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Detailed Explanation

Answers Answers Answers Answers Answers Answers Answers Answers Answers Answers

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1. Ans: C

Exp:

- **Semiconductors** are materials which have a conductivity between conductors (generally metals) and nonconductors or insulators (such as most ceramics).
 - ◆ Semiconductors can be pure elements, such as silicon or germanium, or compounds such as gallium arsenide or cadmium selenide.
 - ◆ They are **also known as integrated circuits or more commonly just chips**, they may be the tiniest yet most exacting product ever manufactured on a global scale.
- They have **four valence electrons in their outermost orbit** and are **formed due to covalent bonding**.
 - ◆ Conductors are formed using metallic bonding and **insulators are formed using ionic bonding**.
- The valence and conduction band in a semiconductor are separated by a forbidden energy gap of 1.1eV.
- Resistance is high in semiconductors whereas it is very small in conductors and very high in insulators.
 - ◆ **Semiconductors have negative temperature coefficients (conductors - positive and insulators - negative)**.
- **Hence, option C is correct.**

2. Ans: C

Explanation:

- Open source software (OSS) is **software that is distributed with its source code**, making it available for use, modification, and distribution with its original rights. **Hence, statement 1 is correct.**
 - ◆ **Source code** is the part of software that most computer users don't ever see.
- It's the code computer programmers **manipulate to control** how a program or application behaves.
 - ◆ OSS typically **includes a licence** that allows programmers to modify the software to best fit their needs and control how the software can be distributed. **Hence, statement 2 is correct.**
- The idea of making source code freely available originated in 1983 from an ideological movement informally founded by **Richard Stallman**, a programmer at MIT.

- ◆ Examples of **Linux, Mozilla Firefox, VLC media player, SugarCRM, etc.**

3. Ans: B

Exp:

- DRDO is the R&D (Research and Development) wing of the **Ministry of Defence** with a vision to empower India with cutting-edge defence technologies. **Hence statement 1 is not correct.**
- Its pursuit of self-reliance and successful indigenous development and production of strategic systems and platforms such as Agni and Prithvi series of missiles, Light Combat Aircraft, Tejas, multi-barrel rocket launcher, Pinaka, air defence system, Akash, a wide range of radars and electronic warfare systems, etc. have given quantum jump to India's military might, generating effective deterrence and providing crucial leverage.
- It was **formed in 1958** from the amalgamation of the Technical Development Establishment (TDEs) of the Indian Army and the Directorate of Technical Development & Production (DTDP) with the Defence Science Organisation (DSO). **Hence statement 2 is correct.**
 - ◆ It is a network of more than 50 laboratories which are deeply engaged in developing defence technologies covering various disciplines, like aeronautics, armaments, electronics, combat vehicles, engineering systems etc.

4. Ans: C

Exp:

Mutation, Variant and Strain

- When a virus replicates it doesn't always manage to produce an exact copy of itself.
 - ◆ This means that, over time, the virus may start to differ slightly in terms of its genetic sequence.
 - ◆ Any changes to the **viral genetic sequence during this process** is known as a **Mutation**.
- The words 'mutation' and 'variant' are sometimes used interchangeably, but they mean quite different things. A mutation is a single change in the genetic material of the virus (RNA in this case). A variant is the whole **sequence of the virus (the genome), which may contain one or more mutations**. **Hence, statements 1 and 2 are correct.**

- When a new variant has different functional properties to the original virus and becomes established in a population, it is sometimes referred to as a New Strain of the virus.

- ◆ All strains are variants, but not all variants are strains.

5. Ans: D

Exp:

- The **Indian Space Research Organisation (ISRO)** is the pioneer space exploration agency of India, headquartered at Bengaluru.
 - ◆ ISRO replaced its predecessor, INCOSPAR (Indian National Committee for Space Research), established by India's first Prime Minister Pt. Jawaharlal Nehru and scientist Vikram Sarabhai, considered amongst the founding fathers of the Indian space program.
- **Achievements of ISRO:**
 - ◆ The first Indian satellite, Aryabhata, was built by the ISRO and launched with the help of the Soviet Union on 19th April 1975.
 - ◆ The year 1980 marked the **launch of Rohini, which was the first satellite to be successfully placed in orbit by SLV-3**, an Indian made launch vehicle.
 - ◆ The PSLV (Polar Satellite Launch Vehicle) for placing satellites into polar orbits and the GSLV (Geosynchronous Satellite Launch Vehicle) for placing satellites into geostationary orbits.
 - ◆ Some remarkable space probes of ISRO include Chandrayaan-1 lunar orbiter, Mars Orbiter Mission (Mangalyaan-1) and ASTROSAT space observatory.
 - India launched Chandrayaan-2, its second lunar exploration mission after Chandrayaan-1 on 22nd July 2019.
- **Major ISRO Achievements of 2021:**
- **Amazonia-1: The 53rd flight of PSLV-C51 marked the first dedicated mission for New Space India Ltd (NSIL), the commercial arm of ISRO.**
 - Amazonia-1, the optical earth observation satellite of National Institute for Space Research (INPE), would provide remote sensing data to users for monitoring deforestation in the Amazon region and analysis of diversified agriculture across the Brazilian territory.

- ◆ **UNITYsat (three satellites):** They have been **deployed to provide Radio relay services.**

- ◆ SDSAT: Satish Dhawan Satellite (SDSAT) is a nano satellite intended to study the radiation levels/ space weather and demonstrate long range communication technologies.

- Hence, option D is correct.

6. Ans: C

Exp:

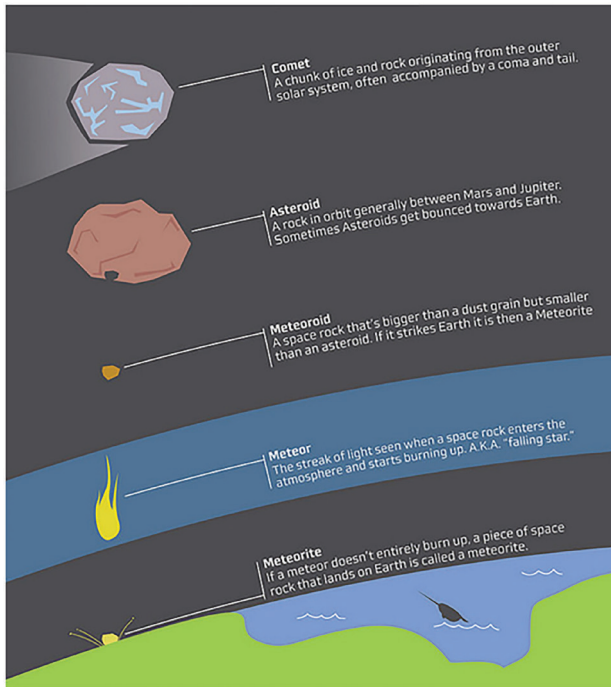
- 5G is the 5th generation mobile network. It is a new global wireless standard after 1G, 2G, 3G, and 4G networks.
 - ◆ The 5G networks **will operate in the mm Wave spectrum. Hence, statement 1 is correct.**
- **The mm-Wave spectrum** is a particular segment of the radio frequency spectrum that ranges between **24 GHz and 100 GHz.**
 - ◆ This spectrum, as the name suggests, **has a short wavelength**, and is appropriate to deliver **greater speeds and lower latencies.** This in turn makes **data transfer efficient and seamless** as the currently available networks work optimally only on lower frequency bandwidths.
- The mm- band had been the subject of controversy due to **out-of-band emissions into the passive satellite band used for weather satellites at 23.6-24 GHz.**
 - ◆ **Out-of-band emission** is emission on a frequency or frequencies immediately **outside the necessary bandwidth** which results from the modulation process.
 - ◆ The level of out-of-band emission can not be reduced without affecting the corresponding transmission of information.
- Hence, statement 2 is correct.

7. Ans: D

Exp:

Difference between Meteor, Meteorite and Meteoroid:

- The difference between a **meteor, meteorite and meteoroid** is nothing but where the object is.
- Meteoroids are objects **in space that range in size from dust grains to small asteroids.** "Think of them as "space rocks,".
- But when meteoroids **enter the Earth's atmosphere** they are called **meteors. Hence statement 1 is not correct.**
- But if a meteoroid **enters the Earth's atmosphere and hits the ground**, it is called a **meteorite. Hence statement 2 is not correct.**



8. Ans: C

Explanation:

- They are a set of **seventeen metallic elements**.
- These include the **fifteen lanthanides** on the **periodic table** in addition to **scandium and yttrium** that show similar physical and chemical properties to the lanthanides.
- These minerals have **unique magnetic, luminescent, and electrochemical properties** and thus are used in many modern technologies, including consumer electronics, computers and networks, communications, health care, national defense, etc. **Hence, statement 1 is correct.**
- They are a set of **seventeen metallic elements**.
 - ◆ The **17 Rare Earths** are cerium (Ce), dysprosium (Dy), erbium (Er), europium (Eu), gadolinium (Gd), holmium (Ho), lanthanum (La), lutetium (Lu), neodymium (Nd), praseodymium (Pr), promethium (Pm), samarium (Sm), scandium (Sc), terbium (Tb), thulium (Tm), ytterbium (Yb), and yttrium (Y). **Hence, statement 2 is correct.**

9. Ans: A

Exp:

- Technical textiles are **functional fabrics** that have applications across various industries including automobiles, civil engineering and construction, agriculture, healthcare, industrial safety, personal protection etc.

- ◆ Technical Textile products derive their demand from development and industrialization in a country.
- **Scenario of Technical Textile:**
 - ◆ The growth of technical textiles in India has **gained momentum in the past five years**, currently growing at an **8% per annum rate**.
 - It is aimed to **hasten this growth to 15-20% range** during the next five years.
 - ◆ The current world market is USD 250 billion and **India's share in it is USD 19 billion**.
 - ◆ India is an aspiring player **with USD 40 billion in this market (8% Share)**.
 - The **biggest players are the USA**, western Europe, China and Japan (20-40% share). **Hence, statement 3 is not correct.**
- **Initiatives Related to Technical Textile:**
 - ◆ **Production Linked Incentive (PLI) Scheme for Textiles Sector:** It aims to promote the production of high value Man-Made Fiber (MMF) fabrics, garments and technical textiles.
 - ◆ **Harmonized System of Nomenclature (HSN) Codes for Technical Textile:** In 2019, **100% FDI under Automatic Route:** The Government of India allows 100% **Foreign Direct Investment (FDI)** under automatic route. International technical textile manufacturers such as Ahlstrom, Johnson & Johnson etc have already initiated operations in India. **Hence, statement 1 is correct.**
 - ◆ **Technotex India:** It is a flagship event organized by the Ministry of Textiles, in collaboration with the **Federation of Indian Chambers of Commerce & Industry (FICCI)** and comprises exhibitions, conferences and seminars with participation of stakeholders from across the global technical textile value chain. **Hence, statement 2 is correct.**
 - ◆ **Amended Technology Upgradation Fund Scheme:** To improve exports and indirectly promote investments in textile machinery.

10. Ans: D

Exp:

- Features of 5G Technology:
 - ◆ **Millimeter wave spectrum:** The 5G networks will **operate in the millimetre wave spectrum (30-300 GHz)** which have the advantage of sending large amounts of data at very high speeds because the frequency is so high, it experiences little interference from surrounding signals. **Hence, statement 1 is correct.**

- ◆ **Upgraded LTE:** 5G is the latest **upgrade in the long-term evolution (LTE)** mobile broadband networks. **Hence, statement 2 is correct.**
- ◆ **Internet speed:** In the high-band spectrum of 5G, internet speeds have been tested to be as high as 20 Gbps (gigabits per second) as compared to the maximum internet data speed in 4G recorded at 1 Gbps.
 - **5G network speeds should have a peak data rate of 20 Gb/s** for the downlink and 10 Gb/s for the uplink. **Hence, statement 3 is correct.**

11. Ans: B

Exp:

Dark Matter:

- Dark matter, though never detected, is believed to be present in the entire universe. **Hence statement 1 is not correct.**
- It is presumed that primordial black holes, those that were formed in the early age of the universe, are a source of dark matter. It was proposed by Professor Stephen Hawking.
- It is believed that combined with dark energy, it makes up more than 95% of the universe.
- Its gravitational force prevents stars in our Milky Way from flying apart. **Hence statement 2 is correct.**
- However, attempts to detect such dark matter particles using underground experiments, or accelerator experiments including the world's largest accelerator, the Large Hadron Collider (LHC), have failed so far.

12. Ans: C

Exp:

- Researchers from **Kerala** have identified **two new species of fungi** from the **genus *Ganoderma*** that are **associated with coconut stem rot disease.**
- The two **fungi** species are ***Ganoderma keralense* and *G. pseudoapplanatum*.**
- The **butt rot or basal stem rot of coconut** is known by several names in different parts of India: *Ganoderma* wilt (Andhra Pradesh), *Anaberoga* (Karnataka) and *Thanjavur wilt* (Tamil Nadu), to mention a few.
- The infection begins at the roots, but symptoms include **discolouration and rotting** of stem and leaves. In the later stages, flowering and nut set decreases and finally the coconut palm (*Cocos nucifera*) dies.
- A reddish brown oozing is seen. This oozing has been reported only in India.
- Once infected, recovery of the plants is not likely. Not surprising then, that this causes a huge loss: By some estimates made in 2017, in India, around 12 million people are said to depend on coconut farming.

- Another sign of infection is **presence of shelf-like "basidiomata,"** which are the fruiting or reproductive structures of the fungus, on the tree trunks.
- **Hence option C is correct.**

13. Ans: B

Exp:

Negative-ion Technology:

- Negative ion technology **embeds negative ions in personal products** and is currently being advertised as a means to maintain health, balance energy, and improve well-being.
- This technology is used in certain silicone wristbands, quantum or scalar-energy pendants, and kinesiology tape.
 - ◆ Negative ions are also made **when sunlight, radiation, air, or water break down oxygen.** **Hence statement 2 is correct.**
- The minerals that produce these negative ions often include **naturally occurring radioactive substances such as uranium and thorium.** **Hence statement 1 is not correct.**
- It is believed that negative ions create positive vibes and uplift the mood. They show the various mental and physical health benefits, such as stress reduction, better sleeping, respiration etc. whereas these ions **may also act on pollutants, make them negatively charged** and get them collected on surfaces. **embeds negative ions in personal products** and is currently being advertised as a means to maintain health, balance energy, and improve well-being.
- This technology is used in certain silicone wristbands, quantum or scalar-energy pendants, and kinesiology tape.
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14. Ans: C

Exp:

- Fungi can be **single celled or very complex multicellular** organisms. **Hence, statement 1 is not correct.**



- They are found in just about any habitat but most live on the land, mainly in soil or on plant material rather than in sea or freshwater.
- A group called the decomposers grow in the soil or on dead plant matter where they play an important role in the cycling of carbon and other elements.
- Some are parasites of plants causing diseases such as mildews, rusts, scabs or canker.
- A very small number of fungi cause diseases in animals. In humans these **include skin diseases such as athletes' foot, ringworm and thrush. Hence, statement 2 is not correct.**

15. Ans: A

Exp:

- **First Amendment Act, 1951** provided for the saving of laws providing for acquisition of estates, etc.
 - ◆ Added **Ninth Schedule to protect the land reforms** and other laws included in it from the judicial review. After Article 31, Articles 31A and 31B were inserted.
 - ◆ Added three more grounds of restrictions on freedom of speech and expression: public order, friendly relations with foreign states and incitement to an offence. Also, it made the restrictions 'reasonable' and thus, justiciable in nature.
 - ◆ Provided that state trading and nationalisation of any trade or business by the state is not to be invalid on the ground of violation of the right to trade or business. **Hence, pair 1 is correctly matched.**
- **Twenty Fourth Amendment Act, 1971** affirmed the power of Parliament to amend any part of the Constitution including fundamental rights by amending Article 13 and 368.
 - ◆ Made it compulsory for the President to give his assent to a Constitutional Amendment Bill. **Hence, pair 2 is not correctly matched.**
- **The Sixty-First Amendment Act, 1989** reduced the voting age from 21 years to 18 years for the Lok Sabha and state legislative assembly elections. **Hence, pair 3 is not correctly matched.**
 - ◆ The 10th Schedule of the Indian Constitution contains Provisions relating to disqualification on the ground of defection.
 - ◆ It was included under the **52nd Constitution Amendment Act**, also called Anti Defection Act (1985).

16. Ans: B

Exp:

- The **SSLV (Small Satellite Launch Vehicle)** aims to cater to the market for the launch of small satellites into **Earth's low orbits(not geostationary orbit at present)** that has emerged in recent years to cater to the needs of developing countries, universities for small satellites, and private corporations. **Hence, statement 1 is not correct.**
- **New Space India Limited (NSIL)** is to mass-produce and manufacture the SSLV and the more powerful PSLV in **partnership with the private sector in India through technology transfers. Hence, statement 2 is correct.**
 - ◆ Its aim is to use research and development carried out by ISRO over the years for commercial purposes through Indian industry partners.

17. Ans: B

Exp:

- **Partial Parasites/Hemi-Parasites:**
 - ◆ Hemi-parasites are commonly referred to as mistletoes that contain 18 families, 160 genera and over 2,200 species.
 - ◆ They need a host tree or shrub in order to thrive and **exhibit a worldwide distribution in tropical as well as temperate habitats** that evolved approximately five times in the order and are important in forest ecology, pathology and medicine.
 - ◆ They play an important role as they provide food for frugivorous (feeding on fruit) birds.

Total Parasite	Partial Parasite
A complete parasite that depends on the host to fulfil all its requirements	A Parasite That Depends On The Host For Some Requirements
Dpend on the host plant for sugar, minerals, and water	Photosynthetic and produce their own food, depending on the host for water and shelter
Called holoparasitic plants	Called hemiparasitic plants
Achlorophyllous (does not contain chlorophyll)	Chlorophyllous (contain chlorophyll)
Ex: dodder, broomrape, and Rafflesia	Ex: Castilleja mistletoe, yellow rattle, etc.

- Hence, option B is correct.

18. Ans: B

Exp:

- Rare earth metals are called 'rare earth' because earlier it was **difficult to extract them from their**



oxides forms technologically. Hence, statement 1 is not correct.

- ◆ They occur in many minerals but typically in low concentrations to be refined in an economical manner.
- China has over time acquired global domination of rare earths, even at one point, it **produced 90% of the rare earths the world needs**.
 - ◆ Today, however, it **has come down to 60% and the remaining is produced** by other countries, including the Quad (Australia, India, Japan and United States).
 - ◆ Since 2010, when China curbed shipments of Rare Earths to Japan, the US, and Europe, production units have come up in Australia, and the US along with smaller units in Asia, Africa, and Latin America.
 - ◆ Even so, the **dominant share of processed Rare Earths lies with China**. Hence, statement 2 is correct.
- India has the **world's fifth-largest reserves of rare earth elements**, nearly twice as much as Australia, but it imports most of its rare earth needs in finished form from China. Hence, statement 3 is not correct.

19. Ans: A

Exp:

- **Dark matter**, though never detected, is believed to be present in the entire universe.
- It is presumed that black holes are a source of dark matter. It was proposed by Professor Stephen Hawking.
- It is believed that combined with dark energy, it makes up more than 95% of the universe.
- Its **gravitational force prevents stars** in our Milky Way from flying apart.
- **Laws of gravity** expect us to see stars closer to the center of galaxies rotating faster than the stars on the edge.
 - ◆ However, in most galaxies, the stars closer to the center and the stars at the edge of the galaxies take almost the same time to make one revolution.
- The material is considered to be a 'matter' since it has gravitational attraction and it is 'dark' because it **does not seem to interact with light** (or any part of the electromagnetic spectrum).
- Hence, option A is correct.

20. Ans: D

Exp:

- **BrahMos** is a joint venture between the Defence Research and Development Organisation of India

(DRDO) and the **NPOM of Russia**. Hence, statement 1 is correct.

