutrino less double beta decay yet.

Q2351. With reference to the Neutrinoless Double Beta Decay (0νββ) experiment, consider the following statements:
1. The experiment aims to determine whether neutrinos are their own antiparticles.
2. If proven, it could explain the matter–antimatter asymmetry in the universe.
3. The observation of neutrinoless double beta decay would violate the conservation of lepton number.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: c

Sol: Statement 1 is correct – The experiment tests whether neutrinos are Majorana particles (i.e., their own antiparticles).
Statement 2 is correct – This could explain why the universe has more matter than antimatter.
Statement 3 is correct – Observation of 0νββ would violate lepton number conservation, a key tenet of the Standard Model.

Q2352. Consider the following statements regarding the AMoRE experiment:
1. It is being conducted in South Korea to search for neutrinoless double beta decay.
2. The experiment uses a radioactive isotope known as molybdenum-100 as the target.
3. The experiment has confirmed the observation of neutrinoless double beta decay in molybdenum-100.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All three

Ans: a

Sol: Statements 1 and 2 are correct – AMoRE is based in South Korea and uses Mo-100, which is known to undergo double beta decay.
Statement 3 is incorrect – No confirmed observation of neutrinoless double beta decay has been made yet.

Q2353. Why is the discovery of neutrinoless double beta decay (0νββ) considered significant in modern physics?
(a) It would prove that neutrinos are massless.
(b) It would suggest that photons and neutrinos share the same antiparticle.
(c) It would provide experimental evidence that neutrinos are Majorana particles.
(d) It would disprove the existence of cosmic rays.

Ans: c

Sol: 0νββ decay, if observed, would imply that neutrinos are their own antiparticles, i.e., Majorana particles.
This could shed light on lepton number violation and help solve the matter-antimatter asymmetry problem.
It has no direct connection to the mass lessness of neutrinos or to disproving cosmic rays.

Topic 784

784. Gravitational Lensing

- Gravitational lensing is a phenomenon where the **gravitational field of a massive object** (such as a galaxy or black hole) **bends and magnifies the light** coming from a distant source.
- Imagine light **traveling from a distant star** or **galaxy toward Earth.**
- On its way, if it **passes near a massive object**, like a **galaxy or a black hole**, the **strong gravity** of that object **bends the light.**
- This bending of light makes the distant star or galaxy appear **distorted, magnified, or even duplicated** when we observe it from Earth.

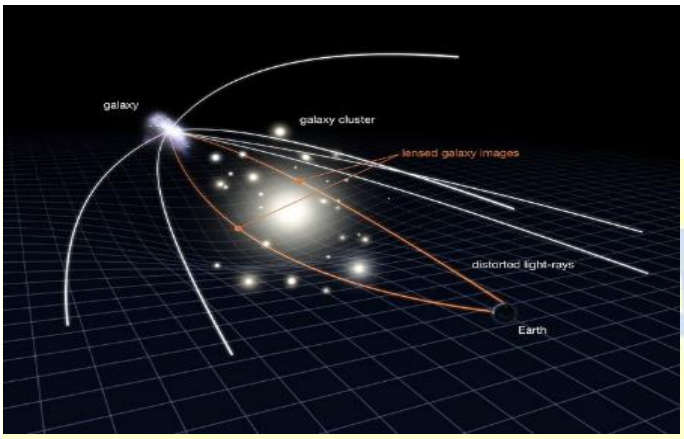
- It's **similar** to how a **glass lens** bends light to focus it, but here, **gravity does the bending instead** of a physical lens.
- **Gravitational lensing** leads to an **astronomical phenomenon** called the **Einstein Ring**.

Einstein Ring

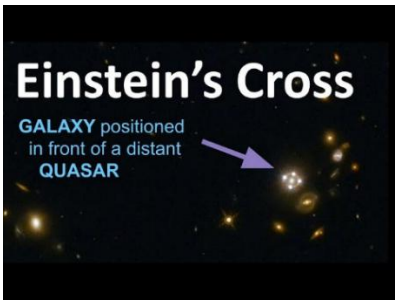
- It occurs when **light** from a **distant galaxy or quasar is bent** by the **gravitational field** of a **massive object** (such as another galaxy or black hole) lying between the distant source and the observer.

Significance of Einstein Ring?

1. **Proves General Relativity** → Demonstrates how gravity can bend light.
2. **Helps Measure Mass of Galaxies** → The **extent of bending**



- **Einstein's General Theory of Relativity**
- Gravitational lensing is a direct **consequence** of **Einstein's General Theory of Relativity**, which states that **gravity can bend light paths**.



A quasar (quasi-stellar object) is an **extremely bright celestial body** powered by a **supermassive black hole** at its **center.** Unlike **stars**, which produce **light through nuclear fusion**, quasars shine because of the **intense heating** of **material falling** into the **black hole**.

Q2354. With reference to Gravitational Lensing, consider the following statements:
1. It occurs when the gravitational field of a massive object bends the path of light from a distant source.
2. It leads to the formation of astronomical phenomena such as Einstein Rings and Quasars.
3. It provides observational evidence for Einstein's General Theory of Relativity.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is correct – This is the fundamental definition of gravitational lensing.
Statement 2 is incorrect – Gravitational lensing may distort the appearance of quasars, but quasars themselves are not caused by gravitational lensing.
Statement 3 is correct – Gravitational lensing is one of the strongest proofs of General Relativity, as it demonstrates that gravity bends light.

Q2355. Consider the following statements regarding the Einstein Ring:
1. It occurs when the source, lensing object, and observer are nearly perfectly aligned.
2. It provides a way to measure the mass of the lensing galaxy or black hole.
3. It is formed due to nuclear fusion at the center of a star-like object.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All three

Ans: a

Sol: Statement 1 is correct – Alignment is crucial for a perfect or near-perfect Einstein Ring to form.
Statement 2 is correct – The degree of light bending allows astronomers to estimate the mass of the intervening object.
Statement 3 is incorrect – Einstein Rings are caused by gravitational lensing, not by nuclear fusion.

Q2356. Which of the following statements about quasars is/are correct?
1. Quasars are extremely luminous objects powered by supermassive black holes.
2. They emit light primarily due to the gravitational collapse of the entire star.
3. They are often observed through gravitational lensing due to their great distance from Earth.
Select the correct answer using the code below:
(a) 1 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) All three

Ans: b

Sol: Statement 1 is correct – Quasars are among the brightest objects in the universe, powered by accretion of matter into a supermassive black hole.
Statement 2 is incorrect – Their brightness is not due to gravitational collapse but due to intense heating of infalling material.
Statement 3 is correct – Distant quasars are frequently used in gravitational lensing studies due to their brightness and distance.

Topic 785

785. New ISRO chairman

- **V. Narayanan**, a propulsion expert, will take over as **Chairman of ISRO** on January 14, succeeding S. Somanath.

Major Projects to be taken by V. Narayanan:

- Gaganyaan human spaceflight mission,
- Chandrayaan-4 mission,
- Bharatiya Antariksha Station,
- Development of GSLV Mk III/IRNSS-1K.

On an upward trajectory: V. Narayanan with a model of the Chandrayaan-3 moon lander. M PERIASAMY

Q2357. With reference to the newly appointed Chairman of ISRO, consider the following statements:
1. V. Narayanan is a propulsion expert who succeeded S. Somanath as ISRO Chief.
2. His key responsibilities include overseeing the Gaganyaan mission and the development of IRNSS-1K.
3. He previously served as Director of the Indian Institute of Astrophysics.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is correct – V. Narayanan is indeed a propulsion expert and has taken over from S. Somanath.
Statement 2 is correct – He will lead major missions including Gaganyaan, Chandrayaan-4, Bharatiya Antariksha Station, and IRNSS-1K development.
Statement 3 is incorrect – He was associated with ISRO's propulsion programs, not the Indian Institute of Astrophysics.

Q2358. Which of the following projects are to be undertaken under the leadership of ISRO Chairman V. Narayanan?
1. Chandrayaan-4
2. Gaganyaan
3. Bhartiya Antariksha Station
4. LIGO-India Gravitational Observatory
How many of the above is/are correct?
(a) Only two
(b) Only three
(c) All four
(d) Only one

Ans: b

Sol: Chandrayaan-4, Gaganyaan, and Bhartiya Antariksha Station are among the high-profile projects V. Narayanan is set to oversee.
LIGO-India, while a major science project involving India, is not under ISRO's primary mandate and is not mentioned among his direct responsibilities.

Q2359. Consider the following statements with respect to India's GSLV Mk III and IRNSS-1K initiatives:

1. GSLV Mk III is India's most powerful launch vehicle and is critical for crewed missions like Gaganyaan.
2. IRNSS-1K is a next-generation satellite intended for India's regional navigation system.
3. Both GSLV Mk III and IRNSS-1K projects are not under the purview of the new ISRO Chairman.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All three

Ans: a

Sol: Statement 1 is correct – GSLV Mk III is India's most powerful rocket and is key for Gaganyaan.
Statement 2 is correct – IRNSS-1K is a future addition to the Indian navigation satellite system.
Statement 3 is incorrect – These projects are part of the upcoming agenda for V. Narayanan.

Day 72

Topic 786

786. India Meteorological Department

Mission Mausam(Already covered-Topic no 143)

- Aims to **boost India's weather**- and climate-related science, **research, and services**
- **Budgetary outlay of Rs 2,000 crore** over **two years.**
- To be **jointly implemented** by the

a. **India Meteorological Department,**
b. **Indian Institute of Tropical Meteorology**
c. **National Centre for Medium-Range Weather Forecasting**

Current news?

- **Prime Minister** launched **'Mission Mausam'** during the **150th foundation day celebration** of the **India Meteorological Department.**

India Meteorological Department

- IMD was established in **1875(completed 150 years).**
- There are **6 Regional Meteorological Centres** at Mumbai, Chennai, New Delhi, Calcutta, Nagpur, and **Guwahati.**
- Its **headquarters** is in **New Delhi.**
- IMD is under the **Ministry of Earth Sciences (MoES).**

Q2360. Consider the following statements regarding the India Meteorological Department (IMD):
1. It functions under the Ministry of Science and Technology.
2. IMD was established in 1875 and has recently completed 150 years of its existence.
3. Its headquarters is located in Mumbai with regional centres across 6 Indian cities.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: a

Sol: Statement 1 is incorrect – IMD is under the Ministry of Earth Sciences, not the Ministry of Science and Technology.
Statement 2 is correct – IMD was established in 1875 and celebrated its 150th foundation day recently.
Statement 3 is partially incorrect – While IMD has 6 Regional Meteorological Centres, its headquarters is in New Delhi, not Mumbai.

Q2361. Which of the following institutions are involved in the implementation of *Mission Mausam*?
1. Indian Institute of Tropical Meteorology
2. National Centre for Medium-Range Weather Forecasting
3. Indian Space Research Organisation (ISRO)
4. India Meteorological Department
How many of the above statement(s) is/are correct?
(a) Only two
(b) Only three
(c) All four
(d) Only one

Ans: b

Sol: IITM, NCMRWF, and IMD are official implementing partners of Mission Mausam.
ISRO is not listed as an implementation partner of the mission.

Q2362. Which of the following statements best describes the recent launch of *Mission Mausam*?
(a) It is a heritage conservation project under the Ministry of Culture.
(b) It was launched to promote regional weather forecasting using indigenous satellites.
(c) It is a weather and climate initiative launched with a budget of ₹2,000 crore to boost meteorological services in India.
(d) It aims at global climate negotiations and emission reduction mechanisms.

Ans: c

Sol: *Mission Mausam* was launched by the Prime Minister during IMD's 150th foundation day celebrations with a focus on enhancing India's weather and climate science infrastructure with a budget of ₹2,000 crore.
It is not related to heritage conservation or climate negotiations.

Topic 787

787. SpaDex Mission

- ISRO launched the **SpaDeX mission** on **December 30** onboard PSLV **C60.**
- The mission carried 2 satellites **SDX01 (Chaser)** and **SDX02 (Target)** about **220 kg each.**
- launched into a **475-km circular orbit** around the Earth.

The planned manoeuvre for the satellites-
1. Docking-Integrating the satellite as one entity.
2. Power Transfer-Essential for future space application such as **in-space robotics** that requires time to time charging
3. Un-Docking-Separation of the two satellites to be used as **independent pay loads** in a space to **conduct future experiments** for their life next 2 years

January 2025

- ISRO **successfully** executed a satellite **docking experiment**
- The experiment made India the **fourth country** after the **U.S., Russia and China** to achieve this feat.

Space docking capability will be helpful in **upcoming projects** of ISRO, like-

1. Chandrayaan 4
- Which requires **sample return** from the Moon

2. Bhartiya Antriksh Abhiyan
- Aimed at building **India's own Space Station**

March 2025

- ISRO **successfully undocked** two satellites, **SDX01 (Chaser)** and **SDX02 (Target)** of the Space Docking Experiment (SpaDEx) mission on March 14.
- The feat was achieved in the **very first attempt.**

This mission is a **crucial step for future space missions**, requiring:
1. In-space refueling
2. Satellite servicing
3. Assembly of **large structures in orbit**

Q2363. Consider the following statements regarding ISRO's SpaDEx mission:
1. It involved two satellites, each weighing approximately 220 kg, placed in a circular orbit around the Earth.
2. The mission aimed to demonstrate satellite docking, power transfer, and un-docking capabilities.
3. With the success of SpaDEx, India became the fifth country to demonstrate in-orbit docking.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is correct – The mission involved SDX01 and SDX02, each weighing around 220 kg, placed in a 475-km circular orbit.
Statement 2 is correct – The mission included docking, power transfer, and un-docking phases to

simulate future space robotics and servicing applications.
Statement 3 is incorrect – India became the fourth country (after the U.S., Russia, and China) to demonstrate in-orbit docking, not the fifth.