- ◆ **BrahMos** is named for the rivers Brahmaputra and Moskva.
- It is a two-stage (solid propellant engine in the first stage and liquid ramjet in second) missile.
- It is a multiplatform missile i.e it can be launched from land, air, and sea and multi capability missile with pinpoint accuracy that works in both day and night irrespective of the weather conditions.
- It **operates on the "Fire and Forgets" principle** i.e it does not require further guidance after launch. Hence, statement 2 is correct.
- **Brahmos is one of the fastest cruise missiles** currently operationally deployed with speed of Mach 2.8, which is **nearly 3 times more than the speed of sound**. Hence, statement 3 is correct.

21. Ans: B

Exp:

ISRO's Coordination with Other Space Agencies:

- **NASA-ISRO Synthetic Aperture Radar Mission (NISAR):** NASA's first global Search And Rescue (SAR) mission, in partnership with ISRO, provides data for studying hazards, changes in glaciers and ice sheets, and global environment.
- **TRISHNA: ISRO, and the French space agency CNES** have partnered in developing advanced upgradation satellites like TRISHNA to monitor the water cycle to help in finding out proper ways to utilize it. Hence, Pair 2 is correctly matched.
- **Gaganyaan project:** The four Indian astronauts training in **Russia** for the Gaganyaan project – India's first manned space mission.
- **Lunar Polar Exploration Mission (LUPEX):** Collaboration between **ISRO and Japan Aerospace Exploration Agency (JAXA)** to have a combined mission, to send a lunar rover and lander to explore the south pole region of the Moon in 2024. Hence, Pair 3 is not correctly matched.
- **Duchifat 3:** Last year, a small remote sensing satellite weighing 2.3 kilogram, **built by students in Israel**, was part of the nine commercial satellites **launched by ISRO** along with its own earth observation satellite. Hence, Pair 1 is not correctly matched.
- Hence, option B is correct.

22. Ans: A

Exp:

- **Lithium-ion Battery Applications:**



- ◆ Electronic gadgets, Tele-communication, Aerospace, Industrial applications.
- ◆ Lithium-ion battery technology has made it the favourite power source for electric and hybrid electric vehicles.
- **Disadvantages of Li-ion Batteries:**
 - ◆ Long charging times.
 - ◆ One major problem is that lithium metal is extremely reactive. Safety issues as instances of **batteries catching fires** have been there.
 - ◆ Expensive to manufacture.
 - ◆ While the Li-ion batteries are seen as sufficiently efficient for applications such as phones and laptops, in case of EVs, these cells still **lack the range that would make them a viable alternative to internal combustion engines.**
- **Hence, option A is correct.**

23. Ans: A

Explanation:

- About Aquamation:
 - ◆ It is a process in which the body of the deceased is **immersed for a few hours in a mixture of water and a strong alkali** in a pressurized metal cylinder and heated to around **150 degree centigrade.**
 - ◆ The combination of **gentle water flow, temperature and alkalinity accentuate the breakdown of the organic materials.**
 - ◆ The process leaves behind **bone fragments and a neutral liquid called effluent.**
 - The effluent is sterile and contains salts, sugars, amino acids and peptides.
 - ◆ There is **no tissue and no DNA** left after the process completes.
 - ◆ The process of aquamation uses energy which is **five times less than fire.**
 - ◆ It also reduces by **about 35% the amount of greenhouse gases** that are emitted during cremation.
 - ◆ This process is referred to as alkaline hydrolysis or as **Cremation Association of North America (CANA)** (an international non-profit organisation) calls it **flameless cremation.**
 - ◆ The process is also known as **water cremation, green cremation or chemical cremation.**
 - ◆ **Hence, option A is correct.**

24. Ans: C

Exp:

- A new study has found that converting annual crops to perennial bioenergy crops can induce a cooling effect

on the areas where they are cultivated. **Hence statement 1 is correct.**

- ◆ The researchers simulated the biophysical climate impact of a range of future bioenergy crop cultivation scenarios. Eucalyptus, poplar, willow, miscanthus, and switchgrass were the bioenergy crops used in the study.
- ◆ The study also demonstrated the importance of the crop type choice, the original land use type upon which bioenergy crops are expanded, the total cultivation area, and its spatial distribution patterns.
- Crops from which Biofuels are produced or manufactured are called Biofuel crops or Bioenergy Crops. "Energy crops" is a term used to describe biofuel crops.
 - ◆ Wheat, corn, main edible oilseeds/edible oils, sugarcane, and other crops are among them. **Hence statement 2 is correct.**
- Biofuels have a number of advantages over fossil fuels, including the ability to burn cleaner and emit fewer pollutants and greenhouse gases, such as carbon dioxide, into the sky. They're also environmentally friendly, and energy corporations frequently mix Biofuels with gasoline.

25. Ans: B

Exp:

Fly Ash

- About:
 - ◆ Fly ash is an **unwanted unburnt residue of coal combustion in a coal thermal power plant.** **Hence statement 1 is not correct.**
 - ◆ It is **emitted along with flue gases** during the burning of coal in a furnace and collected using the electrostatic precipitators.
 - ◆ The fly ash **collected with the help of precipitators is converted into a wet slurry** to minimise fugitive dust emissions.
 - ◆ It is then **transported to the scientifically designed ash ponds** through slurry pipelines.
- **Composition:** Fly ash includes substantial amounts of silicon dioxide (SiO₂), aluminium oxide (Al₂O₃), ferric oxide (Fe₂O₃) and calcium oxide (CaO). **Hence statement 2 is correct.**
- **Properties:**
 - ◆ **Resemble Portland cement** but is chemically different.
 - Portland cement is a binding material in the form of a finely ground powder that is

manufactured by burning and grinding a mixture of limestone and clay.

- Its chemical composition includes calcium silicates, calcium aluminate and calcium aluminoferrite.

◆ **Exhibit cementitious properties.**

- A cementitious material is one that hardens when mixed with water.

- **Uses:** It is used in **concrete and cement products, road base, metal recovery, and mineral filler** among others.
- **Harmful Effects:** Fly ash particles are toxic air pollutants. They can trigger heart disease, cancer, respiratory diseases and stroke.
 - ◆ When combined with water they cause leaching of heavy metals in ground water.
 - ◆ It also pollutes the soil, and affects the root development system of trees.
 - ◆ **Gross under-utilisation of this by-product over the years has led to the accumulation** of 1,670 million tonnes of fly ash according to the Summary of Ash Generation and Utilisation during 2020-2021 by the Joint Committee earlier constituted by the NGT.

26. Ans: C

Exp:

- Graphene is a one-atom-thick layer of carbon atoms arranged in a hexagonal lattice. It is the building-block of Graphite, but graphene is a remarkable substance on its own with a multitude of astonishing properties.
 - ◆ It is the thinnest, most electrically and **thermally conductive material in the world**, while also being flexible, transparent and incredibly strong. **Hence, statement 1 is correct.**
- Often referred to as a wonder material for its extraordinary electrical and electronics properties, graphene could replace Indium and thereby bring down the cost of OLED (organic light-emitting diode) screens in smartphones, studies have shown.
- Graphene has a lot of promise for additional applications: anti-corrosion coatings and paints, efficient and precise sensors, faster and efficient electronics, flexible displays, efficient solar panels, **faster DNA sequencing, drug delivery**, and more. **Hence, statement 2 is correct.**

27. Ans: D

Exp:

- A **polar orbit travels north-south over the poles** and takes **approximately 90 minutes for a full rotation**. **Hence, statement 1 is not correct.**

◆ These orbits have an inclination near 90 degrees. This allows the satellite to see virtually every part of the Earth as the Earth rotates underneath it.

◆ These satellites have many uses such as monitoring crops, global security, measuring ozone concentrations in the stratosphere or measuring temperatures in the atmosphere.

◆ An orbit is called sun-synchronous when the angle between the line joining the centre of the Earth and the satellite and the Sun is constant throughout the orbit.

- **Geosynchronous satellites are launched into orbit in the same direction the Earth is spinning** and can have any inclination.

◆ When the satellite is in orbit at a specific altitude (approximately 36,000km above the Earth's surface), **it will exactly match the rotation of the Earth. Hence, statement 2 is not correct.**

◆ Geostationary orbits fall in the same category as geosynchronous orbits, but with that one special quality of being **parked over the equator**.

◆ In the case of geostationary satellites, **the Earth's force of gravity is exactly enough to provide acceleration** required for circular motion.

28. Ans: C

Exp:

- **Nuclear fusion** is defined as the **combining of several small nuclei into one large nucleus** with the subsequent release of huge amounts of energy.
 - ◆ It is the **opposite reaction of fission**, where heavy isotopes are split apart.
- Fusion reactions **take place in a state of matter called plasma**. Plasma is a hot, charged gas made of positive ions and free-moving electrons that has unique properties distinct from solids, liquids and gases. **Hence, statement 2 is not correct.**
 - ◆ At high temperatures, electrons are ripped from atom's nuclei and become a plasma or an ionised state of matter. Plasma is also known as the **fourth state of matter**.
- **Advantages of Nuclear Fusion:**
 - ◆ **Abundant energy:** Fusing atoms together in a controlled way releases nearly four million times more energy than a chemical reaction such as the burning of coal, oil or gas and four times as much as nuclear fission reactions (at equal mass).
 - ◆ **Sustainability:** Fusion fuels are widely available and nearly inexhaustible. Deuterium can be distilled from all forms of water, while **tritium will**

be produced during the fusion reaction as fusion neutrons interact with lithium. Hence, statement 3 is correct.

- ◆ **No CO₂:** Fusion doesn't emit harmful toxins like carbon dioxide or other greenhouse gases into the atmosphere. Its major by-product is helium: an inert, non-toxic gas.
- ◆ **No long-lived radioactive waste:** Nuclear fusion reactors produce no high activity, long-lived nuclear waste.
- ◆ **Limited risk of proliferation:** Fusion doesn't employ fissile materials like uranium and plutonium (Radioactive tritium is neither a fissile nor a fissionable material). Hence, statement 1 is not correct.
- ◆ **No risk of meltdown:** It is difficult enough to reach and maintain the precise conditions necessary for fusion—if any disturbance occurs, the plasma cools within seconds and the reaction stops.

29. Ans: B

Exp:

- Earth observation satellites are the **satellites equipped with remote sensing technology**. Earth observation is the gathering of information about Earth's physical, chemical and biological systems.
- Many earth observation satellites have been employed on sun-synchronous orbit. Hence, statement 1 is NOT correct.
- Other earth observation satellites launched by ISRO include RESOURCESAT- 2, 2A, CARTOSAT-1, 2, 2A, 2B, RISAT-1 and 2, OCEANSAT-2, Megha-Tropiques, SARAL and SCATSAT-1, INSAT-3DR, 3D, etc. Hence, statement 2 is correct.

30. Answer: A

Expl:

About Properties of Lithium:

- It is a **chemical element** with the symbol Li.
- It is a **soft, silvery-white metal**.
- Under standard conditions, it is the **lightest metal and the lightest solid element**.
- It is **highly reactive and flammable**, and must be stored in mineral oil.
- Lithium has become the **new 'white gold'** as the demand for high performing **rechargeable batteries** is rising.
- Hence, option A is correct.

31. Ans: A

Exp:

- **Chile, Argentina, and Bolivia** make up South America's "lithium triangle" and together hold more than 75% of the world's lithium reserves beneath their salt flats. Hence, option A is correct.



32. Ans: B

Exp:

- **Gaganyaan** is a mission by the **Indian Space Research Organisation (ISRO)**.
 - ◆ Under the Gaganyaan schedule:
 - Three flights will be **sent into orbit**.
 - There will be **two unmanned flights and one human spaceflight**. Hence, statement 1 is not correct.
 - ◆ The Gaganyaan system module, called the **Orbital Module** will have three Indian astronauts, including a woman.
 - ◆ It will circle Earth at a **low-earth-orbit** at an altitude of 300-400 km from earth for 5-7 days.
 - ◆ With that launch, India will be in the **elite club of nations (America, China and Russia)**.
- **GSLV Mk III**, also called the **LVM-3 (Launch Vehicle Mark-3)**, the three-stage heavy lift launch vehicle, will be used to launch Gaganyaan as it has the necessary payload capability. Hence, statement 2 is correct.
 - ◆ Gaganyaan's major missions like the **test vehicle flight** for the validation of crew escape system performance and first uncrewed mission of Gaganyaan (G1) are scheduled during the beginning of the **second half of next year (2022)**.

- ◆ This will be followed by the **second uncrewed mission at the end of 2022** carrying 'Vyomitra', a spacefaring human robot developed by Isro, and finally the **first crewed Gaganyaan mission in 2023**.

33. Ans: B

Exp:

- Recently, National Aeronautics and Space Administration (NASA) launched a new mission named Imaging X-ray Polarimetry Explorer (IXPE).
 - ◆ The IXPE observatory is a **joint effort of NASA and the Italian Space Agency**. Hence, **statement 1 is correct**.
- It will study "the most extreme and mysterious objects in the universe – supernova remnants, supermassive black holes, and dozens of other high-energy objects."
 - ◆ Its primary length is two years and the observatory will be at 600 kilometers altitude, orbiting around Earth's equator.
 - ◆ It is expected to study about 40 celestial objects in its first year in space.
- It will **complement other X-ray telescopes such as the Chandra X-ray Observatory** and the European Space Agency's X-ray observatory, XMM-Newton. Hence, **statement 2 is not correct**.

34. Ans: B

Exp:

- James Webb Space Telescope is the **most powerful infrared telescope** of National Aeronautics and Space Administration (NASA).
- It is also considered a **successor of the Hubble Telescope** and will extend and complement its discoveries. Hence, **statement 1 is not correct**.
- The telescope is the result of an international collaboration between **NASA, the European Space Agency (ESA)** and the **Canadian Space Agency**. Hence, **statement 2 is correct**.
- Webb will reveal new and unexpected discoveries, and help humanity understand the origins of the universe and our place in it.

35. Answer: D

Exp:

- **NASA (National Aeronautics and Space Administration)** has launched its new **Laser Communications Relay Demonstration (LCRD)**. Hence, **statement 2 is correct**.
 - ◆ It is the **first-ever laser communications system** that will **pave the way for future optical communications missions**.

- It uses infrared light and has a shorter wavelength than radio waves. This will **help the transmission of more data** in a short time. Hence, **statement 1 is correct**.
- Further, Optical communications **using lasers, will help increase the bandwidth 10 to 100 times more** than radio frequency systems. Hence, **statement 3 is correct**.

36. Ans: C

Exp:

- A **critical vulnerability called Log4Shell**, detected last week in widely used **open-source logging software Apache Log4J**, is now being exploited by attackers to target organizations all over the world, including India.
 - ◆ The vulnerability is **based on an open-source logging library** used in most applications by enterprises and even government agencies. Hence, **statement 1 is correct**.
 - ◆ The vulnerability is dubbed Log4Shell and is officially called CVE-2021-44228.
 - CVE number is the unique number given to each vulnerability discovered across the world.
 - The vulnerability was first detected on websites that were hosting servers of a Microsoft-owned game called Minecraft.
 - The vulnerability can be exploited by using a single line of code and allows attackers to execute remote commands on a victim's system.
 - ◆ It can be exploited by attackers to take control of any **Java-based web server** and **carry out Remote Code Execution (RCE) attacks**. Hence, **statement 2 is correct**.
 - ◆ In an RCE attack, attackers take control over the targeted system and can perform any function they want.
 - ◆ The exploits for this vulnerability are already being tested by hackers, according to several reports, and it grants them access to an application, and could potentially let them run malicious software on a device or servers.
37. Ans: D
- Exp:
- An '**Application Programming Interface (API)**' is an interface that can be used to program software that interacts with an existing application.
 - An **open source API**, also called public API, is an application programming interface made **publicly available to software developers**.



- ◆ Open APIs are published on the internet and shared freely, allowing the owner of a network-accessible service to give **universal access to consumers**. Hence, **statement 1 is correct**.

- **APIs vs Web Services:**

- ◆ APIs and web services are not mutually exclusive. In fact, one is a subset of the other: **every web service is an API** — since it exposes an application's data and/or functionality — **but not every API is a web service**. Hence, **statement 2 is correct**.
- ◆ **APIs are protocol agnostic**. While APIs can use any protocols or design styles, web services usually use specific protocols. Hence, **statement 3 is correct**.

- Hence, option D is correct.

38. Ans: B

Exp:

Inactivated Vaccines:

- Inactivated vaccines use the **killed version of the germ** that causes a disease. Hence **statement 1 is not correct**.
- Vaccines of this type are created by inactivating a pathogen, typically using heat or chemicals such as formaldehyde or formalin. This destroys the pathogen's ability to replicate, but keeps it "intact" so that the immune system can still recognize it. ("Inactivated" is generally used rather than "killed" to refer to viral vaccines of this type, as viruses are generally not considered to be alive.)
- They usually don't provide immunity (protection) that's as strong as live vaccines. So you may need several doses over time (booster shots) in order to get ongoing immunity against diseases.
- They are **used to protect: Hepatitis A, Flu (shot only), Polio (shot only), Rabies**. Hence **statement 2 is correct**.

39. Ans: D

Exp:

- **Quantum Technology** is based on the principles of Quantum mechanics that was developed in the early 20th century to describe nature at the scale of atoms and elementary particles.
- **Applications:**
 - ◆ **Secure Communication:** China recently demonstrated **secure quantum communication links between terrestrial stations and satellites**.
 - This area is significant to satellites, military and cyber security among others as it promises unimaginably fast computing and safe, unhackable satellite communication to its users.

- ◆ **Research:** It can help in solving some of the fundamental questions in physics related to gravity, black holes etc.

- Similarly, the quantum initiative could give a big boost to the Genome India project.

- ◆ **Disaster Management:** Tsunamis, drought, earthquakes and floods may become more predictable with quantum applications.
- ◆ The collection of data regarding climate change can be streamlined in a better way through quantum technology.
- ◆ **Pharmaceutical: Quantum computing could reduce the time frame of the discovery of new molecules and related processes** to a few days from the present 10-year slog that scientists put in.
- ◆ **Augmenting Industrial revolution 4.0:** Quantum computing is an integral part of Industrial revolution 4.0.

- Success in it will help in Strategic initiatives aimed at leveraging other Industrial revolution 4.0 technologies like the Internet-of-Things, machine learning, robotics, and artificial intelligence across sectors will further help in laying the foundation of the Knowledge economy.

- Hence, option D is correct.

40. Ans: D

Exp:

- Recently, NASA launched a new mission named **Imaging X-ray Polarimetry Explorer (IXPE)**.
 - ◆ IXPE observatory is a joint effort of NASA and the Italian Space Agency.
 - ◆ It will study "the most extreme and mysterious objects in the universe – supernova remnants, supermassive black holes, and dozens of other high-energy objects."
- **Significance:**
 - ◆ It will help **observe polarized X-rays from neutron stars** and supermassive black holes. By measuring the polarization of these X-rays, we can study where the light came from and understand the geometry and inner workings of the light source.
 - ◆ It will help scientists **understand how black holes spin and their location in the past**.
 - ◆ It will help **unravel how pulsars shine so brightly in X-rays**.
 - ◆ It will help learn what powers the jets of energetic particles that are ejected from the region around the supermassive black holes at the centers of galaxies.
- Hence, option D is correct.

41. Ans: B

Exp:

- NASA will launch its **first planetary defense test mission** named the **Double Asteroid Redirection Test (DART)**.
 - ◆ The DART spacecraft **will be launched on a SpaceX Falcon 9 rocket**. Hence, **statement 1 is not correct**.
- The aim of the mission is to test the new technology to **be prepared in case an asteroid heads towards Earth in the future**.
 - ◆ The aim is to test the newly developed technology that **would allow a spacecraft to crash into an asteroid and change its course**. Hence, **statement 2 is correct**.
 - After the mission has collided with the asteroid, **scientists will study its impact on the trajectory of the asteroid** with a range of telescopes deployed on different regions of the planet.
 - DART will be the **first demonstration of the kinetic impactor technique** to change the motion of an asteroid in space.
 - ◆ The target of the spacecraft is a **small moonlet called Dimorphos** (Greek for “two forms”).
 - **Dimorphos** orbits a **larger asteroid named Didymos** (Greek for “twin”).
- It is a **suicide mission** and the spacecraft will be completely destroyed.
- The collision is expected to take place **between 26th September and 1st October, 2022**.