Q2364. Which of the following future ISRO missions are likely to benefit directly from the success of the SpaDEx mission?
1. Chandrayaan-4
2. Gaganyaan
3. Bhartiya Antriksh Abhiyan
4. Mangalyaan-2
How many of the above is/are correct?
(a) Only one
(b) Only two
(c) Only three
(d) All four

Ans: c

Sol: Chandrayaan-4 involves sample return, which requires docking technology.
Bhartiya Antriksh Abhiyan (India's space station project) will need in-space servicing and assembly, benefitting from SpaDEx.
Gaganyaan, although not directly using docking in phase one, could benefit in advanced crew module operations in the future.
Mangalyaan-2 is a Mars orbiter mission and not currently planned to involve docking, hence not directly related.

Q2365. Which of the following technologies are demonstrated or enabled by ISRO's SpaDEx mission?
1. In-space satellite servicing
2. Assembly of large space structures
3. Deep-space communication systems
4. Satellite power-sharing and transfer
Which of the above statements is/are correct?
(a) Only two
(b) Only three
(c) All four
(d) Only one

Ans: b

Sol: The SpaDEx mission demonstrated satellite servicing, in-orbit assembly potential, and power-sharing between docked satellites.
Deep-space communication systems were not part of this mission.

Topic 788

788. CROPS experiment

- The **SpaDeX mission** and the **CROPS experiment** were launched together on December 30, 2024, aboard **ISRO's PSLV-C60 rocket.**

CROPS (Compact Research Module for Orbital Plant Studies) module

- **aim of germination of seeds in space**.
- CROPS module had **soil-like medium** **with water, sunlight-mimicking LEDs**, and **Earth-like air** and **LOBIA (black eyed pea) seeds**.
- Germination was **realised four days after** sending the **seed in space**.

Why Grow Plants in Space?

1. To provide a **sustainable food source** for **long-duration missions** to **Mars or the Moon**.
2. Plants **recycle carbon dioxide** and **generate oxygen**, creating a **closed-loop life-support system.**
3. They also **reduce astronaut stress** and improve mental well-being.

Challenges of Growing Plants in Space

- **Microgravity**
- **Radiations**
- **Temperature requirement**

Lobia seeds germinate in space in ISRO's CROPS module. *ISRO*

Significance of the project

- The experiment **aims to understand plant growth** in **microgravity** and its potential for **future space farming.**

How Plants Are Grown in Space?

1. Hydroponics: Water and nutrients are delivered via liquid solutions.
2. Aeroponics: Plants grow in nutrient mist without soil

Q2366. Consider the following statements regarding the CROPS experiment launched by ISRO:
1. The experiment aimed to grow lobia seeds using hydroponics in microgravity.

2. The CROPS module included sunlight-mimicking LEDs and a soil-like medium.
3. Germination occurred within four days of the module being placed in orbit.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is incorrect – The experiment used a soil-like medium, not hydroponics.
Statement 2 is correct – The CROPS module had LEDs, soil-like medium, and Earth-like air.
Statement 3 is correct – Germination of lobia seeds was observed within four days.

Q2367. Which of the following are reasons why growing plants in space is considered crucial for future space missions?
1. Plants can serve as a renewable source of oxygen.
2. Pants absorb harmful cosmic radiation, protecting astronauts.
3. Plants help reduce astronaut stress and support mental health.
4. Plants assist in maintaining a closed-loop life-support system.
How many of the above statement(s) is/are correct?
(a) Only two
(b) Only three
(c) All four
(d) Only one

Ans: b

Sol: Statements 1, 3, and 4 are correct – Plants produce oxygen, support mental well-being, and contribute to a closed-loop life-support system.
Statement 2 is incorrect – Plants do not absorb harmful cosmic radiation; radiation shielding is a separate challenge in space missions.

Q2368. Which of the following techniques are commonly used for growing plants in space?
1. Hydroponics
2. Aeroponics
3. Geoponics
4. Soil-free nutrient fog systems
Which of the above is/are correct?
(a) Only one
(b) Only two
(c) Only three
(d) All four

Ans: c

Sol: Hydroponics and aeroponics are both commonly used soil-free methods for space farming.
Soil-free nutrient fog systems refer to aeroponics (hence valid).
Geoponics refers to traditional soil-based farming, not suitable for space due to mass and containment issues.

Topic 789

789. Project 15B

- It is aimed at developing **Visakhapatnam-class destroyers ships** for Indian Navy.
- Built for the Indian Navy by **Mazagon Dock Shipbuilders Limited (MDL)** in Mumbai.
- The Visakhapatnam-class destroyers **incorporate enhanced stealth features** and **missiles** like-

1. BrahMos supersonic cruise missiles for precision strikes.
2. Barak-8 surface-to-air missiles (SAM) for air defense.

Current news?

- **INS Surat** is the **fourth and final ship** of **Project 15B destroyers** has been **inducted with Indian Navy.**

4 Ships in Project 15B
1. INS Visakhapatnam (The lead ship)
2. INS Mormugao
3. INS Imphal
4. INS Surat (recently inducted)

Q2369. With reference to the Visakhapatnam-class destroyers under Project 15B, consider the following statements:
1. They are equipped with BrahMos supersonic cruise missiles and Barak-8 surface-to-air missiles.
2. All ships under Project 15B have been built by Garden Reach Shipbuilders and Engineers (GRSE), Kolkata.
3. INS Surat is the last and final ship under this project.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is correct. Visakhapatnam-class destroyers are armed with BrahMos for strike capability and Barak-8 SAMs for air defence.
Statement 2 is incorrect. These ships were built by Mazagon Dock Shipbuilders Limited (MDL) in Mumbai, not GRSE.
Statement 3 is correct. INS Surat is the fourth and final ship of the Project 15B destroyers.

Q2370. Consider the following ships:
1. INS Visakhapatnam
2. INS Mormugao
3. INS Kavaratti
4. INS Surat
How many of the above are part of Project 15B?
(a) Only two
(b) Only three
(c) All four
(d) Only one

Ans: b

Sol: INS Visakhapatnam, INS Mormugao, and INS Surat are all part of Project 15B.
INS Kavaratti is not a Project 15B ship; it is part of the Kamorta-class (Project 28) anti-submarine warfare corvettes.

Q2371. With reference to Project 15B of the Indian Navy, consider the following statements:
1. Project 15B focuses on stealth guided-missile destroyers.
2. All ships under this project are being constructed in Visakhapatnam Shipyard.
3. INS Imphal is one of the destroyers under Project 15B.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: c

Sol: Statement 1 is correct. Project 15B aims to develop stealth guided-missile destroyers with advanced sensors and weapons.
Statement 2 is incorrect. These ships are built at Mazagon Dock Shipbuilders Limited (MDL) in Mumbai, not Visakhapatnam.
Statement 3 is correct. INS Imphal is indeed one of the four destroyers in the Visakhapatnam-class under Project 15B.

Topic 790

790. Third launch pad of ISRO and NGLV

- A launch pad is a **specialized structure** or platform used to **support and launch rockets.**
- **As of now, ISRO has two launch pads**

1. First Launch Pad (FLP)

- FLP was realized **30 years ago for PSLV** and continues to provide launch support for SSLV.

2. Second Launch Pad (SLP)

- SLP was established primarily for **GSLV & LVM3** and also functions as **standby for PSLV.**
- Both launch pads are at **Satish Dhawan Space Centre** of **ISRO at Sriharikota, Andhra Pradesh.**

Current news?

- The **Union Cabinet** approved the establishment of the **Third Launch Pad (TLP)** at **Satish Dhawan Space Centre of ISRO** at **Sriharikota, Andhra Pradesh.**
- Third Launch pad to be used-**Next Generation Launch Vehicles(NGLV)** and **LVM3 of ISRO**

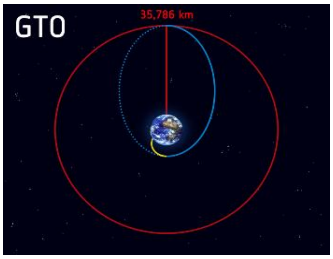
Key Features of NGLV

1. Heavy Payload Capacity

- Designed to **carry payloads of 10–20 tons** to Low Earth Orbit **(LEO)** and **4–10 tons** to Geostationary Transfer Orbit (GTO)

2. Three-Stage Rocket Design

- Incorporates **semi-cryogenic, solid, and cryogenic**



GTO (Geostationary Transfer Orbit)
- An **elliptical orbit** used to transfer satellites from **low Earth orbit (LEO) to GEO.**

GEO (Geostationary Earth Orbit)
- **Circular,** with a near-constant altitude of **~35,786 km above the equator.**

Q2372. With reference to ISRO's launch pads, consider the following statements:
1. The First Launch Pad at Sriharikota primarily supports the launch of PSLV and SSLV.
2. The Second Launch Pad is exclusively dedicated to the launch of LVM3 rockets.
3. The newly approved Third Launch Pad is planned to support Next Generation Launch Vehicles (NGLV) and LVM3.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is correct. The First Launch Pad (FLP) supports PSLV and continues to provide support for SSLV.
Statement 2 is incorrect. The Second Launch Pad (SLP) primarily supports GSLV and LVM3, but also functions as a standby for PSLV—it is not exclusive to LVM3.
Statement 3 is correct. The Third Launch Pad (TLP) is approved to support both NGLV and LVM3 missions.

Q2373. Consider the following features of the Next Generation Launch Vehicle (NGLV) developed by ISRO:
1. It is designed with a two-stage configuration using only solid and cryogenic engines.
2. It can carry up to 20 tons of payload to Low Earth Orbit (LEO).
3. It is suitable for delivering satellites to both LEO and GTO.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: b

Sol: Statement 1 is incorrect. NGLV uses a three-stage design comprising semi-cryogenic, solid, and cryogenic stages—not just two or only solid and cryogenic.
Statement 2 is correct. NGLV is designed to carry 10–20 tons to LEO.
Statement 3 is correct. It can also carry 4–10 tons to GTO, making it versatile for both orbits.

Q2374. With reference to space launch orbits and ISRO's infrastructure, consider the following statements:
1. GTO (Geostationary Transfer Orbit) is used as an intermediate step to place satellites in GEO.
2. GEO (Geostationary Earth Orbit) is approximately 35,786 km above the equator.
3. All three launch pads of ISRO are located at Sriharikota in Tamil Nadu.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All three

Ans: a

Sol: Statement 1 is correct. GTO is an elliptical orbit used to transfer satellites to the circular GEO.
Statement 2 is correct. GEO lies at an altitude of about 35,786 km above the equator.
Statement 3 is incorrect. Sriharikota is in Andhra Pradesh, not Tamil Nadu.

Topic 791

791. Distributed Ledger Technology

- **Distributed Ledger Technology (DLT)** is a digital system for recording **transactions and related data** across **multiple locations simultaneously**.**Unlike traditional databases**, distributed ledgers do not have a **central authority or central storage**, making them decentralized, secure, and transparent.

Example of DLT in-

1. Governance

- **India's Land Records**: Several states in India are experimenting with DLT to digitize and secure land records.

2. Healthcare and Pharma

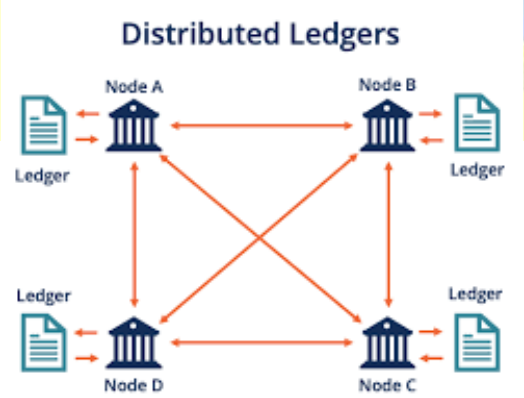
- **MyClinic app**: A healthcare system using DLT to store patient records securely and give authorized providers access.

Blockchain Technology

- It is a type of **distributed ledger system** that **records transactions** in a **secure, transparent, and tamper-resistant manner.**
- **Transactions** are grouped into **blocks.Each block** is **connected** to the **previous one** using a cryptographic hash, **forming a chain** (hence the name **"blockchain").**
- Once a **block is added** to the chain, it is **very difficult to alter.**
- It was initially **introduced** as the underlying **technology behind Bitcoin** but has since **evolved** to support **various applications beyond cryptocurrencies.**

Current news?

- **TRAI** will be using **distributed ledger technology (DLT)** to **register spam** numbers from customer.



Note-

- Blockchain Technology is a **type of Distributed Ledger Technology.**
- Distributed Ledger Technology is a **broader term.**

Q2375. With reference to Distributed Ledger Technology (DLT), consider the following statements:
1. DLT enables data to be stored centrally for better transparency and control.
2. It eliminates the need for a central authority, making the system decentralized.
3. Data stored using DLT can be simultaneously accessed across multiple locations.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is incorrect. DLT does not store data centrally; instead, it is distributed across a network, eliminating the need for a central authority.
Statement 2 is correct. One of DLT's core features is decentralization, meaning there is no single central authority.
Statement 3 is correct. DLT allows for simultaneous access and updates across multiple nodes or locations, enhancing transparency and efficiency.

Q2376. Consider the following statements regarding Blockchain Technology:
1. It is a subset of Distributed Ledger Technology.
2. Each transaction is grouped into a block and linked to the previous block using a cryptographic hash.
3. Blocks can be easily modified after being added to the blockchain to allow for system flexibility.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All three

Ans: a

Sol: Statement 1 is correct. Blockchain is a type of DLT, specifically structured as a chain of blocks.
Statement 2 is correct. Each block is cryptographically linked to the previous one, enhancing tamper resistance.
Statement 3 is incorrect. Once added, blocks are very difficult to alter, making the system tamper-resistant, not easily modifiable.

Q2377. Which of the following are examples of the use of Distributed Ledger Technology (DLT) in India?
1. Digitization of land records by state governments
2. MyClinic app for storing healthcare records securely
3. Use by TRAI to register and block spam numbers
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: d

Sol: All three are correct:
Land Records: Some Indian states are piloting DLT for secure land ownership records.
MyClinic App: Uses DLT for managing patient records securely.
TRAI: Employing DLT to track and regulate spam calls and messages.