42. Ans: D

Exp:

- **Kamo'oalewa was discovered in 2016** (through the **PanSTARRS telescope in Hawaii**),
 - ◆ It is a word that is part of a Hawaiian chant, and alludes to an offspring that travels on its own.
 - ◆ It is **one of Earth's quasi-satellites, a space rock that orbits the Sun, but remains relatively close to the planet** – in this case about 9 million miles away.
 - ◆ The asteroid is roughly the size of a Ferris wheel – between 150 and 190 feet in diameter.
 - ◆ Because of its small size (about 50 metres wide), this quasi-satellite has been difficult for scientists to study, and little was known about it so far.
- Hence, **option D is correct**.

43. Ans: A

Exp:

- Extraction requires creation of fractures in oil and gas rich shale to release hydrocarbons through a process called **hydraulic fracking/fracturing**.

- It requires a mixture of **'pressurised water, chemicals, and sand'** (shale fluid) to break low permeable rocks and have access to the shale gas reserves.
- While fracking, the shale fluid could possibly penetrate aquifers leading to **methane poisoning of groundwater** used for drinking and irrigation purposes.
- Hence, **option A is correct**.

44. Ans: C

Exp:

- The first satellite (IRNSS-1A) of the Indian Regional Navigation Satellite System (IRNSS) was launched on 1st July 2013 and the seventh and final satellite (IRNSS-1G) was launched on 28th April 2016.
 - ◆ With the last launch of the constellation's satellite (IRNSS-1G), **IRNSS was renamed Navigation Indian Constellation (NavIC)** by India's Prime Minister.
 - ◆ Presently, **NavIC consists of eight satellites**, three satellites in geostationary orbit and five satellites in geosynchronous orbit. Hence, **statement 1 is correct**.
 - ◆ It works just like the established and popular US Global Positioning System (GPS) but within a 1,500-km radius over the sub-continent.
 - ◆ Technically satellite systems with more satellites provide more accurate positioning information.
 - However, **compared to GPS (24 satellites)** which has a **position accuracy of 20-30 metres**, the NavIC is able to pinpoint location to an **estimated accuracy of under 20 metres**. Hence, **statement 2 is correct**.
- It was **recognised by the International Maritime Organization (IMO)** as a part of the World Wide Radio Navigation System (WWRNS) **for operation in the Indian Ocean Region in 2020**. Hence, **statement 3 is correct**.
- **India became one of the 5 countries** having their own navigation system like GPS of **USA**, GLONASS of **Russia**, Galileo of **Europe** and BeiDou of **China**. So India's dependence on other countries for navigation purposes reduces. Hence, **statement 4 is not correct**.

45. Ans: D

Exp:

Hypersonic Technology

- Missiles based hypersonic technology **speed at least 5 or more times the Mach** or speed of sound.
 - ◆ Missiles based on **high-hypersonic technology have mach number at least 10** (or 10 times the speed of sound). Hence, **statement 1 is not correct**.



- Most hypersonic vehicles **primarily use the scramjet technology**, which is a type of Air Breathing propulsion System. **Hence, statement 2 is not correct.**
 - ◆ A scramjet engine is an improvement over the ramjet engine.
 - Dual Mode Ramjet (DMRJ) is a mix of ramjet and scramjet.
 - ◆ Scramjet is an extremely complex technology, which also needs to be able to handle high temperatures, making the hypersonic systems extremely costly.

46. Ans: B

Exp:

- White dwarfs are **stars that have burned up all of the hydrogens** they once used as nuclear fuel.
 - ◆ When the hydrogen, used as fuel, vanishes and fusion slows, **gravity causes the star to collapse** in on itself into white dwarfs.
 - ◆ The stars which are less massive than **Chandrasekhar Limit** will turn into white dwarfs. The stars are more massive than **Chandrasekhar Limit, will turn into a thermonuclear supernova. Hence, statement 1 is not correct.**
- **In a nuclear fusion reaction, the nuclei of two atoms combine to create a new atom.** Stars fuse hydrogen in their cores into helium through nuclear fusion reactions. **Hence, statement 2 is correct.**

47. Ans: A

Exp:

- Recently, Russia has successfully placed into **orbit a military satellite**. The satellite is believed to be a **Tundra Satellite**, part of **Russia's early warning anti-missile system named Kupol or dome**.
- Tundra satellite system is a **constellation of Missile Early Warning Satellites** established by Russia between 2015 and 2020.
 - ◆ It carries a secure emergency communications payload to be used in case of a **nuclear war**.
 - ◆ It is a series of satellites that are the next generation of Russian early warning satellites to replace the early warning satellites of the **Oko-1 system**.
 - This final **Oko (Eye) satellite (missile defence early warning program)** reportedly stopped operating in mid 2014, leaving Russia relying on ground-based missile detection systems.
 - ◆ They are part of the **EKS or Unified Space System (USS-Also sometimes referred as Kupol or dome)**, which will also include several satellites in geostationary orbit.

- Unveiled in 2019, Kupol is designed to detect launches of **ballistic missiles** and track them to their landing site, **though its exact configuration is unknown.**

48. Ans: A

Exp:

- The **European Space Agency (ESA) council** has approved a manifesto to accelerate the use of space in Europe.
- Basically, the council has adopted a **resolution that lays down a vision for the continent** in terms of maintaining and expanding its activities in space.
- Other than this, the council recognised two "inspirators" to reinforce European leadership in science, technology development and inspiration: **an icy moon sample return mission and human space exploration.**
- **Hence, option A is correct.**

49. Ans: C

Exp:

- The **Leonids are considered to be a major shower that features the fastest meteors** which typically travel at speeds of 71 km per second, although the rates are often as low as 15 meteors per hour. **Hence, statement 1 is correct.**
- The Leonids are also called fireballs and earthgrazer meteors.
 - ◆ Fireballs, because of their bright colours, and earthgazer, because they streak close to the horizon.
- A **Leonid shower turns into a meteor storm every 33 years** and when it happens hundreds to thousands of meteors can be seen every hour. The last Leonid meteor storm took place in 2002. **Hence, statement 2 is correct.**
- A meteor storm should have at least 1,000 meteors per hour.

50. Ans: B

Exp:

- Recently, Amazon has unveiled its '**Astro**' home robot, which is **designed to help customers with a range of tasks like home monitoring** and keeping in touch with family.
- Astro is primed to be a home security device. It is designed to move around the home and keep a check on pets, and detect something unusual in the absence of the owner.
 - ◆ It comes with a "periscope" camera that pops up from its head and can be used to keep an eye on the home.

- ◆ The device captures live videos, recognises faces, plays music or videos, and delivers a beer across the home.
- ◆ It can recognise the faces of people and analyse them until it figures out if it's a family member or an outsider.

● Hence, option B is correct.

51. Answer: D

Exp.

- **Somatosensation** is a collective term for the sensations of touch, temperature, body position, and pain recognized through neural receptors in the skin and certain internal organs.
 - ◆ It includes processes such as mechanoreception, thermoreception, proprioception. Hence, **statement 1 is not correct.**
- **Mechanosensitive channels** are fascinating proteins, being able to serve both as sensors and effectors.
 - ◆ Embedded in membranes, they convert mechanical stimuli such as in-plane membrane tension and curvature into electrical or biochemical signals, leading to regulation of a wide repertoire of cellular processes allowing adaptive response. Hence, **statement 2 is not correct.**

52. Ans: C

Exp:

- The **2021 Nobel Prize in Chemistry** was awarded to Benjamin List and David MacMillan **for the development of asymmetric organocatalysis.**
 - ◆ They have developed a new and ingenious tool for molecule building: organocatalysis. Hence, **statement 1 is correct.**
- According to researchers, there were just two types of catalysts available: metals and enzymes.
 - ◆ Catalysts are any substance that increases the rate of a reaction without itself being consumed.
- In 2000, they, independent of each other, developed a third type of catalysis. It is called asymmetric organocatalysis and builds upon small organic molecules.
 - ◆ **Asymmetric organocatalysis** is a widely used technique and especially important to the drug discovery process.
 - It uses **small organic molecules as catalysts instead of traditional catalysts such as enzymes or metals.** Hence, **statement 2 is correct.**

- Biologically active molecules are often chiral, and organocatalysts provide a way to make candidate drug compounds quickly and efficiently.

53. Ans: C

Exp:

- **Ethanol** is derived from corn and sugarcane using the **fermentation process.** Hence, **statement 1 is correct.**
 - ◆ A litre of ethanol contains approximately two thirds of the energy provided by a litre of petrol.
 - ◆ When mixed with petrol, it improves the combustion performance and lowers the emissions of carbon monoxide and sulphur oxide.
- **Biodiesel** is derived from **vegetable oils** like soybean oil or palm oil, vegetable waste oils, and **animal fats** by a biochemical process called "**Transesterification.**" Hence, **statement 2 is correct.**
 - ◆ It produces very less or no amount of harmful gases as compared to diesel.
 - ◆ It can be used as an alternative for the conventional diesel fuel.

54. Ans: D

Exp.:

- National Aeronautics and Space Administration (**NASA**) is set to launch 'Lucy', its **first mission to explore the Jupiter Trojan Asteroids (Not a joint mission of NASA and ESA).** Hence, **statement 1 is not correct.**
- The **solar-powered mission** is estimated to be **over 12 years long**, during which the spacecraft will visit **eight asteroids** covering a distance of about **6.3 billion km (not 6.3 million km).** Hence, **statement 2 is not correct.**
- Different Asteroids can have different types of orbits. **Trojan Asteroids are those that share an orbit with a larger planet.** NASA reports the presence of Jupiter, Neptune and Mars trojans. **In 2011, they reported an Earth trojan as well.** Hence, **statement 3 is not correct.**

55. Ans: A

Exp:

- Recently, some researchers studied a **meteorite from Katol, Maharashtra** which was from the **meteor shower of 2012.**
 - ◆ A meteorite is a solid piece of debris from an object, such as a comet, asteroid, or meteoroid, that originates in outer space and survives its passage through the atmosphere to reach the surface of a planet or moon.
- **Findings of the Study:**
 - ◆ **Depth of Olivine:** Initial studies revealed that the host rock was mainly composed of olivine, an olive-green mineral.



○ Olivine is the most abundant phase in our Earth's upper mantle.

◆ **Formation of Bridgmanite:** Various computational and experimental studies have shown that about 80% of the Earth's lower mantle is made up of bridgmanite.

○ Bridgmanite is a magnesium-silicate mineral, $MgSiO_3$, the most abundant mineral on earth.

○ The bridgmanite of the Katol meteorite sample closely matches with the bridgmanite on Earth.

● **Significance of the Study:**

◆ Studying the meteorite could also tell us more about **how our Earth evolved from being a magma ocean to a rocky planet** and researchers can unearth more details about the formation of Earth. **Hence, statement 1 is correct.**

◆ It is important to study these individual minerals to get a thorough idea of **how and when the Earth's layers formed.** **Hence, statement 2 is correct.**

◆ Scientists can also **decode how bridgmanite crystallized** during the final stages of our Earth's formation. **Hence, statement 3 is not correct.**

● **Hence, option A is correct.**

56. Ans: C

Exp:

● A **black hole merger** is the phenomenon of the merging of two or more black holes.

● Merging of two or more black holes results in **different types of black holes.** For eg, **Intermediate-Mass Black Holes** and Binary Black Holes. **Hence, statement 1 is correct.**

◆ Intermediate-Mass black hole (IMBH) is a class of black hole with mass in the range 102–105 solar masses: significantly more than stellar black holes but less than supermassive black holes.

● **Gravitational Waves** are created when two black holes orbit each other and merge. **Hence, statement 2 is correct.**

◆ It travels at the speed of light and squeezes and stretches anything in their path.

◆ As a gravitational wave travels through space-time, it causes it to stretch in one direction and compress in the other, any object that occupies that region of space-time also stretches and compresses as the wave passes over them, though very slightly, which can only be detected by specialized devices like LIGO.

57. Ans: A

Exp:

● The **Indian Space Association (ISpA)** will act as a **single-window and independent agency** on matters related to space technology. **Hence, statement 1 is correct.**

● ISpA aspires to be the **collective voice of the Indian Space industry.** It will be **represented by leading domestic and global corporations** that have advanced capabilities in space and satellite technologies. **Hence, Statement 2 is not correct.**

● In the **2019 Budget**, the government had announced the setting up of a **New Space India Limited (NSIL)**, a public sector company that would serve as a marketing arm of **ISRO (Indian Space Research Organisation).** **Hence, Statement 3 is not correct.**

58. Ans: B

Exp:

● Quantum Key Distribution (QKD), also called **Quantum Cryptography**, is a mechanism to develop secure communication. It provides a way of **distributing and sharing secret keys** that are necessary for cryptographic protocols. **Hence, statement 1 is correct.**

● In the QKD, **encryption keys are sent as 'qubits' (or quantum bits) in an optical fibre.** **Optical fibers** are capable of transmitting more data over longer distances and faster than other mediums. It works on the principle of **total internal Reflections.** **Hence, statement 2 is correct.**

● In the QKD, the encryption is unbreakable and that's mainly because of the way data is carried via the **photon.** **A photon cannot be perfectly copied** and any attempt to measure it will disturb it. This means that a person trying to intercept the data will leave a trace. **Hence, statement 3 is not correct.**

59. Ans: C

Exp:

● Mach Number describes an **aircraft's speed compared with the speed of sound in air**, with Mach 1 equating to the speed of sound i.e. 343 metre per second. **Hence, statement 2 is correct.**

● **Hypersonic speeds are 5 or more times the Mach or speed of sound.** **Hence, statement 1 is correct.**

◆ Types (2):

○ Hypersonic cruise missiles: These are the ones that use rocket or jet propellant through their flight and are regarded as being just faster versions of existing cruise missiles.

- Hypersonic Glide Vehicle (HGV): These missiles first go up into the atmosphere on a conventional rocket before being launched towards their target.

60. Ans: D

Exp:

- **Ballistic Missile** is a **rocket-propelled self-guided strategic-weapons system** that follows a ballistic trajectory to deliver a payload from its launch site to a predetermined target. **Hence, statement 1 is correct.**
 - ◆ Ballistic trajectory is the path of an unpowered object, as a missile, moving only under the influence of gravity and possibly atmospheric friction and with its surface providing no significant lift to alter the course of flight.
- It can carry **conventional high explosives** as well as chemical, biological, or nuclear munitions. **Hence, statement 2 is correct.**
- The International Code of Conduct against Ballistic Missile Proliferation (ICOC), now known as the Hague Code of Conduct against Ballistic Missile Proliferation (HCCOC), is a political initiative aimed at globally curbing ballistic missile proliferation.
 - ◆ India is a signatory to this convention.
- Established in April 1987, the voluntary **Missile Technology Control Regime (MTCR)** aims to **limit the spread of ballistic missiles** and other unmanned delivery systems that could be used for chemical, biological, and nuclear attacks.
 - ◆ India has joined the MTCR. Hence, statement 3 is correct.
- Some of India's Ballistic Missiles:
 - ◆ Agni P missile
 - ◆ Shourya missile
 - ◆ Prithvi missile
 - ◆ Dhanush
- Sagarika etc. **Hence, statement 4 is correct.**

61. Ans: D

Exp:

- The Indian Agricultural Research Institute (IARI) has now moved to newer technologies such as **Site Directed Nuclease (SDN) 1 and 2.**
 - ◆ New technique aims to **bring precision and efficiency into the breeding process using gene editing tools such as CRISPR** (Clustered Regularly Interspaced Short Palindromic Repeats). **Hence, statement 1 is correct.**

- Emmanuelle Charpentier and Jennifer Doudna won the **Nobel Prize for Chemistry in 2020** for the development of the CRISPR tool. **Hence, statement 3 is correct.**

- SDN genome editing involves the use of different DNA-cutting enzymes (nucleases) that are directed to cut the DNA at a predetermined location by a range of different DNA binding systems.
 - ◆ After the cut is made, the cell's own DNA repair mechanism recognizes the break and repairs the damage, using one of two pathways that are naturally present in cells.
 - ◆ It involves the use of gene editing tools to directly tweak (improve/change) the plant's own genes instead.
 - ◆ It would allow plants to be **genetically modified without the need for conventional transgenic technology.** **Hence, statement 2 is correct.**
 - ◆ A research coalition under the Indian Council of Agricultural Research (ICAR), which includes the IARI, is using these techniques to develop rice varieties which are drought-tolerant, salinity-tolerant and high-yielding. They could potentially be ready for commercial cultivation within three years.
 - The IARI has previously worked on golden rice, a traditional GM variety which inserted genes from other organisms into the rice plant, but ended trials over five years ago due to agronomic issues.

62. Ans: A

Exp:

- **Methane** is the simplest hydrocarbon, consisting of one carbon atom and four hydrogen atoms (CH₄). It is a powerful greenhouse gas.
 - ◆ It is flammable, and is used as a fuel worldwide.
 - Methane is **called marsh gas** because it is found at the surface of marshy places.
- **Major Uses:**
 - ◆ It is an important source of hydrogen and some organic chemicals.
 - ◆ It reacts with steam at high temperatures to yield carbon monoxide and hydrogen; the latter is used in the manufacture of ammonia for fertilizers and explosives.
 - ◆ The **incomplete combustion of methane yields carbon black**, which is widely used as a reinforcing agent in rubber used for automobile tires.
- **Environmental Impact of Methane:**

- ◆ It is 84 times more potent than carbon and doesn't last as long in the atmosphere before it breaks down. This makes it a critical target for reducing global warming more quickly while simultaneously working to reduce other greenhouse gases.
- ◆ It is **responsible for creating ground-level ozone**, a dangerous air pollutant.
- Hence, **option A is correct.**

63. Ans: D

Exp:

- Recently, the **Ministry of Earth Sciences (MoES)** has launched India's first manned ocean mission "**Samudrayaan**" in Chennai. Hence, **statement 1 is correct.**
 - ◆ With this Unique Ocean Mission, India joined the **elite club of nations** such as **the US, Russia, France, Japan, and China** to have niche technology and vehicles to carry out subsea activities.
- It is India's **first unique manned ocean mission** that aims to send men into the deep sea in a submersible vehicle for **deep-ocean exploration and mining of rare minerals.** Hence, **statement 2 is correct.**
 - ◆ It will send three persons in a manned submersible vehicle **MATSYA 6000** to a depth of 6000 metres into the sea for deep underwater studies. Hence, **statement 3 is correct.**

64. Ans: A

Exp:

- White dwarfs are **stars that have burned up all of the hydrogen** they once used as nuclear fuel. Hence, **statement 1 is correct.**
 - ◆ Such stars have very high densities.
 - ◆ A typical white dwarf is half the size of our Sun and has a surface gravity of 1,00,000 times that of Earth.
- Fusion in a star's core produces heat and outward pressure (they bloat up as enormous red giants), but this pressure is kept in balance by the inward push of gravity generated by a star's mass.
- When the hydrogen, used as fuel, vanishes and fusion slows, gravity causes the star to collapse in on itself into white dwarfs.
- Stars like our **sun fuse hydrogen in their cores into helium** through **nuclear fusion reactions.** Hence, **statement 2 is not correct.**

65. Ans: B

Exp:

Ballistic Missile vs Cruise Missile:

Ballistic Missile	Cruise Missile
Travel in projectile motion and trajectory depends on gravity, air resistance and Coriolis Force.	Comparatively follows a straight trajectory of motion.
Leave the earth's atmosphere and re enter it.	The flight path is within the earth's atmosphere.
Long-range missiles (300 km to 12,000 km)	Short range missiles (range upto 1000 km)
E.g. Prithvi I, Prithvi II, Agni I, Agni II and Dhanush missiles.	E.g. BrahMos missiles

- Hence, **option B is correct.**

66. Ans: D

Exp:

- **Geospatial Energy Map of India** is developed by the **NITI Aayog** in collaboration with **Indian Space Research Organisation (ISRO)** with the support of Energy Ministries.
- It provides a holistic picture of all energy resources of the country.
- It enables visualisation of energy installations such as conventional power plants, oil and gas wells, petroleum refineries, coal fields and coal blocks, district-wise data on renewable energy power plants and renewable energy resource potential through 27 thematic layers.
- **Significance:**
 - ◆ **Aims to Identify Sources of Energy:** It attempts to **identify and locate all primary and secondary sources of energy** and their transportation/transmission networks to provide a comprehensive view of energy production and distribution in a country. Hence, **statement 1 is correct.**
 - ◆ **Integrate Scattered Data:** It is aimed at **integrating energy data scattered across multiple organizations** and to present it in a consolidated, visually appealing graphical manner. Hence, **statement 2 is correct.**
 - ◆ **Advancements in Web-GIS Technology:** It leverages the latest advancements in web-GIS technology and open-source software to make it interactive and user friendly.

- ◆ **Helpful in making Investment Decisions:** It will be **useful in planning and making investment decisions.** Hence, **statement 3 is correct.**

- It will also aid in disaster management using available energy assets

67. Ans: D

Exp:

- The trojans are the asteroids that share an orbit with a larger planet.
- NASA reports the presence of Jupiter, Neptune and Mars trojans. **In 2011, they reported an Earth trojan as well.** Hence, **statement 1 is not correct.**
- The Jupiter asteroids can be found in what are referred to as “swarms” that lead and follow the planet Jupiter along its orbit around the Sun.
 - ◆ **NASA is set to launch ‘Lucy’,** its first mission to **explore the Jupiter Trojan Asteroids.** Hence, **statement 2 is not correct.**
 - ◆ ‘Lucy’ will reach the first swarm of these asteroids that precede Jupiter by August 2027.
- These asteroids are believed to be the remnants of the early solar system.

68. Ans: A

Exp:

- Black Holes **emit matter and radiation extending out hundreds of thousands of light years.** Hence, **statement 1 is correct.**
- Event Horizon is the **gravitational boundary** beyond which **neither light nor matter can escape.** Hence, **statement 2 is not correct.**
- Black Hole merger happens between Black holes of **both equal and unequal masses.** Hence, **statement 3 is not correct.**
- The **extent of the kick received** by the remnant can be calculated from the **masses of the merging black holes and their spin.** The kick estimates help understand **which mergers have the possibility of forming Intermediate-Mass black holes.** Hence, **statement 4 is correct.**

69. Ans: B

Exp:

- Recently, scientists have developed a **New biodegradable polymer,** using Guar Gum, and Chitosan, which has high potential for packaging material.
- It is a guar gum-chitosan composite film which is a **cross-linked polysaccharide** developed with the help of solution casting method (a simple technique to

make polymer films). It overcomes the challenges of polysaccharides.

- ◆ **Polysaccharides is one of the biodegradable polymers** with high potential for use in synthesis of packaging material. Hence, **statement 1 is correct.**

- ◆ However, due to some **drawbacks of polysaccharides,** such as **low mechanical properties, high water-solubility,** and low barrier properties, they are not preferred. Hence, **statement 2 is not correct.**

- ◆ Guar Gum, and Chitosan are polysaccharides extracted from guar beans and shells of crab and shrimps.

70. Ans: C

Exp:

- **Blue Straggler Stars** are **unusually hot and bright stars** found in the cores of ancient star clusters known as **globulars.** Hence **statement 1 is correct.**

- ◆ Most are located at least several thousand light-years away from the sun, and most are around 12 billion years old or more.

- Blue straggler stars **appear to violate standard theories of stellar evolution.**

- ◆ Under standard stellar evolution, a bunch of stars born at the same time from the same cloud form a star cluster.

- Star formation happens in interstellar molecular clouds: opaque clumps of very cold gas and dust.

- ◆ As time passes, **each star evolves differently depending on its mass,** in which **all stars born at the same time should lie on a clearly defined curve in the Hertzsprung-Russell diagram.**

- ◆ In the **case of a blue straggler star,** they evolve and move off the main sequence creating a bend in their track, **known as the turnoff.**

- Since blue stragglers often lie well off this curve, they **may undergo abnormal stellar evolution.**

- Hence, **statement 2 is correct.**

71. Ans: C

Exp:

- The Sun is an extremely active object, **spewing out vast quantities of gas and plasma** in many violent events. Hence, **statement 1 is correct.**

- ◆ A class of such eruptions are **Coronal Mass Ejections (CMEs).**

- ◆ CMEs are the most powerful explosions happening in the solar system.
- When a really strong CME blows past the Earth, it can **damage the electronics in satellites** and **disrupt radio communication** networks on Earth. **Hence, statement 2 is correct.**
 - ◆ The research in the field of CMEs helps to understand **Space Weather**.
 - ◆ They can trigger intense light in the sky on Earth, called **auroras**.

72. Ans: A

Exp:

Anatomy of the Sun:

- The **Sun's Core** - Energy is generated via **thermonuclear reactions** creating extreme temperatures deep within the Sun's core. **Hence, statement 1 is not correct.**
- The Radiative Zone - Energy moves slowly outward, taking more than 1,70,000 years to radiate through this layer of the Sun.
- The Convection Zone - Energy continues to move toward the surface through convection currents of the heated and cooled gas.
- The **Chromosphere** - This **relatively thin layer of the Sun is sculpted by magnetic field lines** that restrain the electrically charged solar plasma.
 - ◆ The **photosphere is the lowest layer** of the solar atmosphere. **Hence, statement 2 is not correct.**
- **Sunspots** are **areas that appear dark** on the surface of the Sun. They appear dark because **they are cooler than other parts of the Sun's surface**. **Hence, statement 3 is correct.**

73. Ans: D

Exp:

- Recently, the first **Indigenously Designed High Ash Coal Gasification Based Methanol Production Plant** has been opened in Hyderabad.
 - ◆ With this, Government owned engineering firm BHEL (Bharat Heavy Electricals Limited) has successfully demonstrated a facility to create methanol from high ash Indian coal.
- Methanol is a low carbon, hydrogen carrier fuel produced from **high ash coal, agricultural residue**, CO₂ from thermal power plants, **natural gas** and renewable sources such as **municipal waste**, biomass.
- Methanol although slightly lower in energy content than petrol and diesel, methanol can replace both these fuels in the transport sector (road, rail and marine), energy sector (comprising boilers, process

heating modules, tractors and commercial vehicles) and retail cooking (replacing LPG [partially], kerosene and wood charcoal).

- **Hence, option D is correct.**

74. Ans: D

Exp:

Findings of Chandrayaan-2 Orbiter:

- **Detection of Argon-40:** The mass spectrometer CHandra's Atmospheric Compositional Explorer 2 (CHACE 2) conducted first-ever in-situ study of the composition of the lunar neutral exosphere from a polar orbital platform.
 - ◆ It detected and **studied the variability of the Argon-40 at the middle and higher latitudes of the Moon**, depicting the radiogenic activities in the mid and higher latitudes of the Lunar interior. **Hence, statement 1 is correct.**
- **Detection of Chromium and Manganese:** Chandrayaan-2 Large Area Soft X-ray Spectrometer (CLASS) payload **has detected minor elements of chromium and manganese through remote sensing**. **Hence, statement 2 is correct.**
- **Observations of Microflares of the Sun:** The observations of microflares of the Sun, during the quiet-Sun period, which provide important clues on the coronal heating problem of the Sun, were made by the Solar X-ray Monitor (XSM) payload.
- **Detection of the Hydration Features:** The first-ever unambiguous detection of the hydration features of the Moon was achieved by Chandrayaan-2 with its Imaging Infra-Red Spectrometer (IIRS) payload, which captured clear signatures of Hydroxyl and water-ice on the lunar surface.
- **Detection of the Subsurface Water-ice:** The Dual Frequency Synthetic Aperture Radar (DFSAR) instrument **detected signatures of the subsurface water-ice, and achieved high resolution mapping** of the lunar morphological features in the polar regions. **Hence, statement 3 is correct.**
- **Imaging the Moon:** Imaging the moon from 100 km lunar orbit with "best-ever" achieved resolution of 25 cm with its Orbiter High Resolution Camera (OHRC).
- **Geological Findings:** The Terrain Mapping Camera (TMC 2) of Chandrayaan-2, which is conducting imaging of the Moon at a global scale, has found interesting geologic signatures of lunar crustal shortening, and identification of volcanic domes.
- **Study of Moon's Ionosphere:** The Dual Frequency Radio Science (DFRS) experiment onboard

Chandrayaan-2 has studied the ionosphere of the Moon, which is generated by the solar photo-ionisation of the neutral species of the lunar exosphere.

75. Ans.: C

Exp.:

- CRISPR-Cas9 technology behaves like a cut-and-paste mechanism on DNA strands that contain genetic information. A **DNA strand, when broken, has a natural tendency to repair itself.** Scientists intervene during this auto-repair process, supplying the desired sequence of genetic codes that binds itself with the broken DNA strand. **Hence, statement 1 is correct.**
- Recently, **Emmanuelle Charpentier of France and Jennifer A Doudna of the USA** have been awarded the 2020 Nobel Prize in Chemistry for developing CRISPR/Cas9 genetic scissors, one of gene technology's sharpest tools. It is for the first time a Nobel science prize has gone to a women-only team. **Hence, statement 2 is correct.**

76. Ans: C

Exp:

- **Coal (a Hydrocarbon Fuel)** is one of the important sources of hydrogen making apart from natural gas and renewable energy through Electrolysis.
 - ◆ Cost of hydrogen produced from coal can be cheaper and less sensitive to imports.
- However, Coal has not been encouraged in hydrogen production because of the fear of Carbon Emission while extracting hydrogen via coal.
 - ◆ Almost **100% of hydrogen produced in India** is through natural gas. **Hence, statement 1 is correct.**
 - ◆ Grey Hydrogen is hydrogen produced using fossil fuels such as natural gas. **Hence, statement 2 is correct.**

77. Ans: C

Exp:

- **Coal is one of the important sources of hydrogen making** apart from natural gas and renewable energy through Electrolysis.
 - ◆ **Electrolysis** is a promising option for **carbon-free hydrogen production** from renewable and nuclear resources. **Hence, statement 1 is correct.**
 - Electrolysis is the process of using electricity to split water into hydrogen and oxygen. This reaction takes place in a unit called an electrolyzer.
 - Electrolyzers can range in size from small, appliance-size equipment that is well-suited

for small-scale distributed hydrogen production to large-scale, central production facilities that could be tied directly to renewable or other non-greenhouse-gas-emitting forms of electricity production.

- The process of Coal Gasification **chemically transforms the fossil fuel into Synthetic Natural Gas (SNG)**, instead of burning fossil fuel.
 - ◆ It produces Syngas which is a mixture consisting primarily of methane (CH₄), carbon monoxide (CO), hydrogen (H₂), carbon dioxide (CO₂) and water vapour (H₂O). **Hence, statement 2 is correct.**
 - ◆ Syngas can be used to produce a wide range of fertilizers, fuels, solvent and synthetic materials.

78. Ans: D

Exp:

- Lithium is a soft, silvery-white metal with the symbol Li.
- **Under standard conditions**, it is the lightest metal and the **lightest solid element.**
- It is **highly reactive and flammable**, and must be stored in mineral oil.
- It is an alkali metal and a **rare metal.**
 - ◆ **Rare Metals (RM)** include Niobium (Nb), Tantalum (Ta), **Lithium (Li)**, Beryllium (Be), Cesium (Cs) etc.
 - ◆ **Rare Earth (RE) metals** include Lanthanum (La) to Lutetium (Lu) besides Scandium (Sc) and Yttrium (Y).
- **Hence, option D is correct.**

79. Ans: A

Exp:

- **Ammonium Nitrate (NH₄NO₃)** is a nitrogen-rich white, crystalline chemical that is soluble in water.
- **Uses:**
 - ◆ It is a common chemical ingredient of **agricultural fertilisers.**
 - ◆ It is used as an ingredient for the production of **anaesthetic gases and cold packs.**
 - ◆ It is also the main ingredient in the manufacture of **commercial explosives** used in mining and construction.
- **As Explosive:** It is the main component of the explosive composition known as **ANFO- Ammonium Nitrate Fuel Oil.**
 - ◆ Pure ammonium nitrate is not an explosive on its own. For Ammonium nitrate to be explosive, a **primary explosive or detonator** like RDX or TNT is required.
- **Hence, option A is correct.**

80. Ans: C

Exp:

- Recently, the **solar DC cooking technology** was developed by the **Central Mechanical Engineering Research Institute (CMERI)**. Hence, **statement 1 is correct**.
- ◆ The CMERI is an institute under the **Council for Scientific and Industrial Research (CSIR)**.
- It is a Solar Energy based Cooking System which consists of a solar PV panel, charge controller, battery bank and cooking oven.
 - ◆ It provides a Clean Cooking Environment, **Inverter-Less Direct Operation**, Fast and Uniform Heating and a potential to save 1 ton Carbon Dioxide emissions per year/household.
 - ◆ It has **20-25% better efficiency** and is **more Economical** in comparison with **Conventional Solar based Cooking Systems** which loses efficiency owing to AC-DC conversion. Hence, **statement 2 is correct**.
 - ◆ The simple Technology Design also ensures Ease-of-Manufacturing and thus provides a substantial Economic Opportunity for the Micro-Industries.
 - ◆ Along with the widening of the popularity base of Technology, there is a probability of improvement in Job Prospects.

81. Ans: B

Exp:

- Recently, Northwestern University (US) has created an **Electronic Microchip or Microflier** with the capability of flight. It is the **smallest-ever human-made flying structure**.
 - ◆ It is about the size of a grain of sand and **does not have a motor or engine**. Hence, **statement 1 is not correct**.
- It catches flight on the wind — much like a maple tree's propeller seed — and spins like a helicopter through the air toward the ground.
 - ◆ The engineers **optimised their design by studying maple trees and other types of wind-dispersed seeds** and fashioned the micro flier such that when dropped from a height it would fall at a slow velocity in a controlled manner. Hence, **statement 2 is correct**.
- **Significance:**
 - ◆ It can be packed with ultra-miniaturised technology, including sensors, power sources, antennas for wireless communication and embedded memory to store data.

- Miniaturization is the trend to manufacture ever smaller mechanical, optical and electronic products and devices.

◆ It is **ideal for monitoring Air Pollution** and Airborne Disease. Hence, **statement 3 is correct**.

82. Ans: B

Exp:

- Recently, an international team of researchers made the first direct detection of dark energy. The experiment named **XENON1T, is the world's most sensitive dark matter experiment** and was operated deep underground at the INFN Laboratori Nazionali del Gran Sasso in Italy.
 - ◆ Dark energy is the mysterious form of energy that makes up about 68% of the universe, and has intrigued physicists and astronomers for decades.
- The XENON1T is a dark matter research project, operated at the Italian Gran Sasso National Laboratory.
 - ◆ It is a deep underground research facility featuring increasingly ambitious experiments **aiming to detect dark matter particles**.
 - ◆ The experiments aim to detect particles in the form of Weakly Interacting Massive Particles (WIMPs) by looking for rare interactions via nuclear recoils in a liquid xenon target chamber.
- Hence, **option B is correct**.

83. Ans: A

Exp:

- **Dark energy** is the mysterious form of energy that makes up about 68% of the universe, and has intrigued physicists and astronomers for decades.
- While **dark matter** attracts and **holds galaxies together**, **dark energy** repels and **causes the expansion of our universe**. Hence, **statement 1 is correct but statement 2 is not correct**.
- Despite both components being invisible, a lot more is known about dark matter, since its existence was suggested as early as the 1920s, while dark energy wasn't discovered until 1998.
- Hence, **option A is correct**.

84. Ans: B

Exp:

- NASA has launched an **earth monitoring satellite called Landsat 9** from Vandenberg Space Force Base in California. The satellite is a **joint mission of NASA and the US Geological Survey (USGS)**. Hence, **statement 1 is not correct**.



◆ Landsat-9 is the **continuation of a series of Earth-observing spacecraft stretching back almost 50 years.**

- Landsat images have been used to study the **health of forests, coral reefs, monitor water quality and melting glaciers.** This satellite is referred to as NASA's 'new eye in the sky' that will help study climate change. **Hence, statement 2 is correct.**

85. Ans: A

Exp:

Agni V Missiles

- Agni-V is the most advanced **surface-to-surface indigenously built ballistic missile.** **Hence, statement 1 is not correct.**
- It is a three-stage, solid fuelled, 17-metre tall missile, and is capable of carrying a nuclear warhead of about 1.5 tonnes.
- Agni-V is a **fire and forget missile**, which once fired **cannot be stopped, except by an interceptor missile.** **Hence, statement 3 is not correct.**
- It has been developed under the **Integrated Guided Missile Development Programme (IGMDP).** **Hence, statement 2 is correct.**
 - ◆ IGMDP was conceived by Dr. A.P.J. Abdul Kalam to enable India attain self-sufficiency in the field of missile technology. It was approved by the Government of India in 1983 and completed in March 2012.
 - ◆ The 5 missiles (P-A-T-N-A) developed under this program: Prithvi, Agni, Trishul, Nag, Akash.

86. Ans: C

Exp:

Mutation, Variant and Strain

- When a virus replicates it doesn't always manage to produce an exact copy of itself.
 - ◆ This means that, over time, the virus may start to differ slightly in terms of its genetic sequence.
 - ◆ Any changes to the **viral genetic sequence during this process** is known as a **Mutation.** **Hence, statement 1 is correct.**
- The words 'mutation' and 'variant' are sometimes used interchangeably, but they mean quite different things. A mutation is a single change in the genetic material of the virus (RNA in this case). A variant is the whole **sequence of the virus (the genome), which may contain one or more mutations.** **Hence, statement 2 is correct.**

- When a new variant has different functional properties to the original virus and becomes established in a population, it is sometimes referred to as a **New Strain** of the virus.

◆ All strains are variants, but not all variants are strains.

87. Ans: A

Exp:

- **Microplastics:** Plastic pollution that ends up in the ocean deteriorates and breaks down and ends up as Microplastics.
 - ◆ Microplastics are plastic particles less than 5mm in diameter.
- **Categories:**
 - ◆ **Primary Microplastics:** They are tiny particles designed for commercial use and microfibers shed from clothing and other textiles. **Hence, statement 1 is correct.** E.g. microbeads found in personal care products, plastic pellets and plastic fibres. **Hence, statement 2 is not correct.**
 - ◆ **Secondary Microplastics:** They are formed from the breakdown of larger plastics such as water bottles.

88. Ans: B

Exp:

- A **Genetically Modified or transgenic crop** is a plant that has a novel combination of genetic material obtained through the use of modern biotechnology.
 - ◆ For example, a GM crop can contain a gene(s) that has been artificially inserted instead of the plant acquiring it through pollination.
- **Bt cotton is the only GM crop that is allowed in India.** **Hence, statement 1 is not correct.**
 - ◆ It has alien genes from the soil bacterium *Bacillus thuringiensis* (Bt) that allows the **crop to develop a protein toxic to the common pest pink bollworm.** **Hence, statement 2 is correct.**
 - ◆ Herbicide Tolerant Bt (Ht Bt) cotton, on the other hand is derived with the insertion of an additional gene, from another soil bacterium, which allows the plant to resist the common herbicide glyphosate.
- In **Bt brinjal**, a gene allows the plant to resist attacks of fruit and shoot borers.
- In **DMH-11 mustard**, **genetic modification allows cross-pollination** in a crop that self-pollinates in nature. **Hence, statement 3 is not correct.**

89. Ans: D

Exp:

- Recent studies published in Lancet have shown that both **anaemia and Vitamin A deficiencies are overdiagnosed**, meaning that mandatory fortification could lead to hypervitaminosis. **Hence, statement 1 is correct.**
 - ◆ **Hypervitaminosis** is a condition of abnormally high storage levels of vitamins, which can lead to various symptoms such as **over excitement, irritability, or even toxicity.**
- **Undernourishment in India** is caused by monotonous cereal-based diets with low consumption of vegetables and animal protein.
 - ◆ Adding one or two synthetic chemical vitamins and minerals will not solve the larger problem, and undernourished populations can lead to toxicity.
 - ◆ A 2010 study showed iron **fortification causing gut inflammation and pathogenic gut microbiota profile** in undernourished children.
 - ◆ **Hence, statement 2 is correct.**
- Once biofortified food like iron-fortified rice is sold as the remedy to anaemia, **the value and the choice of naturally iron-rich foods** like millets, varieties of green leafy vegetables, and flesh foods, gets **suppressed.**
 - ◆ **This leads to loss of Dietary diversity, which is a healthier and more cost-effective way to fight malnutrition. Hence, statement 3 is correct.**

90. Ans: C

Exp:

- Recently, the launch of **Boeing's uncrewed Starliner Orbital Flight Test-2 (OFT-2)** has been postponed once again.
 - ◆ The spacecraft, which is called the **Crew Space Transportation-100 (CST-100)**, is part of an uncrewed test flight to the International Space Station (ISS). **Hence, statement 1 is correct.**
- The mission is **part of NASA's Commercial Crew Program. Hence, statement 2 is correct.**
 - ◆ The CST-100 spacecraft has been designed to accommodate seven passengers or a mix of crew and cargo for missions to low-Earth orbit.
 - ◆ For NASA service missions to the ISS, it will carry up to four NASA-sponsored crew members and time-critical scientific research.
 - ◆ The Starliner is supposed to carry more than 400 pounds of NASA cargo and crew supplies.