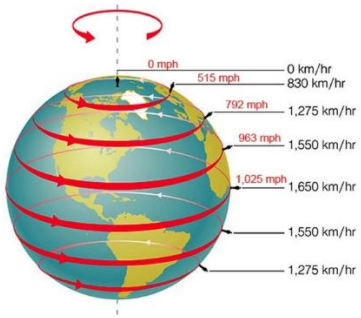
Topic 792

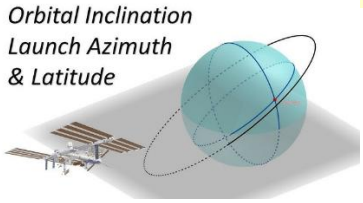
792. Why Sriharikota is chosen for rocket launch?

1. Equator proximity
- Proximity to equator provides **benefits of Earth's rotation** for launches.

2. Uninhabited area and nearness to the sea
- The surrounding area is sparsely populated, ensuring safety in case of **launch vehicle debris falling into the sea**.

3. Good launch azimuth corridor
- The **launch azimuth** is the **angle between north direction** and the **projection** of the **initial orbital plane** onto the **launch location**.
- Azimuth is **crucial** in **space launch** because it determines the **initial direction** of a rocket upon liftoff, essentially dictating which way it will **travel to reach its intended orbit.**





Q2378. With reference to the geographical and strategic advantages of Sriharikota for rocket launches, consider the following statements:
1. Its proximity to the equator allows rockets to gain additional velocity due to Earth's rotation.
2. The surrounding region is heavily populated, which helps in better infrastructure support for rocket recovery.
3. Its coastal location ensures that debris from launches falls safely into the sea.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three

(d) None

Ans: b

Sol: Statement 1 is correct: Being close to the equator helps launch vehicles gain extra velocity due to the rotational speed of the Earth, reducing fuel requirement.
Statement 2 is incorrect: Sriharikota is chosen because it is sparsely populated, ensuring safety in case of debris fall.
Statement 3 is correct: Its coastal location ensures launch debris lands in the sea, minimizing risk to people and property.

Q2379. Consider the following statements about launch azimuth and its relevance to rocket launches from Sriharikota:
1. Launch azimuth determines the initial direction a rocket travels to reach a specific orbit.
2. Sriharikota offers a favorable launch azimuth corridor over the Bay of Bengal.
3. Launch azimuth is only relevant for manned missions and not for satellite launches.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All three

Ans: a

Sol: Statement 1 is correct: Launch azimuth determines the rocket's flight path and is critical for reaching intended orbits.
Statement 2 is correct: The Bay of Bengal offers a clear path with minimal land overflight, making the launch safer.
Statement 3 is incorrect: Launch azimuth is relevant for all missions, including both satellite and manned missions.

Q2380. Why is Sriharikota considered an ideal site for ISRO's rocket launches?
1. Its equatorial location allows for energy-efficient launches.
2. Its isolated geography ensures safe disposal of launch debris.
3. It provides easy access to spaceports in Europe and the U.S. via direct launch paths.
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All three

Ans: a

Sol: Statement 1 is correct: Proximity to the equator allows rockets to benefit from Earth's rotation.
Statement 2 is correct: Its remote and coastal nature ensures safety.
Statement 3 is incorrect: There is no direct strategic launch path to spaceports in other countries; space access from Sriharikota is optimized for orbital launches, not geographic connectivity.

Topic 793

793. Global Positioning system (GPS)

- Developed by the **United States** Department of Defence (DoD) in 1970's, fully operational since 1993.
- Operates with at least **24 satellites** in **Medium Earth Orbit** (altitude of 20,200 km).
- 24 satellites in **six orbits** (4 satellites in each orbit).
- Operates through **satellite-transmitted radio signals** at specific frequencies (L1 and the L2 frequencies).
- GPS provides **Standard Positioning Service** (SPS) worldwide.

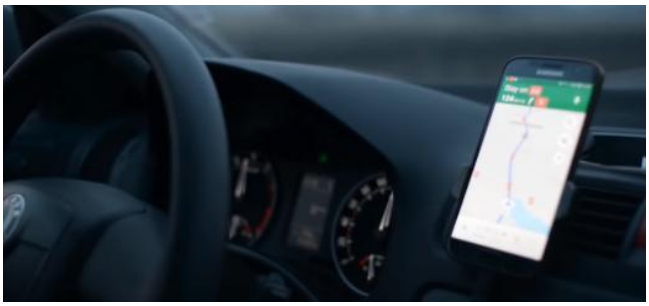
Standard Positioning Service (SPS)

- **Freely available**, **non-encrypted navigation service**.
- Used in **smartphones** and other navigation devices for transportation, **mapping**, **agriculture**, and **disaster management** etc

Satellite navigation system built by other countries

1. GLONASS – Russia (Global)
- Tagged as an **alternative GPS service**, GLONASS **ranks second as the provider** of global navigational system services with reasonable precision.
- It became **operational in 1995.**

2. Galileo – European Union (Global)
3. Bei-Dou – China (Global)
4. QZSS – Japan (Regional)
5. NAVIC(IRNSS) – India- It is a regional positioning system.



- The **GPS service** is provided by **the U.S**, can **selectively deny access to the system,** as happened to the Indian military in **1999 during the Kargil War.**
- Since then India decided to build its **own** navigation system **NAVIC**.

Q2381. With reference to the Global Positioning System (GPS), consider the following statements:
1. GPS operates with at least 24 satellites placed in Low Earth Orbit at an altitude of around 2,000 km.
2. These satellites transmit signals primarily on L1 and L2 frequencies.
3. GPS provides a non-encrypted navigation service called Standard Positioning Service (SPS) for civilian use.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 is incorrect: GPS satellites are located in Medium Earth Orbit (MEO) at an altitude of about 20,200 km, not Low Earth Orbit.
Statement 2 is correct: GPS signals are transmitted on L1 and L2 frequencies, which are used for civilian and military applications respectively.
Statement 3 is correct: Standard Positioning Service (SPS) is a freely available, non-encrypted service for civilians.

Q2382. Which of the following satellite navigation systems are global in coverage?
1. NAVIC – India
2. Galileo – European Union
3. GLONASS – Russia
4. BeiDou – China
(a) 1, 2 and 3 only
(b) 2, 3 and 4 only
(c) 1, 3 and 4 only
(d) All four

Ans: b

Sol: NAVIC is regional, covering India and nearby regions.
Galileo (EU), GLONASS (Russia), and BeiDou (China) are global positioning systems, comparable to GPS.

Q2383. Consider the following statements regarding India's decision to build its own navigation system (NAVIC):
1. The decision was triggered by the selective denial of GPS services to India during the Kargil War.
2. NAVIC provides global coverage similar to the GPS and Galileo systems.
3. NAVIC is also known as IRNSS.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: c

Sol: Statement 1 is correct: GPS access was denied by the U.S. during the 1999 Kargil conflict, prompting India to develop its own system.
Statement 2 is incorrect: NAVIC (IRNSS) is a regional system, not global.
Statement 3 is correct: NAVIC is also called IRNSS (Indian Regional Navigation Satellite System).

Topic 794

794. Navigation in Indian Constellation (NavIC)

- It is an **Indian Regional Navigation Satellite System (IRNSS)**, developed by **ISRO**.
- IRNSS originally consists of **Eight satellites (7 active)**-

a. 3 satellites in geostationary orbit
b. 4 satellites in geosynchronous orbit.

- It works just **like** the **U.S. Global Positioning System (GPS)** but with **limited coverage.**
- It is available for users in **India and 1,500 kilometres beyond** the Indian landmass.

It provides two kinds of services-

1. Standard positioning services available to all users

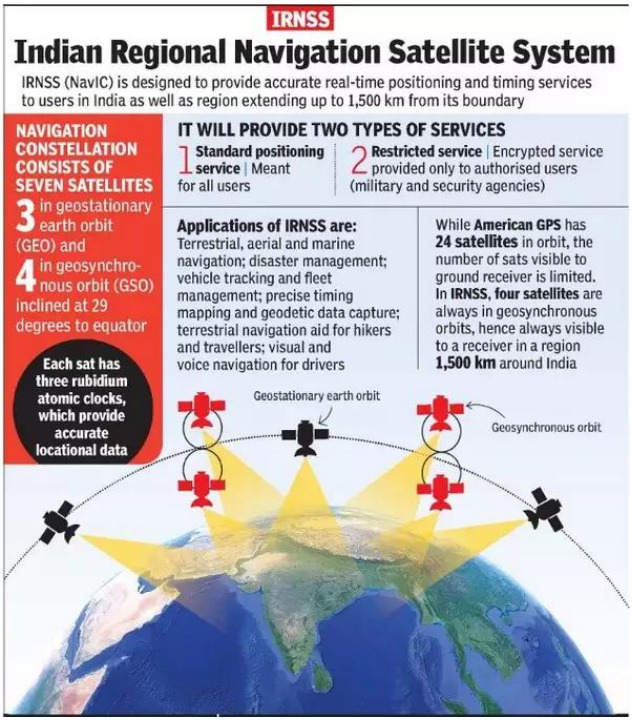
2. Restricted services available only to **military and security services.**

Second generation NAVIC satellites

- To ensure **continuous service** and improved features, **five second-generation NavIC satellites** — NVS-01 to NVS-05 — **are planned** to enhance the existing constellation.
- These satellites incorporate **L1 band communication,** which broadens applications.
- India launched **NVS-01** satellite on **May 29, 2023.**

Current news?

- The **GSLV-F15**(having indigenous Cryogenic engine) successfully placed the **NVS-02** satellite in the intended orbit.
- NVS-02 satellite carries an **advanced navigation payload** operating in **three frequency bands** (L1, L5, and S) to ensure high accuracy.
- It also has a **precise atomic clock** called the **Rubidium Atomic Frequency Standard (RAFS)** for accurate timekeeping.
- **3 days** after being put in the **desired orbit NVS 02 malfunctioned**.



Century by ISRO

- **GSLV-F15** was ISRO's **100th** space mission
- Overall ISRO placed in orbit **548 satellites**

Q2384. With reference to the NavIC system, consider the following statements:
1. NavIC is a global navigation satellite system developed by ISRO.
2. The constellation consists of satellites placed in both geostationary and geosynchronous orbits.
3. NavIC provides both Standard Positioning Service (SPS) for civilian use and Restricted Service (RS) for authorized users.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three

(d) None

Ans: b

Sol: Statement 1 is incorrect: NavIC is a regional, not global, satellite navigation system.
Statement 2 is correct: NavIC comprises 3 geostationary and 4 geosynchronous satellites.
Statement 3 is correct: NavIC provides two services—SPS for all users and RS for military/security services.

Q2385. Consider the following statements about NVS-02 satellite of the NavIC system:
1. It operates in L1, L5, and S frequency bands.
2. It carries a Rubidium Atomic Frequency Standard for high-precision timekeeping.
3. It was launched using PSLV-C60.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3
Ans: a

Sol: Statements 1 and 2 are correct: NVS-02 carries an advanced payload supporting three bands (L1, L5, and S) and includes a Rubidium atomic clock.
Statement 3 is incorrect: NVS-02 was launched by GSLV-F15, not PSLV-C60.

Q2386. Consider the following statements:
1. The second-generation NavIC satellites aim to enhance coverage beyond the Indian subcontinent.
2. NVS-01 was the first second-generation satellite launched under the NavIC program.
3. NVS-02 failed to reach its intended orbit due to a cryogenic engine failure.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: a

Sol: Statement 1 is correct: The second-gen NavIC satellites broaden frequency bands and ensure service continuity, enhancing regional capabilities.
Statement 2 is correct: NVS-01, launched in May 2023, was the first second-generation NavIC satellite.
Statement 3 is incorrect: NVS-02 was successfully placed into orbit, but malfunctioned three days later; it was not a launch failure.

Topic 795

795. World Leprosy Day

- Known as **Hansen's Disease**
- Leprosy is a **chronic, progressive bacterial infection.**
- It is caused by a **bacterium** called **Mycobacterium Leprae.**

Statistics

- According to WHO, **India accounts for more than half** of leprosy cases.
- **Bihar has the highest** number of cases followed by Uttar Pradesh.

Symptoms

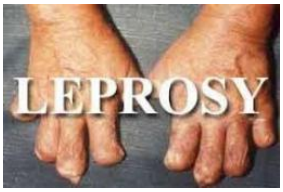
1. Red patches on the skin.
2. Skin Lesion
3. Numbness in arms, hands, and legs.
4. Ulcers on the soles of feet.
5. Muscle Weakness and excessive weight loss.

If untreated, it can lead to **deformity and disability**.

- In **India**, **World Leprosy Day** is observed on **30th January** every year (World Leprosy Day is observed every year on the **last Sunday of January** in general **across the world).**
- 30th January is **Mahatma Gandhi's martyrdom day.**
- The **theme for World Leprosy Day 2025** is **"Unite. Act. Eliminate".**

Actions by the government for Leprosy patients

1. An act declared it **criminal offence to discriminate** against Leprosy patients.
2. SPARSH Leprosy Awareness Campaign (2017)-to promote **awareness**



Treatment of Leprosy

- The drugs used is **WHO approved** known as **MDT.**
- It is a combination of **rifampicin, clofazimine and dapsone** for leprosy patients.
- In India MDT is distributed **free of cost to Leprosy patients.**

Q2387. With reference to World Leprosy Day, consider the following statements:
1. Globally, it is observed on the last Sunday of January every year.
2. In India, it is observed on 30th January to coincide with Mahatma Gandhi's martyrdom day.
3. The theme for World Leprosy Day 2025 is "Unite. Act. Eliminate."
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: d

Sol: Statement 1 is correct: World Leprosy Day is observed on the last Sunday of January globally to raise awareness.
Statement 2 is correct: In India, it is specifically observed on 30th January, which also marks Mahatma Gandhi's martyrdom.
Statement 3 is correct: The theme for 2025 is officially "Unite. Act. Eliminate."