- ◆ The Starliner has an innovative, weldless structure and is reusable up to 10 times with a six-month turnaround time

91. Ans: C

Exp:

- **Biomethanation** is a process by which **organic material is microbiologically converted under anaerobic conditions to biogas. Hence, statement 1 is correct.**
 - ◆ Three main physiological groups of microorganisms are involved: fermenting bacteria, organic acid oxidizing bacteria, and methanogenic archaea.
 - ◆ Microorganisms degrade organic matter via cascades of biochemical conversions to methane and carbon dioxide.
- The **Ministry of New and Renewable Energy** in association with **UNIDO** (United Nations Industrial Development Organisation) and GEF (Global Environment Facility - a financial mechanism) launched two schemes on this occasion which are:
 - ◆ **Interest Subvention Scheme.**
 - It **provides financial assistance to innovative waste to energy biomethanation projects and business models. Hence, statement 2 is correct.**
- GIS based inventory tool of organic waste streams.
- Biofuels programme is also in synergy with Government of India's initiative of Atmanirbhar Bharat.

92. Ans: D

Exp:

- A **Ballistic Missile is a rocket-propelled self-guided strategic-weapons system** that follows a ballistic trajectory to deliver a payload from its launch site to a predetermined target. **Hence, statement 1 is correct.**
 - ◆ It can carry conventional high explosives as well as chemical, biological, or nuclear munitions.
- The International Code of Conduct against Ballistic Missile Proliferation (ICOC), now known as the **Hague Code of Conduct against Ballistic Missile Proliferation (HCOC)**, is a political initiative aimed at globally curbing ballistic missile proliferation.
 - ◆ **India is a signatory** to this convention. **Hence, statement 2 is correct.**
- Established in April 1987, the voluntary Missile Technology Control Regime (MTCR) aims to limit the spread of ballistic missiles and other unmanned delivery systems that could be used for chemical, biological, and nuclear attacks.
 - ◆ India has joined the MTCR.

93. Ans: C

Exp:

About Nuclear Fusion:

- Nuclear fusion is defined as the **combining of several small nuclei into one large nucleus** with the subsequent release of huge amounts of energy.
 - ◆ It is the **opposite reaction of fission**, where heavy isotopes are split apart. **Hence, statement 1 is not correct.**
- Harnessing fusion, **the process that powers the Sun**, could provide a limitless, clean energy source.
 - ◆ In the sun, the extreme pressure produced by its immense gravity creates the conditions for fusion to happen. **Hence, statement 2 is correct.**
- Fusion reactions **take place in a state of matter called plasma**. Plasma is a hot, charged gas made of positive ions and free-moving electrons that has unique properties distinct from solids, liquids and gases.
 - ◆ At high temperatures, electrons are ripped from atom's nuclei and become a plasma or an ionised state of matter. Plasma is also known as the **fourth state of matter**. **Hence, statement 3 is correct.**

94. Ans: D

Exp:

- Nanorobotics describes the technology of producing machines or robots at the nanoscale.
 - ◆ 'Nanobot' is an informal term to refer to engineered nano machines that carry out a very specific function and are ~50–100 nm wide.
- They **can be used very effectively for drug delivery**.
 - ◆ Using nanotechnology, the drug can be targeted to a precise location which would make the drug much more effective and reduce the chances of possible side effects.
- Uses of Nanotechnology in Health Care:
 - ◆ **Nanotech detectors for heart attack.**
 - ◆ **Nanocarriers for eye surgery**, chemotherapy etc.
 - ◆ Diabetic pads for regulating blood sugar levels.
 - ◆ **Nanosponges** are polymer nanoparticles coated with a red blood cell membrane, and can be used for **absorbing toxins and removing them from the bloodstream**.
 - ◆ NanoFlares are used for detection of cancer cells in the bloodstream.
 - ◆ Nanopores are used in making DNA sequencing more efficient.
- **Hence, option D is correct.**

95. Ans: D

Exp:

- **Chikungunya** is a **mosquito-borne viral disease** first described during an outbreak in southern Tanzania in 1952.
 - ◆ The name is derived from the local Kimakonde language and means "to become contorted", evoking the stooped appearance of patients suffering acute joint pain.
 - ◆ It is transmitted to people through the bite of an infected mosquito.
 - It is most **often spread to people by Aedes aegypti and Aedes albopictus mosquitoes**. These are the same mosquitoes that transmit dengue virus. **Hence, statement 1 is correct.**
- Recently, International Vaccine Institute (IVI) has announced that Bharat Biotech's Chikungunya vaccine candidate (BBV87) has entered into Phase II and III clinical trials. Currently, there is no commercial chikungunya vaccine.
 - ◆ BBV87 is an inactivated virus vaccine, similar to Covaxin.
 - ◆ **Bharat Biotech's Chikungunya vaccine candidate was developed in partnership with the International Vaccine Institute (IVI)**. **Hence, statement 2 is correct.**
- Development of Chikungunya Vaccine is an initiative of the United Nations Development Programme (UNDP), as part of the Global Chikungunya Vaccine Clinical Development Program (GCCDP).
 - ◆ It was funded by the **Coalition for Epidemic Preparedness Innovations (CEPI) with support from the Ind-CEPI mission** of the Department of Biotechnology, Government of India. **Hence, statement 3 is correct**

96. Ans: C

Exp:

- **CD4** is a type of **White Blood Cell (T cells)** in the body's immune system.
 - ◆ T cells are those cells that move around the body detecting anomalies and infections in cells. **Hence, statement 1 is correct.**
- **HIV (Human Immunodeficiency Virus)** after entering the body, **multiplies itself and destroys CD4 cells**, thus severely **damaging the human immune system**. Once this virus enters the body, it can never be removed. **Hence, statement 2 is correct.**

- ◆ The CD4 count of a person infected with HIV reduces significantly. In a healthy body, CD4 count is between 500- 1600, but in an infected body, it can go as low as 200.
- ◆ Weak immune system makes a person prone to opportunistic infections and cancer. It becomes difficult for a person infected with this virus to recover from even a minor injury or sickness.

97. Ans: B

Exp:

- Green hydrogen is produced by **electrolysis of water using renewable energy (like Solar, Wind)** and has a lower carbon footprint. **Hence, statement 1 is not correct.**
- Electricity splits water into hydrogen and oxygen with by Products such as Water and Water Vapor. **Hence, statement 2 is correct.**
- **Other Types of Hydrogen:**
 - ◆ **Brown hydrogen** is produced using coal where the emissions are released to the air.
 - ◆ **Grey hydrogen** is produced from natural gas where the associated emissions are released to the air.
 - ◆ **Blue hydrogen** is produced from natural gas, where the emissions are captured using carbon capture and storage.

98. Ans: C

Exp:

- The **Gravitational Waves** are **invisible ripples in space** that form when:
 - ◆ A star explodes in a supernova.
 - ◆ Two big stars orbit each other.
 - ◆ Two black holes merge.
 - ◆ **Neutron star-Black hole (NS-BH) merges. Hence, statement 1 is correct.**
- They travel at the speed of light (1,86,000 miles per second) and squeeze and stretch anything in their path.
- As a gravitational wave travels through space-time, it causes it to stretch in one direction and compress in the other.
- Any object that occupies that region of space-time also stretches and compresses as the wave passes over them, though very slightly, which can only be detected by specialized devices like LIGO.
- These were **proposed by Albert Einstein in his General Theory of Relativity**, over a century ago. **Hence, statement 2 is correct.**

- However, the first gravitational wave was actually detected by LIGO only in 2015.

99. Ans: B

Exp:

- An **Aurora is a display of light** in the sky **predominantly seen in the high latitude regions (Arctic and Antarctic)**. It is also known as a Polar light.
 - ◆ They commonly occur at **high northern and southern latitudes**, less frequent at mid-latitudes, and seldom seen near the equator. **Hence, statement 1 is not correct.**
- While usually a milky greenish color, auroras can also show red, blue, violet, pink, and white. These colors appear in a variety of continuously changing shapes.
- Auroras are not just **something that happens on Earth. If a planet has an atmosphere and magnetic field**, they probably have auroras.
- Auroras are caused when charged particles **ejected from the Sun's surface** - called the solar wind - enter the Earth's atmosphere. **Hence, statement 2 is correct.**
- The typical aurora is caused by collisions between charged particles from space with the oxygen and nitrogen in Earth's upper atmosphere.
- The electrons - which come from the Earth's magnetosphere, the region of space controlled by Earth's magnetic field - transfer their energy to the oxygen and nitrogen atoms and molecules, making them "excited".
- When a large number of electrons come from the magnetosphere to bombard the atmosphere, the oxygen and nitrogen can emit enough light for the eye to detect, giving us beautiful auroral displays.
- In the northern part of our globe, the polar lights are called aurora borealis or Northern Lights, and are seen from the US (Alaska), Canada, Iceland, Greenland, Norway, Sweden and Finland.
- In the south, they are called aurora australis or southern lights, and are visible from high latitudes in Antarctica, Chile, Argentina, New Zealand and Australia.

100. Ans: C

Exp:

- The six most common cancer types in India are breast cancer, oral cancer, cervical cancer, lung cancer, stomach cancer, and colorectal cancer.
 - ◆ **Oral cancer is the most prevalent form of cancer among men in India**, largely fuelled by tobacco-chewing. **Hence, statement 1 is correct.**

- ◆ According to the World Cancer Report 2020, India had an estimated 1.16 million new cancer cases in 2018.
- Recently, the **National Institute of Biomedical Genomics (NIBMG)**, funded by the Department of Biotechnology, has created the **world's first database of genomic variations in oral cancer (dbGENVOC)**. Hence, **statement 2 is correct**.
 - ◆ dbGENVOC, a comprehensive, flexible database framework, developed with an aim to allow potential users to access, query, browse and download clinically relevant somatic and germline variation data from Indian oral cancer patients.
 - It will be updated annually with variation data from new oral cancer patients from different regions of India and southeast Asia.

101. Ans: A

Exp:

- Recently, a six person crew on **Virgin Galactic's VSS Unity spaceship** undertook a brief trip to the "edge of space" which is known as Suborbital Flight.
 - ◆ Virgin Galactic is a **British-American spaceflight company**, operating in the United States. Hence, **statement 3 is not correct**.
- When an object travels at a horizontal speed of about 28,000 km/hr or more, it goes into orbit once it is above the atmosphere.
 - ◆ Such a satellite would be accelerating towards the Earth due to gravity, but its horizontal movement is fast enough to offset the downward motion so that it moves along a circular path.
 - ◆ Any object travelling slower than 28,000 km/hr must eventually return to Earth.
 - ◆ Any object that launches to space but does not reach sufficient horizontal velocity to stay in space falls back to Earth. Hence **they fly in a suborbital trajectory**.
 - ◆ It means that while these vehicles will cross the ill-defined boundary of space, they will **not be going fast enough to stay in space once they get there**.
- Hence, **statement 2 is not correct**.
- The most widely accepted boundary of space is known as the **Karman line**. The Fédération Aéronautique Internationale (FAI) defines Karman Line as the altitude of 100 kilometres above Earth's mean sea level. Hence, **statement 1 is correct**.
 - ◆ It is named after Theodore von Karman (1881–1963), a Hungarian American engineer and physicist, who was active primarily in aeronautics and astronautics.

102. Ans: B

Exp:

- **Superfluidity** is the **frictionless flow** and other exotic behaviour of electrons observed in liquid helium at **temperatures near absolute zero ($-273.15\text{ }^{\circ}\text{C}$)**, and similar frictionless behaviour of electrons in a superconducting solid. Hence, **statement 1 is not correct**.
- **An electron injected into a superfluid form of helium creates a Single Electron Bubble (SEB)** — a cavity that is free of helium atoms and contains only the electron. Hence, **statement 2 is correct**.
 - ◆ An electron bubble is the empty space created around a free electron in a cryogenic gas or liquid, such as neon or helium. They are typically very small, about 2 nm in diameter at atmospheric pressure.

103. Ans: A

Exp:

- The Hubble Space Telescope (HST) is **named after the astronomer Edwin Hubble**.
 - ◆ The observatory is the **first major optical telescope** to be placed in space and has made groundbreaking discoveries in the field of astronomy since its launch (into **Low Earth orbit** in 1990).
 - ◆ It is a part of **NASA's Great Observatories Program** - a family of four space-based observatories, each observing the Universe in a different kind of light. Hence, **statement 1 is correct**.
 - The other missions in the program include the visible-light **Spitzer Space Telescope**, **Compton Gamma-Ray Observatory (CGRO)**, and the **Chandra X-Ray Observatory (CXO)**.
- A **successor to Hubble, the James Webb Space Telescope (JWST)**, is scheduled to launch later this year. Hence, **statement 2 is not correct**.
 - ◆ The telescope will be launched on an Ariane 5 rocket from **French Guiana in 2021**.
 - ◆ It is an **international collaboration between NASA, the European Space Agency (ESA), and the Canadian Space Agency (CSA)**. Hence, **statement 3 is not correct**.

104. Ans: A

Exp:

- Recently, **National Aeronautics and Space Administration (NASA)** has announced that its new spacecraft, named **Near-Earth Asteroid Scout** or **NEA Scout**, has completed all required tests and has been



safely tucked inside the Space Launch System (SLS) rocket

- **Near-Earth Asteroid Scout, or NEA Scout**, is a **miniaturized spacecraft**, known as a CubeSat, developed under NASA's **Advanced Exploration Systems (AES) Program**. Hence, **statement 1 is correct**.
 - ◆ AES pioneers new approaches for rapidly developing prototype systems, demonstrating key capabilities, and validating operational concepts for future human missions beyond low-Earth orbit.
- Its main mission is to fly by and **collect data from a near-Earth asteroid**. Hence, **statement 2 is not correct**.
 - ◆ It will take about two years to cruise to the asteroid and will be about 93 million miles away from Earth during the asteroid encounter.
- It will also be America's first interplanetary mission using a special solar sail propulsion.

105. Ans: D

Exp:

- **Solar PhotoVoltaic (SPV)**: SPV cells convert solar radiation (sunlight) directly into electricity.
 - ◆ A SPV is a semi-conducting device made of silicon and/or other materials, which, when exposed to sunlight, generates electricity. Hence, **statement 1 is not correct**.
- **Solar Thermal**: Solar Thermal Power systems, also known as Concentrating Solar Power systems, use concentrated solar radiation as a high temperature energy source to produce electricity. Hence, **statement 2 is not correct**.

106. Ans: C

Exp:

- Digital Twin is a **virtual replica of the physical world**, its dynamics, and processes, which allow us to **simulate real life situations and analyse its impact**. Hence, **statement 1 is correct**.
- Digital twins are composed of three parts:
 - ◆ the physical entities in the physical world,
 - ◆ the virtual models in the virtual world, and
 - ◆ the connected data that tie the two worlds.
- Digital Twins not only integrate the digital representation of physical assets, like physical systems of pipes, pumps, valves, and tanks, but also include historical data sets such as weather records and realtime dynamic interactions, which allow them to be used for multiple analyses. Hence, **statement 2 is correct**.

107. Ans: D

Exp:

- Recently, the **Russian Space Agency Roscosmos**, launched its **biggest space laboratory named Nauka** to the International Space Station (ISS).
- Nauka means Science in Russian. This is Russia's most ambitious research facility in space and is fitted with an oxygen generator, robotic cargo crane, a toilet and a bed for Russian astronauts.
 - ◆ This was sent into orbit using a Proton rocket (family of rockets in Russia - the most powerful in Russia's space inventory) and will take eight days to reach the ISS.
- Hence, **option D is correct**.

108. Ans: C

Exp:

- **Gamma-Ray Bursts (GRBs)** are the **most powerful events in the universe**, detectable across billions of light-years. Hence, **statement 1 is correct**.
 - ◆ A light-year is the distance a beam of light travels in a single Earth year, or 9.5 trillion kilometers.
- Astronomers classify them as long or short based on whether the event lasts for more or less than two seconds.
 - ◆ **Long GRBs are observed in association with the demise of massive stars**. Hence, **statement 2 is correct**.
 - ◆ Short GRB, on the other hand, forms when pairs of compact objects – such as neutron stars, which also form during stellar collapse – spiral inward over billions of years and collide.

109. Ans: C

Exp:

- An exoplanet or extrasolar planet is a planet **outside the Solar System**. The first confirmation of **detection of exoplanets occurred in 1992**. More than 4,400 exoplanets have been discovered till now. Hence, **statement 1 is correct**.
- Exoplanets are very hard to see directly with telescopes. They are **hidden by the bright glare of the stars they orbit**.
 - ◆ So, astronomers use other ways to detect and study exoplanets such as looking at the effects these planets have on the stars they orbit. Hence, **statement 2 is correct**.

110. Ans: A

Exp:

- **Gamma Rays** are the highest-energy light in the universe. They can have over a billion times the energy of the type of light visible to our eyes.

- ◆ They are **produced by the hottest and most energetic objects** in the universe, such as **neutron stars and pulsars, supernova explosions, and regions around black holes**. Hence, **statement 1 is correct**.
- ◆ The gamma rays possess high energy; they can pass right through any lens or mirror, making it very difficult to focus them in a visible-light telescope.
- Recently, a group of astronomers have detected a very short, powerful burst of high-energy radiation also known as Gamma-Ray Bursts (GRBs) that lasted for about a second.
- It was named **GRB 200826A** after the date it occurred, which is 26th August 2020.
 - ◆ It was **detected by NASA's Fermi Gamma-ray Space Telescope**. Hence, **statement 2 is not correct**.
 - ◆ It is **considered to be the shortest GRB** till now and it was caused by the death of a massive star.

111. Ans: D

Exp:

- **Malware** is short for **malicious software**, refers to any kind of software that is **designed to cause damage to a single computer, server, or computer network**. Hence, **statement 1 is correct**.
 - ◆ Ransomware, Spy ware, Worms, viruses, and Trojans are all varieties of malware.
- **Pegasus** is a type of malicious software or malware **classified as a spyware**. Hence, **statement 2 is not correct**.
 - ◆ It is designed to gain access to devices, without the knowledge of users, and gather personal information and relay it back to whoever it is that is using the software to spy.
 - ◆ Pegasus has been developed by the Israeli firm NSO Group that was set up in 2010.
- **International Telecommunication Union (ITU)**: It is a specialized agency within the United Nations which plays a leading role in the standardization and development of telecommunications and cyber security issues.
- **Budapest Convention on Cybercrime**: It is an international treaty that seeks to address Internet and computer crime (cybercrime) by harmonizing national laws, improving investigative techniques, and increasing cooperation among nations. It came into force on 1st July 2004.
 - ◆ **India is not a signatory to this convention**. Hence, **statement 3 is correct**.

112. Ans: C

Exp:

- Geospatial technologies is a term used to describe the range of modern tools contributing to the **geographic mapping and analysis of the Earth and human societies**. Hence, **statement 1 is correct**.
- The term 'geospatial' refers not to one single technology, but a collection of technologies that help to collect, analyse, store, manage, distribute, integrate, and present geographic information.
- Broadly speaking, it consists of the following technologies:
 - ◆ **Remote Sensing**
 - ◆ **GIS (Geographic Information System)**
 - ◆ **GNSS (Global Navigation Satellite System)**
 - ◆ **Survey**
 - ◆ **3D modelling**
 - ◆ Hence, **statement 2 is correct**.