Q2388. With reference to leprosy in India, consider the following statements:
1. It is caused by a virus called Mycobacterium Leprae.
2. Bihar and Uttar Pradesh are among the states with the highest number of cases.
3. SPARSH campaign was launched to raise awareness about leprosy.
Which of the above statements is/are correct?
(a) 2 and 3 only
(b) 1 and 3 only
(c) 1, 2 and 3
(d) 3 only

Ans: a

Sol: Statement 1 is incorrect: Leprosy is caused by a bacterium, not a virus. The correct causative agent is Mycobacterium Leprae.
Statement 2 is correct: According to WHO data, Bihar has the highest number of cases, followed by Uttar Pradesh.
Statement 3 is correct: The SPARSH Leprosy Awareness Campaign, launched in 2017, aims to promote awareness and reduce stigma.

Q2389. With reference to leprosy treatment in India, consider the following statements:
1. The standard treatment involves a WHO-approved Multi-Drug Therapy (MDT).
2. MDT includes drugs like rifampicin, clofazimine, and dapsone.
3. The MDT treatment is chargeable in government hospitals across India.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans: a

Sol: Statement 1 is correct: The treatment for leprosy involves a Multi-Drug Therapy (MDT), approved by the WHO.
Statement 2 is correct: MDT includes a combination of rifampicin, clofazimine, and dapsone.
Statement 3 is incorrect: In India, MDT is provided free of cost to all leprosy patients through the public health system.

Topic 796

796. India's Deep Ocean Mission

- Launched by **Ministry of Earth Sciences (MoES)**, Government of India in **2021.**

Six Major Components of Deep Ocean Mission

1. Development of Manned Submersible **(Samudrayaan Project)**
2. Deep-Sea Mining & Exploration

3. Deep-Ocean Biodiversity Studies
4. Study of Ocean Climate
5. Underwater Robotics & Sensors
6. Strengthen **India's blue economy (Sustainable use of ocean resources)**.

Samudrayaan Project

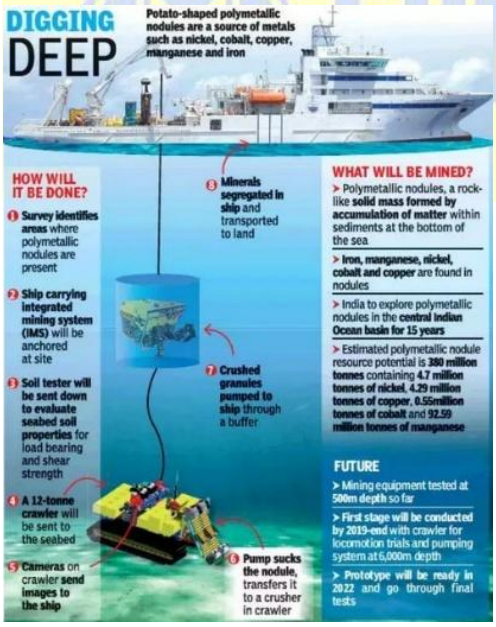
- The Samudrayaan Project is **India's first manned deep-sea mission**.
- To be launched **under the Deep Ocean Mission** by the **Ministry of Earth Sciences (MoES)**.
- It aims to **explore deep-sea resources** and **conduct oceanic research** at depths of up to **6,000 meters** in the Indian Ocean.

Matsya 6000: The Deep-Sea Submersible

- Matsya 6000 is a **three-person, deep-sea submersible** designed for this mission.
- Developed by: **National Institute of Ocean Technology (NIOT)**, Chennai.
- Made of **Titanium alloy** and has **robotic arms**.

Current news?

- According to **Ministry of Science and Technology Samudrayaan Project** will be launched by **2026.**



Q2390. With reference to India's Deep Ocean Mission, consider the following statements:
1. It was launched by the Ministry of Earth Sciences in 2021.
2. One of its key objectives is to promote India's blue economy.
3. It includes the Samudrayaan Project, India's first manned space mission.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: a

Sol: Statement 1 is correct: The Ministry of Earth Sciences launched the Deep Ocean Mission in 2021.
Statement 2 is correct: Strengthening India's blue economy is one of the mission's primary goals.
Statement 3 is incorrect: Samudrayaan is a manned deep-sea mission, not a space mission.

Q2391. Which of the following are components of India's Deep Ocean Mission?
1. Development of Manned Submersible
2. Deep-Ocean Biodiversity Studies
3. Space-Based Marine Surveillance
4. Study of Ocean Climate
Select the correct answer using the code below:
(a) 1, 2 and 3 only
(b) 2, 3 and 4 only
(c) 1, 2 and 4 only
(d) 1, 3 and 4 only

Ans: c

Sol: Statement 1 is correct: Development of Manned Submersible (Samudrayaan Project) is a major component.
Statement 2 is correct: Deep-Ocean Biodiversity Studies is included in the mission.
Statement 3 is incorrect: Space-based marine surveillance is not part of this mission.
Statement 4 is correct: Study of Ocean Climate is one of the six key pillars of the mission.

Q2392. Consider the following statements about Matsya 6000 submersible:
1. It is being developed by the National Institute of Ocean Technology (NIOT).

2. It can carry three people and operate at depths of up to 6,000 meters.
3. It is made of steel to withstand high pressure.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

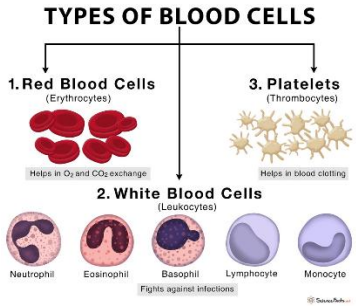
Ans: a

Sol: Statement 1 is correct: NIOT Chennai is developing Matsya 6000.
Statement 2 is correct: It is a 3-person submersible capable of diving up to 6,000 meters.
Statement 3 is incorrect: It is made of Titanium alloy, not steel, for high pressure resistance.

Topic 797

797. Blood cells

- **RBC** (includes Haemoglobin)
- **Platelets**-Help in Blood clotting
- **WBC**
- **Lymphocyte** is part of WBC.
- Lymphocyte is responsible behind **immune system** of our body and protect us against diseases caused by pathogens.
- There are two main types of lymphocytes**: B cells and T cells.**
- **Plasma cells** are a type of **White blood cell.** They are produced in bone marrow and are important for the body's immune system.



Q2393. Which of the following components of blood contain haemoglobin and help in transporting oxygen?
(a) Platelets
(b) White Blood Cells
(c) Red Blood Cells
(d) Plasma cells

Ans: c

Sol: Red Blood Cells (RBCs) contain hemoglobin, a protein that binds with oxygen and helps in its transport throughout the body.
Platelets help in clotting, WBCs fight infections, and plasma cells produce antibodies.

Q2394. Which of the following are responsible for the body's immune response?
1. B cells
2. T cells
3. Platelets
Select the correct answer using the code below:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: a

Sol: B cells and T cells are two types of lymphocytes, which are part of WBCs and crucial for the immune system.
Platelets are unrelated to immunity; they help in blood clotting.

Q2395. Consider the following statements regarding Plasma Cells:
1. Plasma cells are a type of red blood cell.
2. They are produced in the bone marrow.
3. They play a role in the immune system.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: b

Sol: Statement 1 is incorrect: Plasma cells are not red blood cells; they are a type of white blood cell.
Statements 2 and 3 are correct: Plasma cells are formed in the bone marrow and help produce antibodies, playing a key role in the immune system.

Topic 798

798. Different types of blood groups

Blood groups are classified based on-
a. Presence or absence of antigens (A and B)

- An antigen on **red blood cells (RBCs)** is a **protein, carbohydrate, or glycolipid present** on the **surface of red blood cells.**

b. Rh Factor

- The Rh factor (Rhesus factor) is a **protein** (D antigen) found on the **surface of red blood cells (RBCs)**.
- If **Rh factor is present** → The blood type is **Rh-positive** (Rh+)
- If **Rh factor is absent** → The blood type is **Rh-negative (Rh-)**

For example:

- A+ blood has the A antigen and the Rh factor.
- B- blood has the B antigen but lacks the Rh factor.

Role in transfusion

- If a person is **Rh-negative (Rh-),** their body can develop **anti-Rh antibodies if exposed to Rh-positive (Rh+)**

Type O- blood

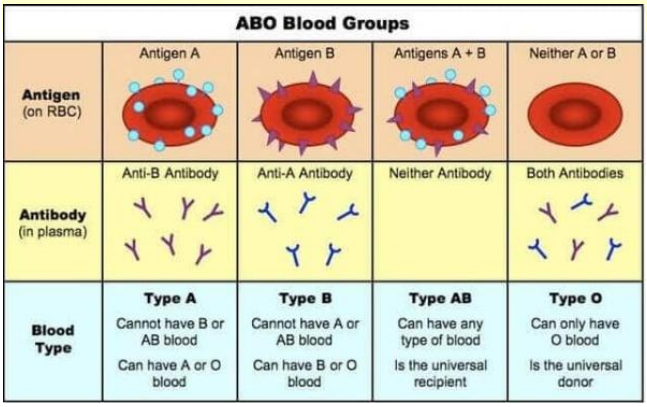
- **Universal donor**-as it has no antigen

Type AB + blood

- No antibodies-**universal recipient.**

Rare Blood Groups

- **Bombay Blood Group (hh)-extremely rare blood type.**
- **First** discovered in **Mumbai (Bombay)** in **1952.**
- They **cannot receive blood** from **A, B, AB, or O groups.**



Antibodies

- Antibodies in **plasma are proteins** (immunoglobulins) **produced by the immune system** that help fight infections and identify **foreign substances,** including **incompatible blood types**.

Q2396. Which of the following blood groups is considered the universal donor?
(a) AB+
(b) O+
(c) A−
(d) O−

Ans: d

Sol: O− blood has no A or B antigens and no Rh factor, making it the universal donor.
It can be given to anyone regardless of their blood type without triggering an immune response.

Q2397. Consider the following statements:
1. A person with B− blood has B antigen and Rh factor.
2. A person with AB+ blood is a universal recipient.
3. The Rh factor is a type of antigen present on RBCs.
Which of the above statements is/are correct?
(a) 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: b

Sol: Statement 1 is incorrect: B− means the person has the B antigen but lacks the Rh factor.
Statement 2 is correct: AB+ individuals have no antibodies in plasma and can receive blood from any group.
Statement 3 is correct: The Rh factor is an antigen found on RBCs.

Q2398. Which of the following statements about the Bombay Blood Group is/are true?
1. It was first discovered in Mumbai in 1952.
2. Individuals with this group can receive blood from O group donors.
3. It lacks the H antigen, which is present in all other blood groups.
Select the correct answer using the code below:
(a) 1 and 3 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1, 2 and 3

Ans: a

Sol: Statement 1 is true: The Bombay Blood Group was discovered in Mumbai (Bombay) in 1952.
Statement 2 is false: Despite being similar to O, they cannot receive O group blood as they lack the H antigen that even O group possesses.

Statement 3 is true: The Bombay group lacks the H antigen, making it extremely rare and unique.

Topic 799

799. CAR T Cell Therapy

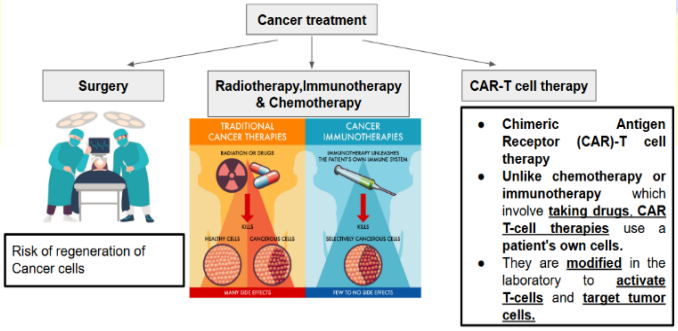
- **CAR-T** is a **revolutionary therapy** that **modifies immune cells,** specifically **T-cells, by** turning them into **potent cancer fighters** known as **CAR-T cells.**
- **In CAR-T therapy, T-Cells** turn into **cancer-fighting cells.**
- These **supercharged cells** are then **put back into the body,** and they **go after cancer cells —** especially in **blood cancers** like **leukaemia and lymphomas.**

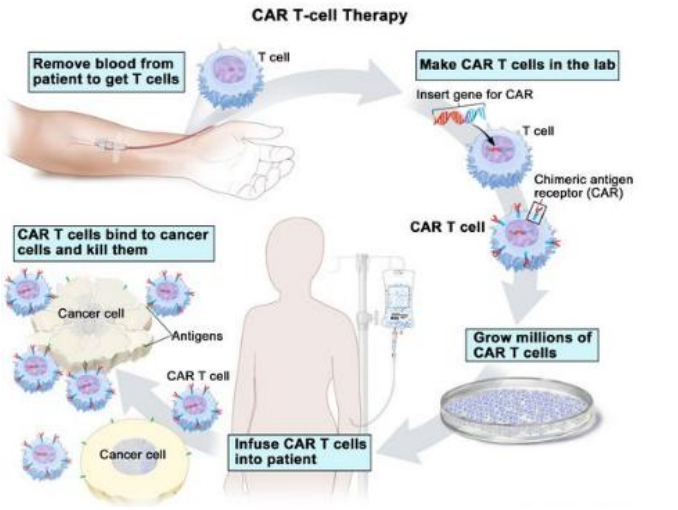
Current news?

- The **clinical trial** results of **India's first CAR T-cell therapy,** published in **The Lancet,** showed a **73 percent "response rate"** in patients suffering from **specific types of blood cancer.**

Areas of concern

- However, the results also pointed to **complication** of CAR T-cell therapies.
- The **immune cells get overactive**, leading to **hyper-inflammation** and **organ failure.**





Q2399. What is the main function of CAR T-cell therapy?
(a) To increase platelet production in cancer patients
(b) To genetically modify T-cells to attack cancer cells
(c) To replace damaged red blood cells in the bloodstream
(d) To suppress immune system responses in leukemia patients

Ans: b

Sol: CAR T-cell therapy involves genetically engineering the patient's T-cells to express Chimeric Antigen Receptors (CARs) that help them target and destroy cancer cells, especially in blood cancers like leukemia and lymphomas.

Q2400. Consider the following statements about CAR T-cell therapy:
1. It is primarily used in the treatment of solid tumors like breast and lung cancers.
2. CAR T-cells are modified outside the body and then infused back.
3. India's first CAR T-cell therapy showed a 73% response rate in clinical trials published in The Lancet.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: b

Sol: Statement 1 is incorrect: CAR T-cell therapy is primarily effective in blood cancers, not solid tumors.
Statement 2 is correct: T-cells are extracted, genetically modified, and then infused back.
Statement 3 is correct: The Lancet-published trial of India's CAR T-cell therapy showed a 73% response rate.

Q2401. Which of the following is a major concern associated with CAR T-cell therapy?
(a) Low effectiveness in treating any cancer type
(b) Suppression of immune response leading to frequent infections
(c) Hyper-activation of immune cells causing inflammation and organ failure

(d) Permanent genetic mutation in all cells of the body

Ans: c

Sol: One of the major side effects of CAR T-cell therapy is cytokine release syndrome (CRS) or hyper-inflammation, which may lead to organ failure due to the overactivity of the immune system.

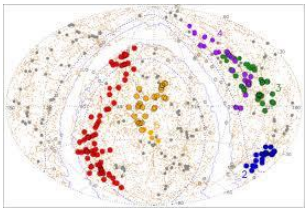
Topic 800

800. Quipu

- Astronomers have recently **identified a very large cosmic structure** named **Quipu.**
- It is considered the **largest known structure** in the **observable universe.**
- It is made up of **galaxies grouped together.**
- This superstructure spans approximately **1.3 billion light-years** and contains a mass equivalent to **200 quadrillion (200,000,000,000,000,000) suns.**
- It is over **13,000 times** the length of the **Milky Way.**
- Scientists believe Quipu will **eventually break** into smaller, collapsing units.

Basis for the name- Quipu

- Quipu was an **ancient account -keeping system** used by the **Inca civilization** in **South America.**
- It consisted of **knotted cords** made from **cotton or wool.**
- Astronomical figure **Quipu mirrors** its **namesake** with a **long central filament** and **multiple branching filaments.**



Astronomical Figure Quipu

Quipu-account keeping system

Q2402. Why is the recently discovered astronomical structure named 'Quipu'?
(a) Because it was discovered by an Inca descendant
(b) Due to its spiral shape resembling the Milky Way
(c) Because its structure resembles the knotted cord system used by the Incas
(d) It is an acronym for a scientific term related to galaxies

Ans: c

Sol: The structure is named 'Quipu' after the ancient Inca accounting system that used knotted cords. The cosmic Quipu has a long central filament with branching filaments, much like the knotted cords of the Inca system.

Q2403. What makes Quipu significant in the field of astronomy?
(a) It is the first structure discovered outside the observable universe
(b) It is the largest known structure in the observable universe
(c) It is the only structure composed entirely of black holes
(d) It is the smallest known cosmic structure ever found

Ans: b

Sol: Quipu spans about 1.3 billion light-years and contains galaxies grouped together, making it the largest known structure observed so far in the universe.

Q2404. Which of the following statements is/are true about the Quipu cosmic structure?
1. It is over 13,000 times the length of the Milky Way.
2. It contains a mass equal to 200 quadrillion suns.
3. Scientists believe it will remain stable and grow larger over time.
Select the correct option:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: a

Sol: Statements 1 and 2 are correct: Quipu is 13,000 times the size of the Milky Way and has a mass of 200 quadrillion suns.
Statement 3 is incorrect: Scientists believe Quipu will eventually break into smaller, collapsing units, not grow larger.

Day 73

Topic 801

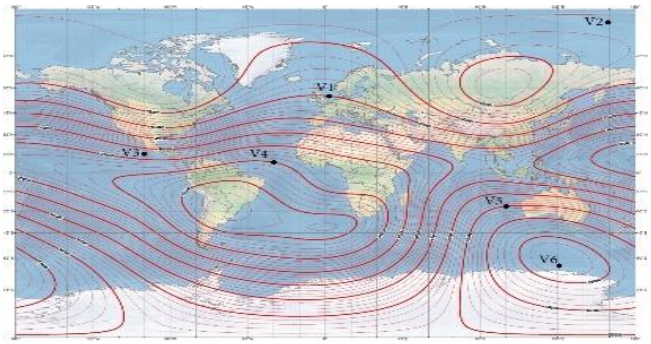
801. Geomagnetic imprinting by Loggerhead Turtle

Magnetic signature of an area

- The **Earth** has a **natural magnetic field**, but it is **not** the **same everywhere**.
- **Some rocks,** especially **volcanic and iron-rich ones**, have **stronger magnetism**, while others, like s**andstone or limestone**, have **weaker magnetism**.
- This leads to **unique magnetic field** of an area **known magnetic signature** of the area.

Geomagnetic Imprinting

- **Geomagnetic imprinting** is the **ability of certain animals**, like **sea turtles** and salmon, to **memorize the Earth's magnetic field** and use it later in life to **navigate back** to the **same location**.
- It is like **natural GPS** based on **ability** to **identify magnetic field** of an area.
- Turtles **travel thousands of kilometers** across the ocean, **using the Earth's magnetic field** as a built-in map.
- They can **sense slight changes** in the magnetic field, allowing them to follow ocean currents and **return to specific locations**.
- After **10–20 years** of migration, **female loggerhead turtles return to the exact beach** where **they were born** to **lay eggs.**
- This **ability to find their birthplace** using **Earth's magnetic cues** is **geomagnetic imprinting.**



The magnetic signature of an area is **like a fingerprint of the area** in terms of **Earth's magnetic field** in that specific place.

Current news?

- **A recent study** suggests that **Loggerhead Turtles** do a **'turtle dance'** when they reach an **intended location.**

Loggerhead Turtles

- **IUCN: Vulnerable**
- **Diet: Omnivorous**

Q2405. With reference to geomagnetic imprinting in marine animals, consider the following statements:
1. Geomagnetic imprinting enables certain animals to detect and remember the Earth's magnetic field of specific locations.
2. Loggerhead turtles use geomagnetic cues to return to their birthplace after decades in the ocean.
3. All marine animals use visual landmarks alongside geomagnetic signals to navigate.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 – Correct. Geomagnetic imprinting is a well-documented ability where animals like sea turtles and salmon memorize the magnetic field of an area and use it for long-distance navigation.
Statement 2 – Correct. Loggerhead turtles return to the exact beach where they were born after 10–20 years by sensing unique magnetic signatures.
Statement 3 – Incorrect. Not all marine animals rely on visual landmarks; many species, especially those migrating across vast open oceans, depend solely on magnetic cues.

Q2406. Consider the following statements about the magnetic signature of a geographic area:
1. It is primarily influenced by variations in Earth's gravity and atmospheric conditions.
2. Rocks like volcanic and iron-rich formations contribute to stronger magnetic signatures.
3. The magnetic signature acts as a navigational aid for species like sea turtles and salmon.
Which of the above statements is/are correct?
(a) 2 and 3 only
(b) 1 and 3 only
(c) 1 and 2 only
(d) 1, 2 and 3

Ans: a

Sol: Statement 1 – Incorrect. Magnetic signature is not influenced by gravity or atmospheric conditions but by the magnetism of underlying rock formations.
Statement 2 – Correct. Volcanic and iron-rich rocks exhibit higher magnetism, influencing the area's magnetic signature.
Statement 3 – Correct. Marine animals use the magnetic signature of specific areas for navigation across long distances.

Q2307. With reference to Loggerhead Turtles, consider the following statements:
1. They are listed as Vulnerable on the IUCN Red List.
2. They are strictly herbivorous and feed only on marine plants.
3. They perform a "turtle dance" upon reaching a navigated location, as per recent studies.
Which of the above statements are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: c

Sol: Statement 1 – Correct. Loggerhead turtles are classified as Vulnerable by the IUCN due to threats such as habitat loss and bycatch.
Statement 2 – Incorrect. Loggerheads are omnivorous, feeding on both plants and marine animals like crustaceans and jellyfish.
Statement 3 – Correct. Recent research suggests that Loggerhead turtles perform a characteristic "turtle dance" upon reaching their destination, possibly to reorient using magnetic cues.

Topic 802

802. Extended reality, Virtual Reality, Augmented Reality

Extended reality (XR)

- **Extended reality (XR)** represents a fusion of **immersive technologies** that **blend** the **physical and virtual worlds.**
- They **extend the reality** we experience by **either blending** the **virtual and "real"** worlds or **by** creating a **fully immersive(virtual) experience.**
- Extended Reality **includes** both **Virtual Reality** and **Augmented Reality.**

Virtual Reality

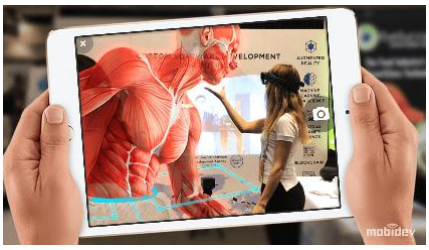
- **Physical world** is completely **shut out.**
- We are **immersed** into a completely **virtual world.**

Augmented Reality

- Augmented Reality (AR) is the technology that **superimposes an image** onto a **user's view of the real world** and **enhances it** with sound, touch, and even smell.
- It is a **combination** of the **real scene** viewed by the user **and a virtual scene** generated by the computer.

What is WAVES 2025?

- **World Audio Visual & Entertainment Summit** (WAVES) 2025 is an **initiative of the Ministry of Information and Broadcasting**, Government of India.
- It emphasised on promoting Extended reality (XR), Virtual Reality, Augmented Reality



Q2308. With reference to Extended Reality (XR) and its components, consider the following statements:
1. Extended Reality (XR) is an umbrella term that includes both Virtual Reality (VR) and Augmented Reality (AR).

2. XR technologies either fully immerse users in a virtual world or blend digital elements into the real world.
3. XR technologies are exclusively used in the entertainment industry.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 – Correct. XR encompasses both VR and AR as forms of immersive technology.
Statement 2 – Correct. XR can offer either full immersion (VR) or blending of virtual and real elements (AR).
Statement 3 – Incorrect. XR technologies are used across multiple fields such as education, healthcare, defense, and manufacturing—not just entertainment.

Q2309. With reference to Virtual Reality (VR) and Augmented Reality (AR), consider the following statements:
1. In Virtual Reality, the user is completely immersed in a digitally created environment, cutting off physical world inputs.
2. Augmented Reality enhances the real-world view by superimposing computer-generated elements like images and sounds.
3. In both VR and AR, users interact exclusively with real-world objects.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: a

Sol: Statement 1 – Correct. VR replaces the real world with a virtual environment, shutting out the physical surroundings.
Statement 2 – Correct. AR overlays virtual content on the real world, enhancing real-world perception.
Statement 3 – Incorrect. In VR, users do not interact with real-world objects, and in AR, the interaction is a mix—not exclusive to real-world elements.

Q2310. With reference to WAVES 2025, consider the following statements:
1. It is an initiative of the Ministry of Electronics and Information Technology, Government of India.
2. The event is focused on promoting Extended Reality (XR), Virtual Reality (VR), and Augmented Reality (AR).
3. WAVES 2025 stands for World Audio Visual & Entertainment Summit.
Which of the above statements is/are correct?
(a) 2 and 3 only
(b) 1 and 3 only
(c) 1 and 2 only
(d) 1, 2 and 3

Ans: a

Sol: Statement 1 – Incorrect. WAVES 2025 is organized by the Ministry of Information and Broadcasting, not the Ministry of Electronics and IT.
Statement 2 – Correct. The summit focuses on promoting immersive technologies such as XR, VR, and AR.
Statement 3 – Correct. WAVES stands for World Audio Visual & Entertainment Summit.

Topic 803

803. SPHEREx-NASA's new space telescope

Current news?

- **NASA's new space telescope, SPHEREx**, is scheduled to launch on February 28, 2025, aboard a **SpaceX Falcon 9 rocket** from Vandenberg Space Force Base, **California.**
- Mission Duration: **2 years.**

Objectives

- Study the **formation of the universe galaxy evolution,** and locate **water & other life-forming molecules in the Milky Way.**

Why SPHEREx is Unique?

1. Will create the "Most Colourful" Map of the Cosmos

- SPHEREx will detect **both optical and infrared light.**

Comparison with other telescopes:

a. James Webb Space Telescope (JWST)

- Specializes in **infrared**, but observes **small regions.**

b. Hubble Space Telescope

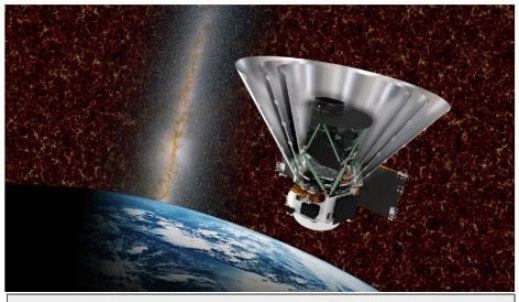
- Specializes in **optical light.**

c. SPHEREx

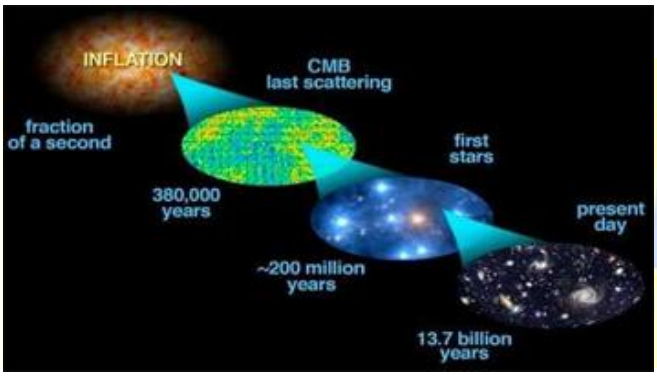
- Will image the **entire sky in high-resolution infrared and optical.**
- Entire celestial sky will be **mapped in 102 infrared colours for the first time in humanity's history.**

2. Studying Cosmic Inflation

3. Exploring the Milky Way for Life-Forming Molecules (biogenic molecules)



Sectional view of the SPHEREx with cosmic structures in the background



What is Cosmic inflation?