113. Ans: C

Exp:

- Recently, Indian Institute of Technology (IIT) Ropar, Punjab **has developed a first-of-its-kind IoT (Internet of Things) device**. Hence, **statement 1 is correct**.
 - ◆ AmbiTag that records real-time ambient temperature during the transportation of perishable products, vaccines and even body organs and blood.
- The device has been developed under Technology Innovation Hub – AWaDH (Agriculture and Water Technology Development Hub) and it's Startup ScratchNest
- 'AmbiTAG' is shaped as a USB (Universal Serial Bus) device.
- It is India's **first indigenous temperature data logger** for cold chain management. Hence, **statement 2 is correct**.
 - ◆ It continuously records the temperature of its immediate surroundings from -40 to +80 degrees in any time zone for a full 90 days on a single charge.
 - ◆ Most of the similar devices available in the international market record data only for a duration of 30- 60 days.
 - ◆ It generates an alert when the temperature goes beyond a pre-set limit.
 - ◆ The recorded data can be retrieved by connecting the USB with any computer.

114. Ans: B**Exp:**

- Venus is the second brightest natural object in the night sky after the Moon, probably that is the reason why it was the first planet to have its motions plotted across the sky, as early as the second millennium BC.
 - ◆ Unlike the other planets in our solar system, **Venus and Uranus spin clockwise** on their axis. **Hence, statement 1 is not correct.**
- A day on Venus is longer than a year. It takes Venus longer to rotate once on its axis than to complete one orbit of the Sun.
 - ◆ That's **243 Earth days to rotate once - the longest rotation of any planet in the Solar System** - and only 224.7 Earth days to complete one orbit of the Sun. **Hence, statement 2 is correct.**
- Recently, the National Aeronautics and Space Administration (NASA) announced two new robotic missions to Venus.
 - ◆ The **two sister missions named DaVinci Plus and Veritas** are aimed at understanding how Venus became an inferno-like world capable of melting lead at the surface.
 - ◆ DaVinci Plus:
 - It will be the first of the two, it will analyze the thick, cloudy Venusian atmosphere in an attempt to determine whether the inferno planet ever had an ocean and was possibly habitable. A small craft will plunge through the atmosphere to measure the gases.
 - ◆ **Veritas:**
 - It will be the second one seeking a geologic history by mapping the rocky planet's surface.
 - ◆ Venera and Vegas were the previous Venusian missions of Russia. **Hence, statement 3 is not correct.**

115. Ans: D**Exp:**

- Recently, **Interpol** has launched a new global database named "I-Familia". **Hence, statement 1 is correct.**
- The **I-Familia** is the first of its kind, I-Familia is a **global database for identifying missing persons** based on international DNA (deoxyribonucleic acid) kinship matching. **Hence, statement 2 is correct.**
 - ◆ The database seeks to identify missing persons or unidentified human remains when direct comparison is not possible, by using DNA samples from family members instead.

- Family members must give their consent for their data to be used for international searching.
- It builds on Interpol's long-standing success in direct DNA matching.
- **I-Familia has three components:**
 - ◆ A dedicated global database to host the DNA profiles provided by relatives, held separately from any criminal data.
 - ◆ DNA matching software called **Bonaparte**. **Hence, statement 3 is correct.**
 - ◆ Interpretation guidelines, produced by **Interpol**, to efficiently identify and report potential matches.
- In the event of a match, notifications are sent to the countries that supplied the DNA profile from the unidentified body and from the family respectively.

116. Ans: C**Exp:**

- Recently, **European Space Agency (ESA)** has announced a new mission- **EnVision mission** to Venus.
 - ◆ It is an European Space Agency (ESA) led mission with contributions from the National Aeronautics and Space Administration (NASA). **Hence, statement 1 is correct.**
- It is likely to be launched sometime in the 2030s. Once launched on an Ariane 6 rocket, the spacecraft will take about 15 months to **reach Venus and will take 16 more months to achieve orbit circularisation.**
 - ◆ The mission will carry a range of instruments to **study the planet's atmosphere and surface, monitor trace gases** in the atmosphere and **analyse its surface composition**. **Hence, statement 2 is correct.**
- EnVision will follow another ESA-led mission to Venus called 'Venus Express' (2005-2014) that focussed on atmospheric research and pointed to volcanic hotspots on the planet's surface.

117. Ans: B**Exp:**

- New Shephard is a rocket system that has been **designed to take astronauts and research payloads past the Karman line**. **Hence, option B is correct.**
 - ◆ The Karman line is the internationally recognized boundary of space
- New Shephard has been named after astronaut Alan Shephard – the first American to go to space – and offers flights to space over 100 km above the Earth and accommodation for payloads.

- The idea is to provide easier and more cost-effective access to space meant for purposes such as academic research, corporate technology development and entrepreneurial ventures among others.
- It will also allow space tourists to experience microgravity by taking them 100 km above the Earth.
- Microgravity is the condition in which people or objects appear to be weightless. The effects of microgravity can be seen when astronauts and objects float in space

118. Ans: C

Exp:

- The Shenzhou-12 craft connected with the Tianhe space station module from the Jiuquan launch center in Gobi Desert.
 - ◆ **Tianhe core module** is the first module to the Tiangong space station. It was launched into orbit on 29 April 2021. **Hence, statement 1 is correct.**
- China is the **third country** after the former Soviet Union and the United States to carry out a manned mission on its own. **Hence, statement 2 is correct.**
- China is **not a participant in the International Space Station (ISS)**, largely as a result of US objections to the Chinese program's secrecy and close military ties.
 - ◆ The ISS is a joint project between five participating space agencies: NASA (United States), Roscosmos (Russia), JAXA (Japan), ESA (Europe), and b (Canada).

119. Ans: A

Exp:

- **Bt cotton** is the **only transgenic crop** that has been approved by the Government of India for commercial cultivation. **Hence, statement 1 is correct.**
- Bt cotton has been **genetically modified (GM) to produce an insecticide** to combat the cotton bollworm, a common pest. **Hence, statement 2 is not correct.**
 - ◆ The Herbicide Tolerant Bt (**HTBt) Cotton** is another variant which provides one more layer of modification **making the plant resistant to the herbicide glyphosate**. However, it has not been approved by regulators yet.

120. Ans: C

Exp:

- **Biofortification** is the process by which the nutritional quality of food crops is improved through agronomic practices, conventional plant breeding, or modern biotechnology.
- Recently, the Prime Minister dedicated 17 biofortified varieties of 8 crops to the nation. Some examples:

- ◆ **Rice- CR DHAN 315 has excess zinc. Hence, statement 2 is correct.**
- ◆ Wheat- HI 1633 rich in protein, iron and zinc.
- ◆ Maize- Hybrid varieties 1, 2 and 3 are enriched with lysine and tryptophan.
- ◆ **Madhuban Gajar, a biofortified carrot variety**, is benefitting more than 150 local farmers in Junagadh, Gujarat. It has higher β -carotene and iron content. **Hence, statement 1 is correct.**

121. Ans: B

Exp:

- LiDAR (Light Detection and Ranging) is a **remote sensing method that uses light in the form of a pulsed laser** to measure ranges & variable distances. **Hence, statement 1 is correct.**
 - ◆ These light pulses—combined with other data recorded by the airborne system— generate precise, three-dimensional information about the shape of the Earth and its surface characteristics.
- A LiDAR instrument principally consists of a laser, a scanner, and a specialized Global Positioning System (GPS) receiver.
- Lidar is **commonly used to make high-resolution maps**, with applications in surveying, geodesy, geomatics, archaeology, geography, geology, geomorphology, seismology, forestry, atmospheric physics, laser guidance, airborne laser swath mapping (ALSM), and laser altimetry. **Hence, statement 2 is correct.**
- LiDAR follows a simple principle — **throw laser light at an object on the earth surface and calculate the time it takes to return to the LiDAR source. Hence, statement 3 is not correct.**
 - ◆ Given the speed at which the light travels (approximately 186,000 miles per second), the process of measuring the exact distance through LiDAR appears to be incredibly fast.

122. Ans:A

Exp:

- **Polar-Areas Stellar-Imaging in Polarisation High-Accuracy Experiment (PASIPHAE) is an international collaborative sky surveying project.**
- The PASIPHAE polarimetric map will be used to **perform magnetic tomography of the Milky Way Galaxy.**
 - ◆ It will deduce the 3-dimensional structure of the magnetic field and the dust that resides in our own Galaxy.



- ◆ This map will provide invaluable information for future **Cosmic Microwave Background (CMB)** B-mode experiments searching for inflationary gravitational waves, providing unique information regarding line-of-sight integration effects.
- It is an opto polarimetric survey aiming to measure the linear polarization from millions of stars.
 - ◆ The survey will use two high-tech optical polarimeters to observe the northern and southern skies, simultaneously.
- Hence, option A is correct.

123. Ans: C

Exp:

- Neanderthal (Homo neanderthalensis, Homo sapiens neanderthalensis) is member of a group of archaic humans who **emerged at least 2,00,000 years ago during the Pleistocene Epoch** (about 2.6 million to 11,700 years ago). Hence, statement 1 is correct.
 - ◆ They were replaced or assimilated by early modern human populations (Homo sapiens) between 35,000 and perhaps 24,000 years ago.
- A genome is all the genetic matter in an organism. It is defined as an **organism's complete set of Deoxyribose Nucleic Acid (DNA), including all of its genes.** Hence, statement 2 is correct.
 - ◆ In humans, a copy of the entire genome contains more than 3 billion DNA base pairs.

124. Ans: B

Exp:

- **2G technology** was launched in the 1990s which uses **digital radio signals** and supported both voice and data transmission with a bandwidth of 64 Kbps. Hence, statement 1 is not correct.
 - ◆ 1G technology, launched in the 1980s, worked on analog radio signals.
- **4G** was launched in 2009 with a peak speed of **100 Mbps to 1 Gbps** and it also enables 3D virtual reality. Hence, statement 2 is correct.
- 5G technology is the latest upgrade in the long-term evolution (LTE) mobile broadband networks.
 - ◆ 5G mainly works in 3 bands, namely low, mid and high frequency spectrum — all of which have their own uses as well as limitations.
 - Low band spectrum: It has shown great promise in terms of coverage and speed of internet and data exchange however the maximum speed is limited to 100 Mbps (Megabits per second).

- Mid-band spectrum: It offers higher speeds compared to the low band, but has limitations in terms of coverage area and penetration of signals.
- High-band spectrum: It has the **highest speed** of all the three bands, but has **extremely limited coverage** and signal penetration strength. Hence, statement 3 is not correct.

125. Ans: D

Exp:

- **Venus**, the second planet from the sun, is similar in structure but slightly smaller than Earth (Earth's Twin).
- It has a thick and toxic atmosphere that consists primarily of carbon dioxide, with clouds of sulfuric acid droplets.
 - ◆ Presence of **phosphine** was detected in the atmosphere of Venus. This indicates the possibility of the presence of lifeforms on Venus. Hence, statement 2 is correct.
- According to a study published in Nature Geoscience, **Venus is still geologically active.** Hence, statement 1 is not correct.
 - ◆ The study identified 37 active volcanoes, in the form of ring-like structures known as coronae, on the surface of Venus.
- Missions Related to Venus:
 - ◆ **ISRO Shukrayaan:** The Indian Space Research Organisation (ISRO) is also planning a mission to Venus, tentatively called Shukrayaan
 - ◆ Akatsuki (Japanese 2015)
 - ◆ Venus Express (European Space Agency 2005)
 - ◆ NASA's Magellan (1989). Hence, statement 3 is not correct.

126. Ans: C

Exp:

- Methane is gas that is found in small quantities in Earth's atmosphere. Methane is the simplest hydrocarbon, consisting of one carbon atom and four hydrogen atoms (CH₄). Methane is a **powerful greenhouse gas**. It is flammable, and is used as a fuel worldwide.
- Methane is produced by the **breakdown or decay of organic material** and can be introduced into the atmosphere by **either natural processes** — such as the decay of plant material in wetlands, the seepage of gas from underground deposits or the digestion of food by cattle — **or human activities** — such as oil and gas production, rice farming or waste management.

Hence, statement 1 is correct but statement 2 is not correct.

- Methane is **84 times more potent than carbon and doesn't last as long in the atmosphere before it breaks down**. This makes it a critical target for reducing global warming more quickly while simultaneously working to reduce other greenhouse gases. **Hence, statement 3 is not correct.**
- It is responsible for creating ground-level ozone, a dangerous air pollutant.

127. Ans: C

Exp:

- Technology Development Board is a **statutory body** of Government of India functioning under the Department of Science of Technology. **Hence, statement 1 is correct.**
- It **provides financial assistance** to Indian industrial concerns and other agencies, for **commercialization of indigenized technologies** or adaptation of imported technologies for wider domestic applications. **Hence, statement 2 is not correct.**
- Every year on the occasion of **National Technology Day (11th May)**, the **Technology Development Board** of India celebrates the day by awarding individuals with the **National Award for their contribution to science and technology in India**. **Hence, statement 3 is correct.**

128. Ans: (c)

Exp:

- Recently, **NASA's OSIRIS-REX spacecraft departed** from asteroid Bennu, and started its two-year long journey back to Earth.
- The OSIRIS-REX is **NASA's first mission to visit a near-Earth asteroid**. It is the United States' first asteroid sample return mission, aiming to collect and carry a pristine, unaltered sample from an asteroid back to earth for scientific study. **Hence, statement 1 is correct.**
- The OSIRIS-REX (Origins, Spectral Interpretation, Resource Identification, Security, Regolith Explorer) spacecraft was **launched in 2016 for the journey to Bennu**. **Hence, statement 2 is correct.**
 - ◆ The mission is essentially a seven-year-long voyage and will conclude when at least 60 grams of samples are delivered back to the Earth (in 2023).
 - ◆ As per the National Aeronautics and Space Administration (NASA), the mission promises to bring the largest amount of extraterrestrial material back to the Earth since the Apollo era.

- ◆ The spacecraft contains five instruments meant to explore Bennu including cameras, a spectrometer and a laser altimeter.
- ◆ Recently, the spacecraft's robotic arm called the Touch-And-Go Sample Acquisition Mechanism (TAGSAM), made an attempt to "TAG" the asteroid at a sample site and collected a sample.

129. Ans: B

Exp:

- **Advanced Chemistry Cells (ACCs)** are the new generation of advanced storage technologies that can **store electric energy either as electrochemical or as chemical energy and convert it back to electric energy** as and when required. **Hence, statement 1 is correct.**
 - ◆ Such battery storages will cater not only to electric vehicles but also to the consumer electronics industry and electricity grids.
- The Union Cabinet has approved a Rs. 18,100-crore **Production Linked Incentive (PLI) scheme for manufacturers of Advanced Chemistry Cell (ACC) battery storage**, to reduce imports (**PLI scheme is applicable to ACCs**). **Hence, statement 2 is not correct.**
 - ◆ The PLI Scheme has also been approved for sectors such as automobiles, pharmaceuticals, IT hardware including laptops, mobile phones & telecom equipment, white goods, chemical cells and textiles, etc.
- The scheme called the **National Programme on Advanced Chemistry Cell Battery Storage (NPACC)** is launched under the **Ministry of Heavy Industries & Public Enterprises (and not under Meity)**. **Hence, statement 3 is not correct.**
 - ◆ The plan is to set up 50 gigawatt hour (GWh) manufacturing capacity for ACC batteries by attracting investments totaling Rs. 45,000 crore.
 - ◆ Requires each selected ACC battery Storage manufacturer to set-up an ACC manufacturing facility of minimum 5 GWh capacity, achieve a domestic value addition of at least 25% and incur the mandatory investment Rs.225 crore /GWh within 2 Years.

130. Ans: C

Exp:

- Mars is the fourth planet from the Sun and the second-smallest planet in the Solar System.
 - ◆ Mars is about half the size of Earth.
- Similarity to the Earth (Orbit and Rotation):
 - ◆ As Mars orbits the Sun, it completes **one rotation every 24.6 hours, which is very similar to one day on Earth (23.9 hours)**.

- ◆ Mars' axis of rotation is tilted 25 degrees with respect to the plane of its orbit around the Sun. **This is similar to Earth, which has an axial tilt of 23.4 degrees. Hence, statement 1 is correct.**
- ◆ Mars has distinct seasons like Earth, but they last longer than seasons on Earth.
 - Martian days are called sols—short for 'solar day'.
- It has two small moons, **Phobos and Deimos. Hence, statement 2 is not correct.**
 - ◆ It has the largest volcano in the solar system i.e. Olympus Mons.
- Recently, **China's spacecraft Tianwen-1** landed on Mars carrying its first Mars rover named Zhurong. **Hence, statement 3 is not correct.**
 - ◆ China's Other Space Programmes:
 - **Chang'e-5 (Moon)**
 - Tianhe (Permanent Space Station)

131. Ans: C

Exp:

- International Space Station (ISS) is a habitable artificial satellite - the single largest man-made structure in **low earth orbit. Hence, statement 1 is not correct.**
 - ◆ Its first component was launched into orbit in 1998.
- It circles the Earth in roughly 92 minutes and completes 15.5 orbits per day.
- The ISS programme is a joint project between **five participating space agencies:** NASA (United States), Roscosmos (Russia), JAXA (Japan), ESA (Europe), and CSA (Canada) but its ownership and use has been established by intergovernmental treaties and agreements. **Hence, statement 2 is not correct.**
- **NASA will send baby squids** and tardigrades (also called water bears) to the International Space Station for conducting various scientific studies. **Hence, statement 3 is correct.**

132. Ans: B

Exp:

- The FASTag is a reloadable tag that allows automatic deduction of toll without having to stop for carrying out the cash transaction.
- The tag uses **Radio Frequency Identification (RFID) technology** and is fixed on the windscreen of the vehicle once active. **Hence, statement 1 is correct.**
 - ◆ RFID is the use of radio waves to read and capture information stored on a tag attached to an object.

- ◆ A tag can be read from up to several feet away and does not need to be within the direct line-of-sight of the reader to be tracked.
- From 15th February, 2021, FASTag has become **compulsory for all vehicles across the country. Hence, statement 2 is not correct.**
- It is operated by **National Highway Authority of India (NHA).** **Hence, statement 3 is correct.**

133. Ans: B

Exp:

- **White Fungus or Candidiasis** is a **fungal infection caused by a yeast** (a type of fungus) called Candida (and not by group of molds). **Hence, statement 1 is not correct.**
- Candida normally lives on the skin and inside the body, in places such as the mouth, throat, gut, and vagina, without causing any problems.
 - ◆ Candida can cause infections if it grows out of control or if it enters deep into the body (for example, the bloodstream or internal organs like the kidney, heart, or brain).
 - The most common species that causes infection is Candida albicans.
- This infection can be caused due to low immunity, or if people come in contact with things that contain these moulds like water, etc.
 - ◆ Children and women are more at risk of contracting the fungal infection.
- Like the black fungus, **white fungus is also more likely to afflict people with compromised immune systems, pre-existing medical conditions, AIDS, a recent kidney transplant or diabetes. Hence, statement 2 is correct.**

134. Ans: A

Exp:

- **Water hyacinth** is a **type of invasive floating plant** found in water bodies across the world.
 - ◆ These invasive species block the sunlight reaching an oxygen level in water systems, which results in damaging water quality and seriously affecting various life forms in the ecosystem.
- It is also referred to as the **terror of Bengal** given its effect on the local ecology and lives of the people.
 - ◆ It has an effect on irrigation, hydroelectric generation and navigation.
 - ◆ It also leads to a drastic reduction in fish production, aquatic crops and an increase in diseases caused by mosquitoes.
- Recently, six young girls from the fishing community from Assam have developed a biodegradable and compostable yoga mat called '**Moorhen Yoga Mat**'.

- ◆ The 'Moorhen Yoga mat' is named after Kam Sorai (Purple moorhen, a resident bird of Deepor Beel Wildlife sanctuary).
- ◆ It is a **hand-woven 100% biodegradable and 100% compostable mat developed from water hyacinth.**

● Hence, option A is correct.