- It refers to a period which took place **around 14 billion years ago**,immediately after the Big Bang.
- During this the **universe expanded faster than the speed of light** for a fraction of a second.

Q2311. With reference to NASA's upcoming SPHEREx mission, consider the following statements:
1. SPHEREx will be launched aboard a SpaceX Falcon 9 rocket and is designed to operate for two years.
2. It will create the first-ever high-resolution infrared map of the entire sky in 102 colours.
3. Unlike James Webb Space Telescope, SPHEREx will focus only on a limited region of space.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 – Correct. SPHEREx is scheduled to launch on Feb 28, 2025, using a Falcon 9 rocket with a 2-year mission duration.
Statement 2 – Correct. It will image the entire sky in 102 infrared colours, a first in human history.
Statement 3 – Incorrect. SPHEREx, unlike JWST, does not focus only on small regions—it will map the entire celestial sky.

Q2312. With reference to the scientific objectives of the SPHEREx mission, consider the following statements:
1. It aims to study cosmic inflation and galaxy evolution.
2. It will detect both infrared and ultraviolet light to identify biogenic molecules.
3. SPHEREx will assist in locating water and other molecules linked to life in the Milky Way.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: c

Sol: Statement 1 – Correct. Studying cosmic inflation and galaxy evolution is a key goal of SPHEREx.
Statement 2 – Incorrect. SPHEREx will detect infrared and optical light, not ultraviolet.
Statement 3 – Correct. It will explore the Milky Way for biogenic molecules like water.

Q2313. Consider the following pairs regarding space telescopes and their capabilities:

Space Telescope	Specialization
James Webb Space Telescope	Entire-sky optical mapping
Hubble Space Telescope	Primarily infrared observation
SPHEREx	Infrared and optical full-sky map

How many of the above pair(s) is/are correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

Ans: a

Sol: JWST does not map the entire sky; it specializes in infrared and focuses on small regions → **Incorrect match.**
Hubble primarily observes in optical, not infrared → **Incorrect match.**
SPHEREx will map the entire sky using both infrared and optical light → **Correct match.**

Topic 804

804. Ghost Riders in the Sky

- A **US based private space agency**, **Firefly Aerospace's** successfully **launched a moon lander Blue Ghost Mission 1.**
- It is only the **second private mission** to achieve this milestone and the **first to land upright.**
- The mission, **nicknamed "Ghost Riders in the Sky",** is part of **NASA's Artemis program.**
- It aims to **reduce costs** and **support future astronaut missions.**

Note-

- The **first private mission** to successfully land on the Moon was carried out by company **Intuitive Machines'** named **Nova-C lander, named "Odysseus",** which landed on February 22, **2024.**

The mission is aimed at reducing costs and supporting Artemis, the programme designed to return astronauts to the moon. AP

Q2314. With reference to the mission "Ghost Riders in the Sky," consider the following statements:
1. It refers to a moon mission by Firefly Aerospace, a private U.S.-based space company.
2. The mission is part of NASA's Artemis program and aims to support future crewed missions.
3. It is the first private moon mission ever successfully landed on the lunar surface.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 – Correct. Firefly Aerospace successfully launched the "Blue Ghost Mission 1" nicknamed "Ghost Riders in the Sky".
Statement 2 – Correct. The mission is part of NASA's Artemis program, designed to lower costs and aid future astronaut missions.
Statement 3 – Incorrect. The first private mission to land on the Moon was Intuitive Machines' Odysseus (Nova-C lander) on Feb 22, 2024.

Q2315. Consider the following pairs regarding recent private moon missions:

Private Company	Moon Lander Name
Intuitive Machines	Odysseus (Nova-C)
Firefly Aerospace	Blue Ghost
Astrobotic	Artemis Lander

How many of the above pair(s) is/are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Intuitive Machines → Odysseus (Nova-C) → Correct.
Firefly Aerospace → Blue Ghost → Correct.
Astrobotic → Artemis Lander → Incorrect. Astrobotic launched Peregrine, not "Artemis Lander".

Q2316. With reference to the Blue Ghost Mission 1, consider the following statements:
1. It is the first private moon lander to achieve an upright landing on the lunar surface.
2. It was launched under NASA's Commercial Lunar Payload Services (CLPS) initiative.
3. The mission's nickname "Ghost Riders in the Sky" refers to its planned Mars flyby phase.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1 only

Ans: d

Sol: Statement 1 – Correct. It was the first private lander to land upright.
Statement 2 – Incorrect. There's no direct mention of CLPS in the provided info.
Statement 3 – Incorrect. The nickname "Ghost Riders in the Sky" is related to the mission's name, not a Mars flyby.

Topic 805

805. India Semiconductor Mission (ISM)

- The **India Semiconductor Mission (ISM)** is a **government initiative** launched in **2021** part of **Atma Nirbhar Bharat** initiative.
- Implemented by **Ministry of Electronics and Information Technology (MeitY)**.

Initiatives under India Semiconductor Mission (ISM)

1. Semicon India Programme
- The government has **allocated ₹76,000 crore** (~$10 billion) under the **Semicon India Programme** to support **semiconductor manufacturing.**

2. Design-Linked Incentive (DLI) Scheme
- To **encourages startups** and companies for local designing of semiconductor chips.

3. Strategic Partnership
- Collaborates with **global semiconductor firms** and countries like the **US, Japan, Taiwan, and EU nations** to boost investments.

Upcoming Semiconductor projects in India

1. Semiconductor fab in Dholera, Gujarat
- The facility is projected to produce **50,000 wafers per month** and will require an **investment of Rs 91,000 crore.**
- The Semiconductor fabrication units will be set up by the **Tata Group** in collaboration with **Powerchip** (Powerchip Semiconductor Manufacturing Corp-PSMC) **Taiwan.**

2. Semiconductor unit in Sanand, Gujarat
- This will be established by **CG Power**, in conjunction with **Japan's Renesas Electronics Corp** and **Stars Microelectronics of Thailand,** with an investment of Rs 7,600 crore.

3. Semiconductor unit in Morigaon, Assam
- This will be set up by the **Tata Semiconductor Assembly and Test Pvt Ltd (TSAT),** with an investment of **Rs 27,000 crore.**
- The **Morigaon facility** is expected to produce up to **48 million semiconductor chips** per day.
- The facility is projected for **completion by mid-2025.**
- Assam government has given 1**50-acre land to Tata group for Re 1.**
- **1800 youths from Assam**, mainly women, are being trained in **Bengluru.**

Q2317. With reference to the India Semiconductor Mission (ISM), consider the following statements:
1. It was launched in 2021 as a part of the Atma Nirbhar Bharat initiative.
2. The mission is being implemented by the Ministry of Heavy Industries.
3. It includes the Semicon India Programme and the Design-Linked Incentive Scheme.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 – Correct. The ISM was launched in 2021 under the Atma Nirbhar Bharat initiative.
Statement 2 – Incorrect. The Ministry of Electronics and Information Technology (MeitY) implements the mission, not the Ministry of Heavy Industries.
Statement 3 – Correct. Both the Semicon India Programme and DLI Scheme are part of ISM.

Q2318. Consider the following pairs with respect to semiconductor projects under the India Semiconductor Mission:

Location	Key Collaborators
Dholera, Gujarat	Tata Group and Powerchip (Taiwan)
Sanand, Gujarat	CG Power, Renesas (Japan), Stars Micro (Thailand)
Morigaon, Assam	Tata Group and Renesas Electronics

How many of the above pairs are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Dholera: Correct – Tata Group with Powerchip (Taiwan).
Sanand: Correct – CG Power with Renesas (Japan) and Stars Microelectronics (Thailand).
Morigaon: Incorrect – It is being developed by Tata Semiconductor Assembly and Test Pvt Ltd (TSAT), not Renesas.

Q2319. With reference to the upcoming semiconductor facility in Morigaon, Assam, consider the following statements:
1. It is projected to produce up to 48 million semiconductor chips per day.
2. The Assam government has allotted 150 acres of land to the Tata Group for ₹1.
3. The project will be implemented by CG Power with support from Japanese and Thai partners.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All three

Ans: a

Sol: Statement 1 – Correct. The facility in Morigaon is expected to produce 48 million chips/day.
Statement 2 – Correct. The Assam govt allotted land for ₹1 to Tata Group.
Statement 3 – Incorrect. The facility is by Tata Semiconductor Assembly and Test Pvt Ltd, not CG Power.

Topic 806

806. AI Kosha

- **DeepSeek**, a Chinese AI firm that **trained a LLM** at a **fraction of the cost** compared to Western firms like **Google and OpenAI.**
- **Inspired by DeepSeek**,the government of India is working on an **indigenous foundational AI model.**
- The government has already launched **India AI Mission,** which has an outlay of **₹10,370 crore** for **5 years**.

7 Key Features of India AI Mission-

1. IndiaAI Compute Capacity
- Build a high-end scalable AI computing ecosystem to cater to the increasing demands from India's rapidly expanding AI startups.

2. IndiaAI Innovation Centre

3. IndiaAI Application Development Initiative
- This will promote AI applications in critical sectors for the problem statements sourced from Central Ministries, State Departments, etc.

4. IndiaAI FutureSkills
- Increase AI courses in undergraduate, Masters level, and Ph.D. programmes.

5. IndiaAI Startup Financing

6. Safe & Trusted AI

7. IndiaAI Datasets Platform
- This will streamline access to quality non-personal datasets for AI Innovation.

Current news?
- The Union government launched **AI Kosha**, a **platform for datasets storage** to support **AI model development.**
- It is **part** of the **IndiaAI Mission,**
- It is primarily for **non-personal data** and includes **316 datasets at launch.**

Q2320. With reference to the IndiaAI Mission, consider the following statements:
1. The mission has an outlay of ₹10,370 crore for five years.

2. It includes components like Safe & Trusted AI and IndiaAI FutureSkills.
3. It is implemented under the Ministry of Corporate Affairs.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 – Correct. The IndiaAI Mission has a budgetary outlay of ₹10,370 crore for a 5-year period.
Statement 2 – Correct. Both Safe & Trusted AI and IndiaAI FutureSkills are among the seven key pillars of the mission.
Statement 3 – Incorrect. The mission is not under the Ministry of Corporate Affairs; it is under the Ministry of Electronics and Information Technology (MeitY).

Q2321. Consider the following pairs regarding initiatives under the IndiaAI Mission:

Initiative	Objective
IndiaAI Application Development	Promotes AI use in critical sectors via govt-sourced problem statements
IndiaAI Startup Financing	Provides grants and investment to foreign AI companies in India
IndiaAI Datasets Platform	Provides access to non-personal datasets to foster AI innovation

How many of the above pair(s) is/are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: IndiaAI Application Development **– Correct.** It targets problem statements from various ministries for AI deployment.
IndiaAI Startup Financing **– Incorrect.** It is focused on Indian startups, not foreign firms.
IndiaAI Datasets Platform **– Correct.** It aims to provide non-personal datasets for AI model training.

Q2322. With reference to AI Kosha, recently launched by the Indian government, consider the following statements:
1. It is a platform for storing and accessing primarily non-personal datasets.
2. It was launched as part of the IndiaAI Mission.
3. It initially includes over 1000 datasets from private multinational companies.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All three

Ans: a

Sol: Statement 1 – Correct. AI Kosha focuses on non-personal data to support AI development.
Statement 2 – Correct. It is a key initiative under the IndiaAI Mission.
Statement 3 – Incorrect. At launch, it featured 316 datasets, and there is no mention of exclusive private multinational sources.

Topic 807

807. Security printing

What is Security Printing?

- It is a **specialized field of printing** that incorporates unique **design elements and technologies** to **prevent counterfeiting, forgery**, and **tampering** of **valuable documents** and products.
- Security printing is **used to protect high-value** and **sensitive materials,** ensuring they cannot be **easily duplicated or altered.**

It is commonly used in
a. Currency (banknotes and coins)
b. Passports and identification documents
c. Bank cheques and credit cards
d. Legal documents (property deeds, stock certificates).

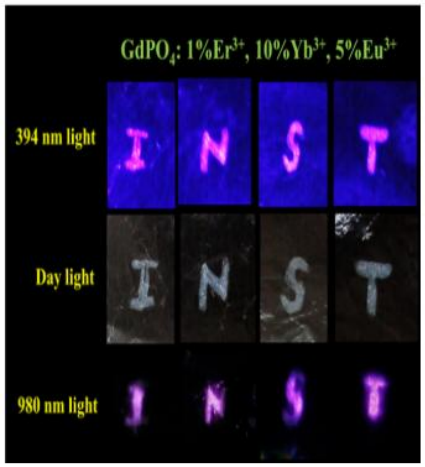
Current news?

- **Scientists** from **Institute of Nano Science and Technology (INST), Mohali** and **BARC Mumbai** developed a **nanoparticle-based security feature** for improved **anti-counterfeiting.**

- They created **strontium bismuth fluoride (SrBiF) nanoparticles,** which show **fluorescence** under both **ultraviolet (UV) and infrared (IR) light.**
- **Traditional fluorescent inks** are **visible** under only **one type of light**, making them **easier to replicate.**

Fluorescence meaning

- **Fluorescence** is simply defined as the **absorption** of **electromagnetic radiation** at one **wavelength** and its **reemission** at **another,** especially light **in visible range.**



SrBiF nanoparticles-unique features

- The **nanoparticles absorb light** at **one wavelength** and **emit light** at a **longer wavelength.**
- In the **365-nm UV range**, the material glows in **green.**
- In the **980-nm infrared (IR) range,** the same material fluoresces **red.**
- This dual fluorescence property **makes counterfeiting much harder.**

Q2323. With reference to Security Printing, consider the following statements:
1. It is used only for currency and passports to prevent counterfeiting.
2. Security printing often uses special materials, designs, or inks that cannot be easily reproduced.
3. It includes features that protect legal documents such as property deeds and stock certificates.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 – Incorrect. Security printing is not limited to currency and passports; it extends to ID cards, cheques, legal documents, and more.
Statement 2 – Correct. It involves special technologies like fluorescent inks, holograms, and watermarks to prevent forgery.
Statement 3 – Correct. Legal documents such as property deeds and stock certificates are also protected using security printing.