135. Ans: D

Exp:

- Yellow fungus, also called mucor septic, initially develops by the presence of moulds (a type of fungi) in the environment. Hence, statement 1 is correct.
- It may be present with unnecessary fatigue, rashes, burning sensation on skin etc. Hence, statement 2 is correct.
- Humidity levels below 30-40% can promote the growth of fungus.
- It may **not start from the lungs but it invades internal organs of the body** and affects the entire functioning. Hence, statement 3 is correct.

136. Ans: A

Exp:

- Recently, Astronomers have discovered a **new active galaxy called Narrow-Line Seyfert 1 (NLS1)** which has been identified as the farthest gamma-ray emitting galaxy.
- Scientists from Aryabhata Research Institute of Observational Sciences (ARIES) in collaboration with researchers from other institutions, studied around 25,000 luminous Active Galactic Nuclei (AGN) from the Sloan Digital Sky Survey (SDSS).
 - ◆ They found a unique object that emits high-energy gamma rays located at a high redshift (more than 1)
 - ◆ It was identified as a gamma-ray emitting NLS1 galaxy, which is a rare entity in space.
 - ◆ The new gamma-ray emitting NLS1 was formed when the Universe was only about 4.7 billion years old as compared to its current age of about 13.8 billion years.
- ◆ Hence, option A is correct.

137. Ans: C

Exp:

- An Internet Exchange Point is a facility that allows Internet Service Providers to "meet" and exchange traffic, also called peering.
 - ◆ Internet Exchange Points (IXPs) are the most critical part of the Internet's Infrastructure.

- ◆ This saves money on International bandwidth for the ISPs and improves connectivity for their customers by reducing latency. Hence, statement 1 is correct.

- National Internet Exchange of India (NIXI) is a not-for-profit organization (section 8 of the Companies Act 2013) working since 2003 for spreading the internet infrastructure to the citizens of India through the following activities:

- ◆ Internet Exchanges through which the internet data is exchanged amongst Internet Service Providers (ISP's), Data Centers, and Content Delivery Network (CDNs).
- ◆ IN Registry, managing, and operation of .IN country-code domain and .BHARAT IDN (Internationalized Domain Name) domain for India.
- ◆ Indian Registry for Internet Names and Numbers (IRINN), managing and operating Internet Protocol (IPv4/IPv6). Hence, statement 2 is correct.

138. Ans: B

Exp:

- Any changes to the viral genetic sequence during this process is known as a **Mutation**.
 - ◆ When a virus replicates it doesn't always manage to produce an exact copy of itself.
 - ◆ This means that, over time, the virus may start to differ slightly in terms of its genetic sequence.
 - ◆ Hence, statement 1 is not correct.
- Viruses with new mutations are sometimes called **Variants**. Variants can differ by one or multiple mutations.
 - ◆ When a new variant has different functional properties to the original virus and becomes established in a population, it is sometimes referred to as a **New Strain of the virus**.
 - ◆ Hence, statement 2 is correct.

139. Ans: B

Exp:

- Recently, a team of researchers from **Purdue University** have created an **ultra-white paint**. The newer paint is whiter and keeps the surface areas it is painted on cooler and thus can act as a breakthrough in combating the woes of global warming. Hence, statement 1 is not correct.
- The new ultrawhite white paint **reflects 99% of all light** that hits it, remaining significantly cooler than the ambient temperature, even when sitting in full sunlight. Hence, statement 2 is correct.



- Typical commercial white paint gets warmer instead of cooler and paints currently available in the market reflect only 80-90% of the sunlight and therefore, they can't make surfaces cooler than their surroundings.
- Older formulations of white paints were made of calcium carbonate, while the new one is made up of barium sulphate making it more white.

140. Ans: B

Exp:

- **Aditya-L1 Mission** is India's first scientific expedition to study the Sun. Hence, statement 1 is correct.
 - ◆ It will be ISRO's (Indian Space Research Organisation) second space-based astronomy mission after AstroSat, which was launched in 2015.
- ISRO categorises Aditya L1 as a 400 kg-class satellite that will be **launched using the Polar Satellite Launch Vehicle (PSLV)** in XL configuration. Hence, statement 2 is correct.
- It will be **inserted in a halo orbit around the L1 (Lagrangian point 1)**, which is 1.5 million km from the Earth. Hence, statement 3 is not correct.
- Lagrange Points, named after Italian-French mathematician Josephy-Louis Lagrange, are positions in space where the gravitational forces of a two-body system (like the Sun and the Earth) produce enhanced regions of attraction and repulsion.

141. Ans: D

Exp:

- **Dhruv Mk III** is an **indigenously** designed and **developed Advanced Light Helicopter (ALH-DHRUV)**. Hence, statement 1 is correct.
 - ◆ It is a multi-role chopper with the Shakti engine manufactured by Hindustan Aeronautics Limited (HAL).
 - HAL is an Indian state-owned aerospace and defence company, headquartered in Bangalore, India. It is governed under the management of the Ministry of Defence.
 - ◆ Recently, Indian Naval Air Squadron (INAS) 323, the first unit of the Dhruv Mk III aircraft, was commissioned into the Indian Navy.
- The aircraft, a step up from Mk 1, will be able to **mitigate low visibility during search and rescue operations** even at night. Hence, statement 2 is correct.
 - ◆ It has a 0.7 mm gun, which will give a huge capability from a LIMO (low intensity maritime operations) standpoint.

- ◆ The automatic flight control system is hugely superior to the previous one.

142. Ans: C

Exp:

- Recently, **Indian Space Research Organisation (ISRO)** has announced that it will support eight joint research projects mooted by the Space Technology Cell (STC), IIT-Delhi.
 - ◆ The ISRO has extended support to the projects under its **RESPOND programme**. Hence, statement 1 is correct.
- ISRO started the RESPOND (Research Sponsored) programme in the 1970s, with the objective of encouraging academia to participate and contribute in various Space related research activities.
- Under the Programme, ISRO **provides financial support for conducting research** and development activities related to Space Science, Space Technology and Space Applications in Academic Institutions in India. Hence, statement 2 is correct.

143. Ans: B

Exp:

- Coal gasification is the process of **converting coal into synthesis gas (also called syngas)**, which is a mixture of hydrogen (H₂), carbon monoxide (CO) and carbon dioxide (CO₂). Hence, statement 1 is correct.
 - ◆ The syngas can be used in a variety of applications such as in the production of electricity and making chemical products, such as fertilisers.
- The **hydrogen obtained from coal gasification** can be used for various purposes such as **making ammonia, powering a hydrogen economy**. Hence, statement 2 is correct.
- In-situ gasification of coal—or Underground Coal Gasification (UCG)—is the technique of converting coal into gas while it is still in the seam and then extracting it through wells.
- India has set the target that by 2030 it will gasify 100 million tonne of coal under four major projects with an overall investment of Rs. 20,000 crore. Hence, statement 3 is not correct.

144. Ans: C

Exp:

- A **Free and Open Source Software (FOSS)** may also be referred to as Free/Libre Open Source Software (FLOSS) or Free/Open Source Software (F/OSS).
 - ◆ It doesn't mean software is free of cost. Hence, statement 1 is not correct.



- ◆ The term “free” indicates that the software does not have constraints on copyrights.
- It allows other people also to contribute to the development and improvement of the software like a community.
- India’s largest-government projects (including **Aadhaar**) and many technology start-ups have also been built using FOSS. Hence, **statement 2 is correct.**
- Recently, the **Ministry of Electronics & IT (MeitY)** has announced **#FOSS4GOV Innovation Challenge** to accelerate adoption of Free and Open Source Software (FOSS) in Government. Hence, **statement 3 is correct.**

145. Ans: C

Exp:

- **Liquid Medical Oxygen (LMO)** is high purity oxygen suitable for use in the human body. So, it is used for medical treatments.
 - ◆ This oxygen **provides a basis for virtually all modern anaesthetic techniques**, restores tissue oxygen tension by increasing the oxygen availability, aids cardiovascular stability, etc. Hence, **statement 1 is correct.**
- The **World Health Organisation (WHO)** includes this on their **List of Essential Medicines**.
 - ◆ According to the Drug Prices Control Order, 2013, LMO is placed under the **National List of Essential Medicines (NLEM)**. Hence, **statement 2 is correct.**

146. Ans: D

Exp:

- **Antimicrobial Resistance (AMR)** is the resistance **acquired by any microorganism** (bacteria, viruses, fungi, parasite, etc.) **against antimicrobial drugs** (such as antibiotics, antifungals, antivirals, antimalarials, and anthelmintics) that are used to treat infections. Hence, **statement 1 is correct.**
 - ◆ As a result, standard treatments become ineffective, infections persist and may spread to others.
- Microorganisms that develop antimicrobial resistance are sometimes referred to as “**superbugs**”. Hence, **statement 2 is correct.**
- AMR is already responsible for up to 7,00,000 deaths a year.
- India, with its combination of large population, rising incomes that facilitate purchase of antibiotics, high burden of infectious diseases and easy over-the-counter access to antibiotics, is an important locus for the generation of resistance genes.

- The **Ministry of Health & Family Welfare (MoHFW)** identified AMR as one of the top 10 priorities for the ministry’s **collaborative work with the World Health Organisation (WHO)**. Hence, **statement 3 is correct.**

- ◆ India has also launched the National Action Plan on AMR resistance 2017-2021.

147. Ans: D

Exp:

- Recently, Indian Scientists have developed a **high-yielding and pest-resistant variety of soybean**, called **MACS 1407**.
 - ◆ Using the conventional cross breeding technique, scientists developed MACS 1407 which gives 39 quintals per hectare making it a high yielding variety.
 - ◆ It requires an average 43 days for 50% flowering and takes 104 days to mature from the date of sowing. Hence, **option D is correct.**
 - ◆ It has white coloured flowers, yellow seeds and black hilum. Its seeds have 19.81% oil content, 41% protein content and show good germinability.
 - ◆ Its thick stem, higher pod insertion (7 cm) from ground, and resistance to pod shattering make it suitable even for mechanical harvesting.
- It is suitable for rain-fed conditions of north- east India.
 - ◆ It is suitable for cultivation in the states of Assam, West Bengal, Jharkhand, Chhattisgarh and North-Eastern states.
- Variety is also resistant to major insect-pests like girdle beetle, leaf miner, leaf roller, stem fly, aphids, white fly and defoliators.
- Its seeds will be made available to farmers for sowing during the 2022 Kharif season.
 - ◆ It is highly adaptive to sowing from 20 June to 5 July without any yield loss. This makes it resistant to the vagaries of Monsoon as compared to other varieties.

148. Ans: B

Exp:

- National Science Day (NSD) is celebrated every year on **28th February** to commemorate the discovery of the ‘**Raman Effect**’ by Sir Chandrasekhara Venkata Raman. Hence, **statement 1 is not correct.**
- Sir Chandrasekhara Venkata Raman was awarded the **Nobel Prize** in 1930. The first NSD was celebrated in 1987. Hence, **statement 2 is correct.**

149. Ans.B

Exp:

- Recently, the **53rd flight of PSLV-C51** marked the first dedicated mission for New Space India Ltd (NSIL), the commercial arm of Indian Space Research Organisation (ISRO).
- Amazonia 1 belongs to the Brazilian **National Institute for Space Research (INPE)**, was injected into its precise orbit of 758 km in a **sun-synchronous polar orbit** successfully. **Hence, statement 1 is not correct.**
- UNITYsat satellites have been deployed to provide radio relay services. **Hence, statement 2 is correct.**
- Satish Dhawan Satellite (SDSAT) is a **nano satellite** intended to study the radiation levels/space weather and demonstrate long range communication technologies. **Hence, statement 3 is correct.**

150. Ans: C

Exp:

- The Office of the Principal Scientific Adviser to the Government of India under its “Waste to Wealth” Mission launched the “Swachhta Saarthi Fellowship”.
- The Waste to Wealth Mission is one of the nine national missions of the **Prime Minister’s Science, Technology, and Innovation Advisory Council (PM-STIAC)**. **Hence, statement 1 is correct.**
- The mission will **assist and augment the Swachh Bharat and Smart Cities projects** to create circular economic models that are financially viable for waste management to streamline waste handling in the country. **Hence, statement 2 is correct.**

151. Ans: D

Exp:

- **Quasars** are very luminous objects in faraway galaxies that emit jets at **radio frequencies**. **Hence, statement 1 is not correct.**
 - ◆ The word quasar is short for “**quasi-stellar radio source**”.
 - ◆ The name, which means star-like emitters of radio waves, was given in the 1960s when quasars were first detected.
- Most quasars are larger than our solar system. A quasar is approximately 1 kiloparsec in width.
- They are **only found in galaxies that have supermassive blackholes** which power these bright discs. **Hence, statement 2 is correct.**
 - ◆ Black hole refers to a point in space where matter is so compressed as to create a gravity field from which even light cannot escape.

- ◆ Most active galaxies have a supermassive black hole at the centre which sucks in surrounding objects.
- Recently, an international team of astronomers has discovered the **most distant ‘Radio-Loud’ Quasar** with the help of European Southern Observatory’s **Very Large Telescope (ESO’s VLT)**. **Hence, statement 3 is not correct.**
 - ◆ Named **P172+18**, the quasar emitted wavelengths which had a redshift of 6.8.
 - ◆ It took 13 billion years for the quasar’s light to reach earth.
 - ◆ It is also one of the fastest accreting quasars.

152. Ans: B

Exp:

- The Defence Research and Development Organisation (DRDO) has conducted the final development test of **Air Independent Propulsion (AIP) System, crucial for diesel electric submarines**(not for nuclear submarines).
 - ◆ The AIP system based submarines will be required to surface much less frequently, thus increasing their lethality and stealth multifold. **Hence, statement 1 is not correct.**
- The **AIP system based conventional submarines** can stay underwater for a longer duration.
 - ◆ Diesel-electric submarines require them to come to the surface frequently to charge their batteries, thus their underwater endurance time is less.
 - ◆ However, ‘Air-independent’ propulsion technology helps to make the diesel generator less dependent on surface air, thus reducing the need to come on surface frequently. **Hence, statement 2 is correct.**

153. Ans: C

Exp:

- The National Aeronautics and Space Administration (NASA) has predicted that the asteroid ‘2001 FO32’ is the largest to pass by Earth in 2021. It will be at its closest on 21st March.
- The near-Earth asteroid will make its closest approach at a distance of about 2 million kilometers or 5 1/4 times the distance from Earth to the Moon.
 - ◆ The distance is close in astronomical terms, that’s why it **has been designated a “potentially hazardous asteroid”**. **Hence, statement 1 is correct.**
 - ◆ There is no threat of a collision with our planet now or for centuries to come.

- The majority of known asteroids orbit within the asteroid belt between Mars and Jupiter.
- The **Trojans asteroids share an orbit with a larger planet, but do not collide with it** because they gather around two special places in the orbit (called the L4 and L5 Lagrangian points). There, the gravitational pull from the sun and the planet are balanced. **Hence, statement 2 is correct.**
- Near-Earth Asteroids: These objects have orbits that pass close by that of Earth. Asteroids that actually cross Earth's orbital path are known as Earth-crossers.

154. Ans: D

Exp:

- **Raman Thermometry** is a **thermal characterization technique** which makes use of **Raman scattering phenomena** to determine the local temperature in microelectronics systems. **Hence, statement 1 and 2 are correct.**
- The **Raman Effect** or Raman Scattering is a **phenomenon in spectroscopy** discovered by the eminent physicist Sir Chandrasekhara Venkata Raman in **1928**.
 - ◆ In 1930, he got a Nobel Prize for this remarkable discovery and this was the **first Nobel Prize for India in the field of Science**. **Hence, statement 3 is correct.**

155. Ans.: B

Exp.:

- Gravitational Waves are invisible ripples that form when:
 - ◆ A star explodes in a supernova.
 - ◆ Two big stars orbit each other.
 - ◆ Two black holes merge. **Hence, statement 1 is not correct.**
- They travel at the **speed of light** and squeeze and stretch anything in their path. As a gravitational wave travels through space-time, it causes it to stretch in one direction and compress in the other, Any object that occupies that region of space-time also stretches and compresses as the wave passes over them, though very slightly, which can only be detected by specialized devices like LIGO. **Hence, statement 2 is correct.**

156. Ans: B

Exp:

- Helium is a colourless, odourless, tasteless, non-toxic, inert, **monatomic gas**, the first in the noble gas group in the periodic table.
 - ◆ Its **boiling point is the lowest** among all the elements. **Hence, statement 1 is correct.**

- Helium was discovered in the gaseous atmosphere surrounding the Sun in the year 1868.
- In India it was first discovered in 1906 by an Englishman Morris Travers in Kerala.

- ◆ **India's Rajmahal volcanic basin in Jharkhand** is the storehouse of helium trapped for billions of years, since the very birth of Earth from the Sun. **hence, statement 2 is correct.**

- The **USA became the most important exporter of helium** across the world after the discovery of helium in large quantities under the American Great Plains.
 - ◆ It was soon realized that the USA was also the biggest storehouse of helium.
 - ◆ Qatar is a possible exporter but acute political and diplomatic wrangles have made Qatar unreliable. **Hence, statement 3 is not correct.**

157. Ans: C

Exp:

- **NASA and ISRO** are collaborating on developing an **SUV-sized satellite called NISAR**, which will detect movements of the planet's surface as small as 0.4 inches over areas about half the size of a tennis court. **Hence, statement 1 is not correct.**
- The name 'NISAR' is short for NASA-ISRO-SAR.
 - ◆ SAR here refers to the Synthetic Aperture Radar that NASA will use to measure changes in the surface of the Earth.
 - ◆ It refers to a technique for producing high-resolution images. Because of the precision, the radar can penetrate clouds and darkness, which means that it can collect data day and night in any weather.
- The satellite will be launched in 2022 from the Satish Dhawan Space Center in Sriharikota (Andhra Pradesh) into a **near-polar orbit**. **Hence, statement 2 is not correct.**
- In this mission, NASA will provide one of the radars for the satellite, a high-rate communication subsystem for science data, GPS receivers and a payload data subsystem.
 - ◆ NISAR will be equipped with the largest reflector antenna ever launched by NASA.
- **ISRO will provide** the spacecraft bus, the second type of radar (called the **S-band radar**), the **launch vehicle** and associated launch services. **Hence, statement 3 is correct.**

158. Ans: D

Exp:

- Asteroids are divided into three classes:



- ◆ **First Group:** Those found in the main asteroid belt between Mars and Jupiter, which is estimated to contain somewhere between 1.1-1.9 million asteroids.
- ◆ **Second Group:** It is that of **trojans**, which are asteroids that **share an orbit with a larger planet**. NASA reports the presence of Jupiter, Neptune and Mars trojans. In 2011, they reported an Earth trojan as well. **Hence, statement 1 is not correct.**
- ◆ **Third Group:** It is **Near-Earth Asteroids (NEA)**, which have orbits that pass close by the Earth.
- ◆ Those that cross the Earth's orbit are called Earth-crossers.
- ◆ More than 10,000 such asteroids are known, out of which over 1,400 are classified as **Potentially Hazardous Asteroids (PHAs)**.
- ◆ Hence, statement 2 is not correct.

159. Ans: A

Exp:

- Raman is the inelastic **scattering of a photon** by molecules which are excited to higher vibrational or rotational energy levels. It is also called Raman scattering. **Hence, statement 1 is correct.**
 - ◆ In simpler words, it is a change in the wavelength of light that occurs when a light beam is deflected by molecules.
- The Raman effect forms the basis for Raman spectroscopy which is used by chemists and physicists to gain information about materials. **Hence, statement 2 is correct.**
 - ◆ Spectroscopy is the study of the interaction between matter and electromagnetic radiation.
- A Doppler radar is a specialized radar that **uses the Doppler effect** (not the Raman Effect) to produce velocity data about objects at a distance. **Hence, statement 3 is not correct.**

160. Ans: C

Exp:

- Recently, an international team of astronomers has discovered the most distant 'Radio-Loud' Quasar with the help of **European Southern Observatory's Very Large Telescope (ESO's VLT)**. **Hence, statement 1 is correct.**
- The Very Large Telescope used to observe the P172+18 is located at Paranal Observatory in the **Atacama Desert**. **Hence, statement 2 is correct.**
 - ◆ The four Unit Telescopes boast 8.2-meter (27 feet) mirrors.