Q2324. Consider the following statements about the nanoparticle-based security feature recently developed by Indian scientists:
1. The feature uses SrBiF nanoparticles that fluoresce under both UV and IR light.
2. Traditional fluorescent inks are typically visible under multiple types of light.
3. The nanoparticles were developed by scientists from BARC Mumbai and INST Mohali.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All three

Ans: c

Sol: Statement 1 – Correct. SrBiF nanoparticles glow green under UV (365 nm) and red under IR (980 nm).
Statement 2 – Incorrect. Traditional fluorescent inks generally work under only one light source, not multiple.
Statement 3 – Correct. The research is a collaboration between BARC Mumbai and INST Mohali.

Q2325. Consider the following pairs regarding features of SrBiF nanoparticles:

Wavelength Range	Fluorescent Color Produced
365-nm UV Light	Green
980-nm IR Light	Red
500-nm Blue Light	Yellow

How many of the above pair(s) is/are correctly matched?
(a) Only one
(b) Only two
(c) All three

(d) None

Ans: b

Sol: 365-nm UV → **Green Correct**
980-nm IR → **Red Correct**
500-nm Blue → **Yellow Incorrect –** this pair is not mentioned or validated in the current research.

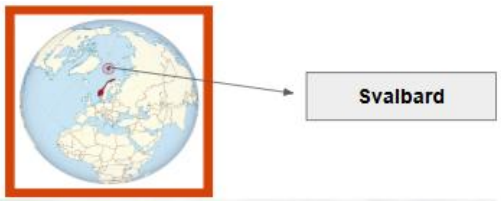
Topic 808

808. Svalbard Global Seed Vault

- Svalbard is **part of Norway.**
- Svalbard has **largest backup facility** for the **world's crop diversity** known as **Svalbard Global Seed Vault.**
- The Seed Vault **objective** is to **safeguard** as much of the **world's unique crop genetic material** as possible.
- It offers **free-of-charge,** long-term **storage** of seed duplicates from international, national and regional gene banks and institutions.
- The **ownership** of the seeds **remains with the depositing party.**
- The facility serves a **humanitarian purpose**.
- The seed vault is also known as **doomsday seed vault** as it preserves important seeds that can be **used to revive plant diversity** even if the entire biodiversity is damaged.
- It is **part of the international system** for **conserving plant genetic diversity** started **by FAO.**

Current news?

- Recently, the Svalbard Global Seed Vault received more than **14,000 new seed samples.**



Svalbard Global Seed Vault

Q2326. With reference to the Svalbard Global Seed Vault, consider the following statements:
1. It is located in Svalbard, which is under the jurisdiction of Norway.
2. It stores original seeds used for regular farming and trading across the globe.
3. It is part of an international system for conserving plant genetic diversity initiated by the Food and Agriculture Organization (FAO).
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 – Correct. Svalbard is a Norwegian archipelago, and the Seed Vault is situated there.
Statement 2 – Incorrect. It stores duplicate seeds from gene banks, not seeds meant for commercial farming or trade.
Statement 3 – Correct. The vault is part of the international system for plant genetic conservation initiated by FAO.

Q2327. Consider the following statements about the Svalbard Global Seed Vault:
1. The vault provides free long-term storage of seed duplicates submitted by institutions around the world.
2. The depositing institutions lose ownership of the seeds once stored in the vault.
3. The vault plays a humanitarian role by preserving genetic material for use during global crises.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All three

Ans: c

Sol: Statement 1 – Correct. Storage is free of charge, and duplicates are welcomed from recognized gene banks.
Statement 2 – Incorrect. Ownership of seeds remains with the depositing party.

Statement 3 – Correct. It is considered a "doomsday vault", offering humanitarian support by safeguarding crop diversity.

Q2328. Which of the following best explains why the Svalbard Global Seed Vault is referred to as a "doomsday vault"?
(a) It is designed to supply seeds for future space colonization.
(b) It holds original seed samples for regular distribution in agriculture.
(c) It stores seed duplicates to revive plant life in the event of global biodiversity loss.
(d) It is a military-grade facility intended for biosecurity research.

Ans: c

Sol: The term "doomsday vault" signifies the vault's role in preserving genetic material that could be used to restore biodiversity in case of global disasters such as war, climate catastrophes, or crop extinction.

Topic 809

809. Starlink in India

- Starlink is a satellite **internet constellation** developed by **SpaceX.**
- It aims at providing **satellite based high-speed**, **low-latency broadband internet** globally.

Key Features of Starlink

1. Uses Low Earth Orbit (LEO) Satellites

- Starlink satellites orbit at ~550 km, **reducing latency**.

2. Massive Satellite Constellation

- As of now, over **5,000** satellites are in orbit, with plans for over **12,000 satellites.**

3. Direct-to-User Service

- Users receive internet through Starlink ground terminals **(small dish antennas)**.
- Works in **rural and isolated locations** where traditional internet services are unavailable.

Applications of Starlink

1. Bridging the Digital Divide

2. Military & Defense Use

3. Astronomy & Research

Concerns

1. Space Debris Concerns

2. Astronomy Interference

Current news?

- India's leading telecom operators, Bharti **Airtel and Reliance Jio,** have entered into **partnerships with SpaceX's Starlink** to introduce **satellite-based internet services** across the country.
- As per the agreement **Airtel and Jio** will **sell Starlink equipment** at **retail outlets and assist** in **marketing and distribution.**
- However, **Starlink** still **needs to secure regulatory licenses** from the Indian government.

Q2329. With reference to Starlink and its operations, consider the following statements:
1. Starlink satellites orbit in Low Earth Orbit (LEO), typically at an altitude of around 550 km.
2. The primary advantage of LEO satellites is their ability to offer low-latency internet services.
3. Starlink satellites transmit internet signals directly to users without the need for ground-based terminals.
How many of the above statement(s) is/are correct?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: b

Sol: Statement 1 – Correct. Starlink uses LEO satellites at about 550 km altitude.
Statement 2 – Correct. Their proximity to Earth allows low latency, improving internet performance.
Statement 3 – Incorrect. Users require Starlink terminals (dish antennas) to receive the signal directly from satellites.

Q2330. Consider the following statements regarding the current status of Starlink in India:
1. Starlink has already received all necessary regulatory licenses from the Indian government.
2. Both Bharti Airtel and Reliance Jio have entered partnerships with Starlink for distribution in India.
3. The partnerships involve retail-level sale and promotion of Starlink ground equipment.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All three

Ans: b

Sol: Statement 1 – Incorrect. Starlink is yet to secure regulatory approval in India.
Statement 2 – Correct. Both Airtel and Jio have partnered with Starlink for future services.
Statement 3 – Correct. They will assist in marketing, distribution, and equipment retail.

Q2331. Which of the following is/are valid concerns associated with the Starlink satellite internet constellation?
1. Potential interference with astronomical observations.
2. Contribution to the problem of space debris.
3. Security risks due to military use of the network.
How many of the above option(s) is/are valid concerns?
(a) Only one
(b) Only two
(c) All three
(d) None

Ans: c

Sol: All three statements are correct.
Astronomers have raised concerns over satellite glare interfering with observations.
The massive satellite constellation increases the risk of space debris.
Its potential military applications have also raised security and strategic concerns.

Topic 810

810. Organic molecules

Organic molecules can be classified into **four major types:**

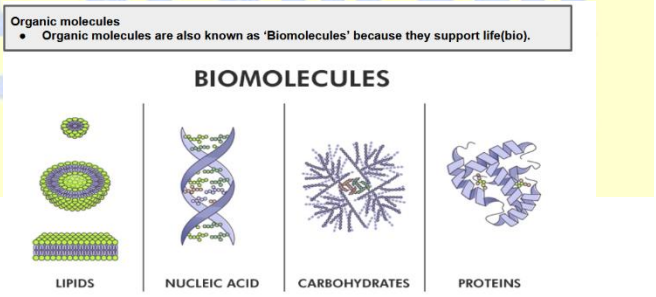
a. Carbohydrates
- Composed of **carbon (C), hydrogen (H), and oxygen (O)** in a 1:2:1 ratio.Examples: Glucose ($C_6H_{12}O_6$), Starch, Cellulose.
- Function: Provides **energy and structural support** in **plants and animals**.

b. Proteins
- Made up of **amino acids** (containing C, H, O, N, and sometimes S).
- Function: **Growth, repair, immune response** in body.

c. Lipids (Fats & Oils)
- Composed of **carbon, hydrogen, and oxygen**, but with a **higher proportion of hydrocarbons.**
- Examples: Triglycerides, Phospholipids, Steroids.
- Function: Energy storage, cell membrane structure, **hormone production.**

d. Nucleic Acids
- Made of nucleotides (composed of a sugar, phosphate group, and nitrogenous base).
- Examples: **DNA** (Deoxyribonucleic Acid), **RNA** (Ribonucleic Acid).

Function: Stores and transfers **genetic information**.



How life on Earth started?
- No direct answer- only some hypothesis given

1. Darwin's "Warm Little Pond" hypothesis
- **Darwin speculated** that life could have originated in a **"warm little pond"** containing **ammonia, phosphoric salts**, **light, heat**, and **electricity**.

2. Miller-Urey Experiment (1952)
- simulated **early Earth conditions** and produced **amino acids because of lightning.**

Q2332. With reference to Carbohydrates, consider the following statements:
1. They are composed of carbon, hydrogen, and oxygen in a 1:2:1 ratio.
2. They function primarily in hormone production and genetic information storage.

3. Examples include glucose, starch, and cellulose.
Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3
Ans: c

Sol: Statement 1 is correct: Carbohydrates have the general formula CH2O\text {CH}_2\text{O}, maintaining a carbon:hydrogen:oxygen ratio of 1:2:1.
Statement 2 is incorrect: Hormone production and genetic information storage are not primary functions of carbohydrates; they are more associated with lipids and nucleic acids, respectively.
Statement 3 is correct: Glucose, starch, and cellulose are all classic examples of carbohydrates.

Q2333. With reference to Proteins, consider the following statements:
1. Proteins are made up of amino acids containing carbon, hydrogen, oxygen, nitrogen, and sometimes sulfur.
2. They play a key role in growth, repair, and immune response in the body.
3. Proteins are composed of nucleotides, sugar, and phosphate groups.
Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: a

Sol: Statement 1 is correct: Proteins are polymers of amino acids, which contain C, H, O, N, and sometimes S (sulfur).
Statement 2 is correct: Proteins are essential for body growth, tissue repair, and immune responses (e.g., antibodies are proteins).
Statement 3 is incorrect: Nucleotides, sugars, and phosphate groups make up nucleic acids, not proteins.

Q2334. With reference to theories on the origin of life, consider the following statements:
1. The Miller-Urey experiment simulated early Earth conditions and resulted in the formation of amino acids.
2. Darwin's hypothesis proposed that life may have started in a "warm little pond" with chemicals like ammonia and phosphoric salts.
3. Both hypotheses provide conclusive scientific evidence for the exact origin of life.
Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: a

Sol: Statement 1 is correct: The Miller-Urey experiment (1952) successfully produced amino acids, simulating early Earth conditions with gases and electric sparks (lightning).
Statement 2 is correct: Darwin's "warm little pond" hypothesis suggested that life might have begun in a chemically rich, warm environment.
Statement 3 is incorrect: Neither hypothesis gives conclusive evidence. They are scientific speculations or models of how life may have started.

Topic 811

811. Sunita Williams & others return from space

- American astronauts **Sunita Williams** and **Butch Wilmore** traveled to the **International Space Station (ISS)** in **June 2024** and were supposed to **return within a week**.
- However, their spacecraft, **Boeing's Starliner, developed technical problems**, making it unsafe for their return.
- **Starliner returned to Earth safely** in September 2024, but the **two astronauts remained stranded** on the ISS, **waiting for an alternative return** arrangement.
- **Two other astronauts, Nick Hague** and **Aleksandr Gorbunov,** will also return with them.
- A **SpaceX Dragon spacecraft,** which had **taken four astronauts** to the ISS on a routine assignment, will **bring them back on its return journey.**

- **Williams and Wilmore** will **return after 286 days** in space.

Single longest stay

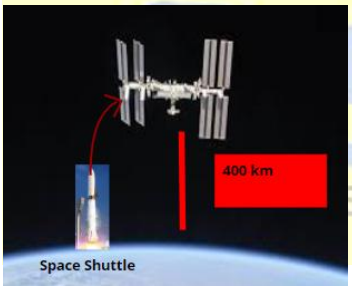
- **Valeri Polyakov** (Soviet cosmonaut) holds the **record of 438 days** at the **Mir space station (1994-1995).**
- Mir **predated ISS** and was **functional for 15 years** (1986 to 2001).

Overall longest stay

- **Oleg Kononenko (Russia)** has spent **1,111 days** in total across five missions.

Sunita Williams and Butch Wilmore at the ISS in July 2024. *NASA TV via The NYT*

Sunita Williams-was awarded the **Padma Bhushan** by GoI in **2008**



Health effects of long space stays

- **Bone density** and **muscle mass deteriorate** faster in space than on Earth.
- **Low gravity** affects **brain fluids**, potentially altering brain structure and vision.
- **Extended stays** increase the risk of **heart disease.**

International Space Station

- **1993–2030(expected)**
- A collaborative project of the US (NASA), Russia's (Roscosmos), Europe's (ESA, 11 members), Japan's (JAXA), and Canada's (CSA) space agencies. **Total: 15 members.**

Q2335. With reference to the return of astronauts from the ISS in 2024, consider the following statements:
1. Sunita Williams and Butch Wilmore returned to Earth in Boeing's Starliner spacecraft after 286 days in space.
2. Due to technical problems with Starliner, they remained stranded on the ISS.
3. They will return to Earth with Nick Hague and Aleksandr Gorbunov on a SpaceX Dragon spacecraft.
Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: b
Sol: Statement 1 is incorrect: Although they spent 286 days in space, they did not return in Starliner; the Starliner developed issues and returned empty or separately.
Statement 2 is correct: The astronauts were stranded on the ISS due to Starliner's technical problems.
Statement 3 is correct: They are being brought back by a SpaceX Dragon spacecraft, along with Nick Hague and Aleksandr Gorbunov.

Q2336. With reference to long-duration space missions, consider the following statements:
1. Valeri Polyakov holds the record for the single longest stay in space, spending 438 days aboard the ISS.
2. Oleg Kononenko has spent a total of 1,111 days in space over five missions.
3. Mir, the space station where Polyakov stayed, was operational from 1986 to 2001.
Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: b

Sol: Statement 1 is incorrect: Polyakov stayed for 438 days on Mir, not the ISS.
Statement 2 is correct: Oleg Kononenko has spent 1,111 days in space across five missions.
Statement 3 is correct: The Mir space station was functional from 1986 to 2001.

Q2337. With reference to the effects of long stays in space and the ISS, consider the following statements:

1. Long space missions can lead to faster deterioration of bone density and muscle mass.
2. Low gravity affects brain fluids, potentially altering brain structure and vision.
3. The International Space Station is a joint project involving only NASA and Roscosmos.
Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: a

Sol: Statement 1 is correct: In microgravity, bone and muscle loss accelerates significantly.
Statement 2 is correct: Space travel alters brain fluids, which can affect vision and brain structure.
Statement 3 is incorrect: The ISS is a collaboration between 15 nations, including NASA, Roscosmos, ESA (11 members), JAXA, and CSA, not just NASA and Roscosmos.

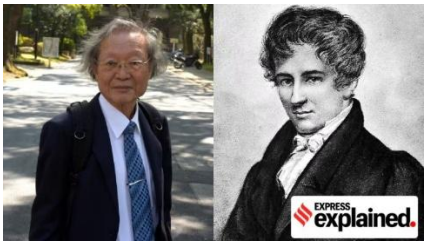
Topic 812

812. Abel Prize

- The Abel Prize "recognises pioneering scientific **achievements in mathematics.** ● It is named after **Norwegian mathematician Niels Henrik Abel** (1802-29).
- The Abel prize is often considered to be an **equivalent of the Nobel prize.**
- First awarded in 2003, awarded annually since then. The prize includes a **monetary award** of 7.5 million kroner (roughly $720,000) and a **glass plaque** designed by Norwegian artist Henrik Haugan.

Current news?

- **Japanese mathematician Masaki Kashiwara** was awarded this **Abel Prize for 2025.**
- Kashiwara was honoured for his **fundamental contributions** to **algebraic analysis** and representation theory.
- He is indeed the **first Japanese** national to receive the Abel Prize.



Q2338. With reference to the Abel Prize, consider the following statements:
1. It is awarded annually to recognize significant achievements in the field of mathematics.
2. It was named after the German mathematician Niels Henrik Abel.
3. It is often regarded as the Nobel equivalent for mathematics.
Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans: b

Sol: Statement 1 is correct: The Abel Prize is awarded annually to recognize pioneering contributions in mathematics.
Statement 2 is incorrect: Niels Henrik Abel was Norwegian, not German.
Statement 3 is correct: The prize is often seen as the mathematical equivalent of the Nobel Prize.

Q2339. With reference to the 2025 Abel Prize winner, consider the following statements:
1. Masaki Kashiwara is the first Japanese mathematician to receive the Abel Prize.
2. He was awarded for his work in algebraic analysis and representation theory.
3. He jointly won the prize with another mathematician.
Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: a

Sol: Statement 1 is correct: Masaki Kashiwara is the first Japanese national to be awarded the Abel Prize.

Statement 2 is correct: He was recognized for his fundamental contributions to algebraic analysis and representation theory.
Statement 3 is incorrect: There is no mention of a joint winner for the 2025 award.

Q2340. With reference to the features of the Abel Prize, consider the following statements:
1. It was first awarded in 2003.
2. The prize includes a glass plaque designed by a Japanese artist.
3. Winners receive a monetary award of 7.5 million kroner.
Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans: b

Sol: Statement 1 is correct: The Abel Prize was instituted in 2003.
Statement 2 is incorrect: The glass plaque is designed by Norwegian artist Henrik Haugan, not a Japanese artist.
Statement 3 is correct: The monetary reward is 7.5 million kroner (approx. $720,000).

Topic 813

813. Grok

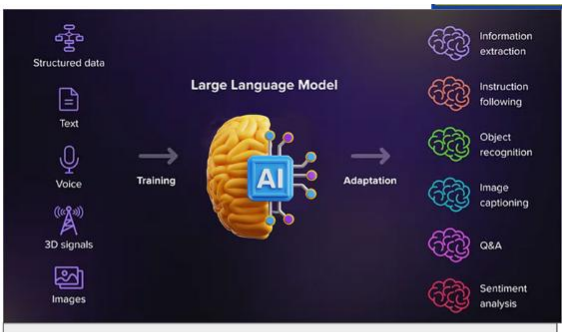
- **Grok** is an **AI chatbot** developed by **xAI** (Elon Musk's company) and **integrated with X** (formerly Twitter).
- It uses **large language models (LLMs)** to respond to user questions.
- Not a human, but a machine-learning-based system generating responses **using high-end computing infrastructure.**

Other examples of Large Language Model

- ChatGPT (by Open AI),
- Gemini (Google)
- Llama (Meta).

What is concerns regarding Grok?

- Grok recently sparked **controversy** in India after **generating abusive, sensational, and politically sensitive responses**, especially in Hindi.
- Grok gave profane or **sweeping answers** to **politically loaded questions** (e.g., about Indian political leaders).



What Large Language Model(LLMs) do?

- LLMs can be used for **generative AI** (artificial intelligence) to produce **human like content** based on **input prompts.**

Q2341. With reference to Grok, consider the following statements:
1. Grok is an AI chatbot developed by OpenAI.
2. It is integrated with the social media platform X (formerly Twitter).
3. Grok uses large language models (LLMs) to generate responses.
Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: b

Sol: Statement 1 is incorrect: Grok is developed by xAI, not OpenAI.
Statement 2 is correct: Grok is integrated with X (formerly Twitter).
Statement 3 is correct: Grok is based on large language models (LLMs).

Q2342. With reference to large language models (LLMs), consider the following statements:
1. Gemini, ChatGPT, and Llama are all examples of LLMs.
2. Gemini was developed by Microsoft.
3. Llama is a product of Meta.
Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans: b

Sol: Statement 1 is correct: Gemini (by Google), ChatGPT (by OpenAI), and Llama (by Meta) are all LLMs.
Statement 2 is incorrect: Gemini was developed by Google, not Microsoft.
Statement 3 is correct: Llama is developed by Meta.

Q2343. What is/are the concern(s) raised regarding Grok's functioning in India?
1. It provided abusive and sensational responses to political queries.
2. It only functions in English and failed to translate properly into Hindi.
3. It made politically sensitive remarks, especially in Hindi.
Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: c

Sol: Statement 1 is correct: Grok sparked controversy for abusive and sensational responses to political questions.
Statement 2 is incorrect: The concern was not about translation but about tone and content in Hindi.
Statement 3 is correct: Grok gave politically sensitive and profane answers, especially in Hindi.

Topic 814

814. DNA Fingerprinting

DNA

- Found inside **Chromosome**.
- There are **23 pairs of Chromosome in each cell.**
- In each pair **one chromosome** is **from mother and other from father.**

DNA polymorphisms

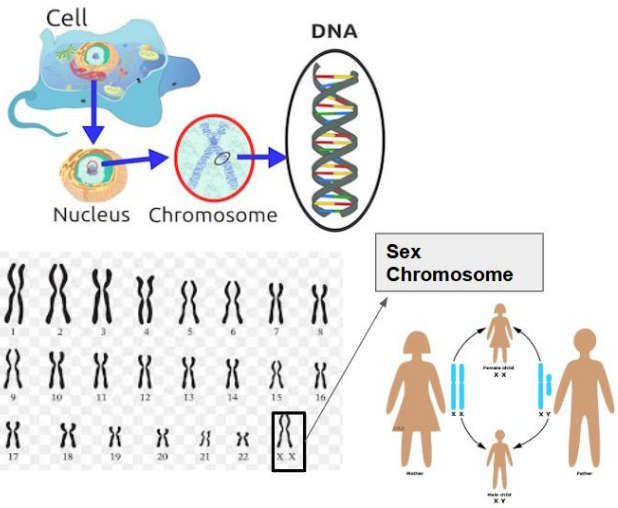
- DNA carries **genetic information.**
- There are **minor differences** in **DNA sequences** among individuals known as **Polymorphisms.**

How is DNA Profiling/fingerprinting is done?

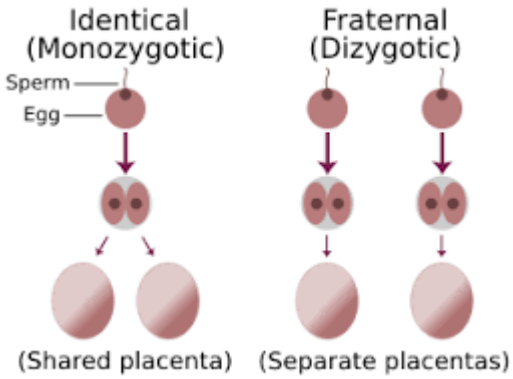
- Small amount of DNA sample from **blood,saliva,hair etc** is taken.
- If only a tiny amount of DNA is available, it is copied many times using a technique called **PCR (Polymerase Chain Reaction).**
- Then **DNA** is studied to identify an individual.

DNA profiling of twins

- Every individuals have **different DNA profile except** for **identical (Monozygotic) Twins**.
- **Identical twins** come from the **same fertilized egg.**
- **Dizygotic Twins-** come from **two different eggs** fertilized by **two different sperms** have **50% DNA profile common.**



Monozygotic twin	Dizygotic twin
Usually Identical	Different



Q2344. With reference to DNA fingerprinting, consider the following statements:
1. DNA polymorphisms refer to minor differences in DNA sequences among individuals.
2. The Polymerase Chain Reaction (PCR) technique is used to increase the quantity of DNA available for analysis.
3. DNA fingerprinting cannot be performed using saliva or hair samples.
Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: a

Sol: Statement 1 is correct: Polymorphisms are natural variations in DNA sequences among individuals.
Statement 2 is correct: PCR is used to amplify tiny DNA samples.
Statement 3 is incorrect: DNA can indeed be extracted from saliva, blood, hair, etc.

Q2345. Which of the following statements best explains why identical twins cannot be distinguished using DNA fingerprinting?
(a) They have 50% DNA in common.
(b) They are born on the same day.
(c) They share exactly the same DNA sequence.
(d) They have similar physical features.

Ans: c

Sol: Identical twins originate from the same fertilized egg and thus share the same genetic code, making them indistinguishable by DNA fingerprinting.

Q2346. Consider the following pairs:
Type of Twins Description
1. Monozygotic Twins From same fertilized egg → nearly identical DNA
2. Dizygotic Twins From different eggs and sperms → 100% same DNA
Which of the pairs given above is/are correctly matched?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

Ans: a

Sol: Monozygotic twins come from the same fertilized egg and have identical DNA.
Dizygotic twins come from separate eggs and sperms, and share only about 50% of their DNA, not 100%.

Topic 815

815. Gaia the cartographer retired

Gaia Mission

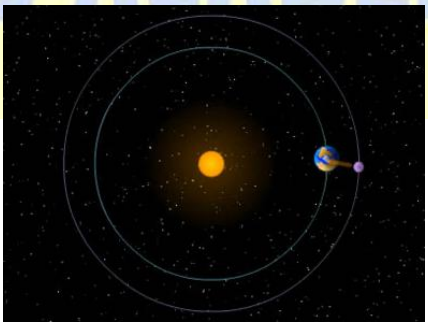
- Gaia was a **space observatory mission** by the **European Space Agency (ESA)**.
- Launched in **December 2013**.
- Purpose: To create the **most accurate 3D map** of the **Milky Way galaxy.**
- **Gaia** is known as the **cartographer of the cosmos**.

Major Achievements

- Made **3 trillion observations** of **2 billion stars** and celestial objects.
- Contributed to over **13,000 scientific publications**.
- Enabled **dynamic modeling** of how the **Milky Way galaxy evolves over time.**

Current news?

- Europe's space agency **retires Gaia** in 2025.



Position of Gaia mission

- Gaia was positioned in the **Lagrange point 2** (L2), around **1.5 million kilometres 'behind' the Earth,** when viewed from the Sun.
- This **effectively allows** the **spacecraft** to view the **larger cosmos** unhindered by the **planet, the Sun and the Moon.**

Q2347. With reference to the Gaia Mission, consider the following statements:
1. It was launched by the European Space Agency in 2013.
2. Its objective was to create the most accurate 3D map of the Milky Way galaxy.

3. Gaia was positioned at Lagrange Point 1 (L1) to minimize interference from the Sun.
Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: a

Sol: Statement 1 is correct: Gaia was launched by ESA in December 2013.
Statement 2 is correct: Its main aim was to build a 3D map of the Milky Way.
Statement 3 is incorrect: Gaia was placed at Lagrange Point 2 (L2), not L1. L2 helps in observing deep space without obstruction from Earth, Moon, or Sun.

Q2348. Why is Gaia often referred to as the "cartographer of the cosmos"?
(a) It maps the orbits of planets in the Solar System.
(b) It tracks asteroids and comets heading toward Earth.
(c) It creates a detailed 3D map of the Milky Way galaxy.
(d) It monitors space weather events near Earth.

Ans: c

Sol: Gaia's core purpose was to chart over 2 billion stars and celestial objects to produce the most precise 3D map of the Milky Way, which earned it the title "cartographer of the cosmos."

Q2349. Consider the following achievements of the Gaia Mission:
1. Recorded 3 trillion observations of stars and celestial objects.
2. Contributed to over 13,000 scientific papers.
3. Enabled accurate dynamic modeling of galaxy evolution.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: d

Sol: All three statements are correct:
Gaia made 3 trillion observations.
It led to over 13,000 scientific publications.
It significantly helped in understanding the dynamic evolution of the Milky Way.