- ◆ Just one of these instruments can spot objects that are 4 billion times fainter than what can be seen with the unaided eye.
- ◆ According to the European Southern Observatory, the Very Large Telescope is the world's most advanced optical telescope.

161. Ans: C

Exp:

- **Science and Engineering Board(SERB)** is a **statutory body** under the **Department of Science and Technology**, Ministry of Science and Technology established by an Act of the Parliament of India in 2009. **Hence, statement 1 is correct.**
 - ◆ It was set up for promoting basic research in science and engineering and to provide financial assistance to scientists, academic institutions, Research and Development laboratories, industrial concerns and other agencies for such research.
 - ◆ It has a mandate to plan, promote and fund internationally competitive research in emerging areas.
- SERB is **chaired by the Secretary to the Government of India** in the Department of Science and Technology and has other senior government officials and eminent scientists as members. **Hence, statement 2 is not correct.**
- The Science and Engineering Board (SERB) has set up a portal called **Project Information System & Management (PRISM)** that offers real time information on the various research projects supported by it. **Hence, statement 3 is correct.**

162. Ans: C

Exp:

- **Black Hole** refers to a point in space where the matter is so compressed as to create a gravity field from which even light cannot escape.
 - ◆ The **concept was theorized by Albert Einstein in 1915** and the term 'black hole' was coined in the mid-1960s by American physicist John Archibald Wheeler. **Hence, statement 1 is correct.**
- In April 2019, the scientists at the Event Horizon Telescope Project released the first-ever image of a Black Hole (more precisely, of its shadow).
 - ◆ The Event Horizon Telescope is a group of 8 radio telescopes (used to detect radio waves from space) located in different parts of the world.
- **Gravitational waves** are created when two black holes orbit each other and merge. **Hence, statement 2 is correct.**

163. Ans: D

Exp.

- The **National Aeronautics and Space Administration (NASA)** has predicted that the **asteroid '2001 FO32'** is the **largest** to pass by Earth in **2021**. It will be at its closest on 21st March. **Hence, option D is correct.**
- It will provide a rare opportunity for astronomers to get a good look at a rocky relic that formed at the dawn of our solar system.
- The asteroid '2001 FO32' was **discovered 20 years ago** and ever since scientists have been tracking its orbital path around the Sun very accurately.
 - ◆ It was discovered in March 2001 by the **Lincoln Near-Earth Asteroid Research (LINEAR)** program in **Socorro, New Mexico**.
 - ◆ **1998 OR2** was the last notably large asteroid that passed close to earth on **29th April, 2020**. While 2001 FO32 is somewhat smaller than 1998 OR2, it will be **three times nearer to Earth**.

164. Ans: A

Exp

- Helium is a chemical element with the symbol He and atomic number 2.
 - ◆ It is a colourless, odourless, tasteless, non-toxic, inert, monatomic gas, the first in the noble gas group in the periodic table.
 - ◆ Its boiling point is the lowest among all the elements. **Hence, statement 1 is correct.**
- Helium was discovered in the gaseous atmosphere surrounding the Sun by the French astronomer Pierre Janssen, who detected a bright yellow line in the spectrum of the solar chromosphere during an eclipse in India in the year 1868.
- Joseph Norman Lockyer recorded the same line by observing the sun through London smog and, assuming the new element to be a metal, he named it helium.
- The British chemist Sir William Ramsay discovered the existence of helium on Earth in 1895. **Hence, statement 2 is not correct.**
- In 1906 a young Englishman by the name of Morris Travers extracted helium in small quantities by heating up monazite sand abundantly available in Kerala beach, in a pioneering effort.
 - ◆ Monazite is a primarily reddish-brown phosphate mineral that contains rare-earth elements.

165. Ans: C

Exp:

- Recently, the **Square Kilometre Array Observatory (SKAO)** Council held its inaugural meeting and

approved the establishment of the world's largest radio telescope.

- ◆ The new venture is being deemed as important following the collapse of one of the most prolific radio telescopes in the world, the Arecibo in Puerto Rico, in December last year.
- SKAO is a new **intergovernmental organisation dedicated to radio astronomy** and is headquartered in the UK. **Hence, statement 1 and statement 3 are correct.**
 - ◆ At the moment, organisations from ten countries are a part of the SKAO.
 - These include Australia, Canada, China, **India**, Italy, New Zealand, South Africa, Sweden, the Netherlands and the UK. **Hence, statement 2 is correct.**

166. Ans: C

Exp:

- The Indian Institute of Horticultural Research (IIHR) has **developed a new marigold variety named Arka Shubha**. **Hence, statement 1 is not correct.**
- Arka Shubha has carotene content of around 2.8% (for all marigolds, it's maximum upto 1.4%) which is the highest among all plant sources. **Hence, statement 2 is correct.**
 - ◆ This new variety of marigold can be used for extraction of crude carotene even if spoiled after full bloom, unlike that of other varieties.
- Carotenes are carotenoid pigments that are oxygen-free. Mostly they are unsaturated hydrocarbons that contain only carbon and hydrogen. **Hence, statement 3 is correct.**

167. Ans: C

Exp:

- **Gaganyaan** is a mission by the **Indian Space Research Organisation (ISRO)**.
- Under the Gaganyaan schedule:
 - ◆ Three flights will be sent into orbit.
 - ◆ There will be two unmanned flights and one human spaceflight.
- The human space flight programme will have **three Indian astronauts, including a woman**. **Hence, statement 1 is correct.**
- **GSLV Mk III, also called the LVM-3 (Launch Vehicle Mark-3)**, the three-stage heavy lift launch vehicle, will be used to launch Gaganyaan as it has the necessary payload capability. **Hence, statement 2 is not correct.**
- The mission will help in enhancement of science and technology levels in the country and help inspire youth.

- ◆ Gaganyaan will involve numerous agencies, laboratories, disciplines, industries and departments.
- ◆ Recently, the Government has announced a **new organisation, IN-SPACe**, part of reforms to **increase private participation in the space sector. Hence, statement 3 is correct.**

168. Ans: B

Exp:

- **Navigation in Indian Constellation (NavIC) is an Indian Regional Navigation Satellite System (IRNSS)**, developed by the **Indian Space Research Organization (ISRO). Hence, statement 1 is correct.**
 - ◆ The main objective is to provide reliable position, navigation and timing services over India and its neighbourhood.
- It consists of **eight satellites, three satellites in geostationary orbit and five satellites in geosynchronous orbit. Hence, statement 2 is not correct.**
- NavIC works just like the established and popular U.S. Global Positioning System (GPS) but **within a 1,500-km radius over the sub-continent. Hence, statement 3 is not correct.**
- It has been certified by the 3rd Generation Partnership Project (3GPP), a global body for coordinating mobile telephony standards.
- **Potential Uses:**
 - ◆ Terrestrial, aerial and marine navigation;
 - ◆ Disaster management;
 - ◆ Vehicle tracking and fleet management (especially for mining and transportation sector);
 - ◆ Integration with mobile phones;
 - ◆ Precise timing (as for ATMs and power grids);
 - ◆ Mapping and geodetic data capture.

169. Ans: B

- Recently, Perseverance Rover has landed on Mars. This was one of the most crucial aspects of the Mars 2020 Mission of National Aeronautics and Space Administration (NASA's). **Hence, statement 1 is not correct.**
- The mission is designed to better understand the geology of Mars and seek signs of ancient life.
 - ◆ It is different from previous missions because it is capable of drilling and collecting core samples of the rocks and soils and sending them back to Earth. **Hence, statement 2 is correct.**

- Perseverance Rover has landed in the Jezero Crater (an ancient river delta that has rocks and minerals that could only form in water). **Hence, statement 3 is correct.**

170. Ans: D

Exp:

- Helina and Dhruvastra are anti-tank guided missiles for the Army and Indian Air Force respectively. **Hence, statement 1 is not correct.**
- Nag is a third-generation, fire-and-forget, anti-tank guided missile developed by Defence Research and Development Organisation (DRDO) to support both mechanized infantry and airborne forces of the Indian Army.
 - ◆ DRDO has developed nag Missiles under the **Integrated Guided Missile Development Program. Hence, statement 2 is not correct.**
- **Project 75 India (P75I)** envisages the construction of six conventional submarines with better sensors and weapons and the Air Independent Propulsion System (AIP). The project has been cleared under the strategic partnership model.

171. Ans: C

Exp:

- The thermo-electric effect involves the process by which heat is transformed to electrical energy. **Hence, statement 1 is correct.**
 - ◆ Traditionally, the thermo-electric effect has been demonstrated and utilised by using two different metals joined together, and by mechanically maintaining two different temperatures at the ends. But such materials do not offer efficient or economical solutions.
- The thermo-electric effect is based on the temperature difference between the two ends of the material for very long.
 - ◆ Thus, being a good conductor of electricity but a bad conductor of heat is an important property for Thermo-electric effect. **Hence, statement 2 is correct.**
 - ◆ Good conductivity of electricity to transmit current and bad conductivity of heat to be able to create a temperature difference.

172. Ans: B

Exp:

- The central government has launched the **"Go Electric" Campaign** to spread awareness on the benefits of e-mobility and EV Charging Infrastructure as well as electric cooking in India.



- Green hydrogen is produced using renewable energy and electrolysis to split water. Blue hydrogen, which captures those emissions and stores them underground to prevent them causing climate change. **Hence, statement 1 is not correct.**
- Grey hydrogen, which is produced from methane and releases greenhouse gases into the atmosphere. **Hence, statement 2 is correct.**

173. Ans: D

Exp:

- Hydrogen is the lightest and first element on the periodic table. Since the weight of hydrogen is less than air, it rises in the atmosphere and is therefore **rarely found in its pure form, H₂. Hence, statement 1 is not correct.**
- At standard temperature and pressure, hydrogen is a nontoxic, nonmetallic, odorless, tasteless, colorless, and highly combustible diatomic gas.
- Hydrogen fuel is a zero-emission fuel burned with oxygen. It can be used in fuel cells or internal combustion engines. It is also used as a fuel for spacecraft propulsion.
- **Type of Hydrogen:**
 - ◆ **Grey Hydrogen:** Constitutes India's bulk Production. Extracted from hydrocarbons (fossil fuels, natural gas).
 - By product: CO₂
 - ◆ **Blue Hydrogen:** Sourced from **fossil fuels.**
 - By product: CO, CO₂
 - By products are Captured and Stored, so better than grey hydrogen.
- **Green Hydrogen: Generated from renewable energy** (like Solar, Wind). Electricity splits water into hydrogen and oxygen. **Hence, statement 2 is not correct.**
 - ◆ By Products : Water, Water Vapor

174. Ans: C

Exp:

- The **Indian National Centre for Ocean Information Services (INCOIS)** is planning to conduct **airline mapping of Andaman and Nicobar Islands and Lakshadweep** to get a better picture of the ocean floor.
- INCOIS is an **autonomous organization** under the **Ministry of Earth Sciences (MoES)**. **Hence, statement 1 is correct.**
 - ◆ It is located in **Hyderabad** & was established in 1999. **Hence, statement 2 is correct.**
 - ◆ It is a unit of the **Earth System Science Organization (ESSO)**, New Delhi.

- The ESSO operates as an **executive arm of the Ministry of Earth Sciences (MoES)** for its policies and programmes.

175. Ans: C

Exp:

- Coal is the most abundant fossil fuel which holds 55% of India's energy need. Based on the uses, coal is divided into two types:
- **Coking Coal:**
 - ◆ This type of coal when subjected to high temperature carbonisation i.e. heating in the absence of air to a temperature above 600 degree Celsius, forms a solid porous residue called coke.
 - Coke is fed into a blast furnace along with iron ore and limestone to produce steel in steel plants. Hence, statement 1 is not correct.
 - ◆ Coking coal is desired to be of low ash percentage.
 - ◆ Mainly used in steelmaking and metallurgical industries and for hard coke manufacturing.
- **Non Coking Coal:**
 - ◆ These are coals without coking properties.
 - ◆ This is the **coal used in thermal power plants to generate electricity**, so it is also known as **steam coal or thermal coal. Hence, statement 2 is not correct.**
 - ◆ Also used for cement, fertilizer, glass, ceramic, paper, chemical and brick manufacturing, and for other heating purposes.
- Coal is also classified into **four ranks: anthracite, bituminous, subbituminous, and lignite**. The **ranking depends on the types and amounts of carbon the coal contains and on the amount of heat energy the coal can produce.**

176. Ans: C

Exp:

- A global navigation system is a system of satellites, usually managed by one company or country that provides geo-spatial positioning. Some of the Global Navigational Systems include:
 - ◆ Global Positioning System: USA
 - ◆ **BeiDou/BDS: China**
 - ◆ Galileo: Europe
 - ◆ GLONASS: Russia
 - ◆ Quasi-Zenith Satellite System (QZSS): Japan
- **Hence, option C is correct.**

177. Ans.: A

Exp.:

- Hydrogen Fuel Cell combines hydrogen and oxygen to generate an electric current. They are similar to the

conventional internal combustion engines because they also rely on a constant supply of fuel (hydrogen) and oxygen. However, there are no moving parts in the fuel cell, so they are **more efficient and reliable**.

- They emit only heat and water as a byproduct and are **far more energy-efficient than traditional combustion technologies**. Hence, **statement 1 is correct**.
- There is a wide availability of resources for producing hydrogen. However, handling of hydrogen is a safety concern because it is more explosive than petrol. Hence, **statement 2 is not correct**.

178. Ans: A

Exp:

- Akash is India's **first indigenously produced medium-range Surface to Air missile** that can engage multiple targets from multiple directions.
 - ◆ The all-weather missile can engage targets at a speed **2.5 times more than the speed of sound** and can detect and destroy targets flying at **low, medium and high altitudes**.
- The Akash missile system has been designed and developed as part of India's 30-year-old **integrated guided-missile development programme (IGMDP)** which also includes other missiles like **Nag, Agni, Trishul and Prithvi**.
- It is a **nuclear-capable missile that can fly** at a speed of up to **Mach 2.5** (nearly 860 meters per second) at a maximum height of **18 km**.
- Hence, **option A is correct**.

179. Ans:C

Exp:

- Food Safety and Standards Authority of India (FSSAI) has capped the amount of trans fatty acids (TFA) in oils and fats to 3% for 2021 and 2% by 2022 from the current permissible limit of 5% through an amendment to the Food Safety and Standards (Prohibition and Restriction on Sales) Regulations 2011.
- Trans fatty acids (TFAs) or Trans fats are the most harmful type of fats which can have much more **adverse effects on a human body** than any other dietary constituent. Hence, **statement 2 is correct**.
- These fats are largely produced artificially but a small amount also occurs naturally. Thus in our diet, these may be present as Artificial TFAs and/ or Natural TFAs.
- Artificial TFAs are formed when hydrogen is made to react with the oil to produce fats resembling pure ghee/butter.
- In our diet the major sources of artificial TFAs are the partially hydrogenated vegetable oils (PHVO)/

vanaspati/ margarine while **the natural TFAs are present in meats and dairy products**, though in small amounts. Hence, **statement 1 is correct**.

180. Ans.C

Exp

- The Drugs Controller General of India's (DCGI) has approved COVISHIELD and COVAXIN vaccines for restricted use against Covid-19 in the country.
- COVAXIN is India's only indigenous Covid-19 vaccine.
- It is an inactivated vaccine which is developed by inactivating (killing) the live microorganisms that cause the disease.
- This **destroys the ability of the pathogen to replicate**, but keeps it intact so that the immune system can still recognise it and produce an immune response. Hence, **statement 1 is correct**.
- It is expected to target more than just the spike protein.
- It also aims to develop an immune response to the **nucleocapsid protein** (the shell of the virus that encloses its genetic material). Hence, **statement 2 is correct**.

181. Ans: D

Exp:

- A recent study has shed light on the mineralogy of the meteorite named Mukundpura CM2 which fell in Mukundpura village near Jaipur in 2017.
 - ◆ A meteorite is a solid piece of debris from an object, such as a comet, asteroid, or meteoroid, that originates in outer space and survives its passage through the atmosphere to reach the surface of a planet or moon.
- Mukundpura CM2 is a type of **stony meteorite, considered the most primitive meteorite** and a **remnant of the first solid bodies** to accrete in the solar system. Hence, **statement 1 is correct**.
- The meteorite **Mukundpura CM2** was classified to be a **carbonaceous chondrite**. The composition of carbonaceous chondrites are **also similar to the Sun**. Hence, **statement 2 and 3 are correct**.
- Chondrites are silicate droplet bearing meteorites, and this Mukundpura chondrite is the 5th carbonaceous meteorite known to fall in India.
 - ◆ Meteorites are classified into three groups: Stony (silicaterich), Iron (Fe-Ni alloy), and Stony Iron (mixed silicate iron alloy).
- **Components of Meteorite:**
 - ◆ Detailed spectroscopic studies revealed that the meteorite had very high (about 90%) phyllosilicate minerals comprising both magnesium and iron.

- ◆ Forsterite and FeO olivine, calcium aluminium rich inclusion (CAI) minerals.
- ◆ Few magnetites, sulphides, aluminium complexes and calcites were also found.

182. Ans: A

Exp:

- Vanadium is a chemical element with the symbol V. It is a scarce element, hard, silvery grey, ductile, **malleable and it is a transition metal in the periodic table**. It also has good structural strength.
 - ◆ Transition metals are all the elements in groups 3–12 of the periodic table.
 - ◆ These are superior conductors of heat as well as electricity. Hence, statement 1 is correct.
- A recent exploration by Geological Survey of India (GSI) has found reserves of Vanadium in **Arunachal Pradesh**.
 - ◆ GSI is an attached office to the Ministry of Mines.
- There are other potential sites in various districts in Arunachal Pradesh.
 - ◆ This is the first report of a primary deposit of Vanadium in India. Hence, statement 2 is not correct.

183. Ans: C

Exp

- An international research team led by the University of Bonn (Germany) has identified and further developed novel antibody fragments (nanobodies) against SARS-CoV-2, the virus that causes Covid-19.
- **Antibodies** are an important weapon in the immune system's defense against infections.
 - ◆ They **bind to the surface structures of bacteria or viruses and prevent their replication**. Hence, **statement 1 is correct**.
 - ◆ One strategy in the fight against disease is therefore to produce effective antibodies in large quantities and inject them into patients. However, producing antibodies is difficult and time-consuming; they are, therefore, probably not suitable for widespread use.
- Nanobodies are **antibody fragments that are so simple that they can be produced by bacteria or yeast**, which is less expensive. Hence, **statement 2 is correct**.
 - ◆ These are antibodies with a single variable domain located on a heavy chain, also known as VHH antibodies.
 - ◆ These are often seen as an alternative to conventional antibodies, and have significant differences in both production and use that influence their suitability.

184. Ans: A

Exp:

- **Two Dimensional Electron Gas (2DEG):**
 - ◆ It is an electron gas that is free to move in **two dimensions**, but tightly **confined in the third**. This tight confinement leads to **quantized energy levels for motion in the third direction**. Thus the electrons appear to be a **2D sheet embedded in a 3D world**. Hence, **statement 1 is not correct**.
 - ◆ 2DEG is a valuable system for exploring the physics of **superconductivity magnetism and their coexistence**.
- The need for attaining new functionalities in modern electronic devices has led to the **manipulation of property of an electron called spin degree of freedom along with its charge**. This has given rise to an altogether new field of spin-electronics or '**spintronics**'. Hence, **statement 2 is correct**.
 - ◆ The manipulation of **electron spin** offers **new dimensions for basic and applied research**, and the potential for **new capabilities for electronics technology**. This motivates studies of spin polarized electrons in a **high mobility two dimensional electron gas (2DEG)**.
 - Spintronics is the study of the **intrinsic spin of the electron** and its associated **magnetic moment**, in addition to its fundamental electric charge, in solid-state devices. Hence, **statement 3 is correct**.

185. Ans: D

Exp:

- The **mitochondria** are organelles found in cells that are the sites of energy production. They produce **cellular energy in the form of adenosine triphosphate (ATP)**, hence they are called 'power houses' of the cell. The mitochondria divide by fission. Hence, **statement 2 is correct**.
- Mitochondrial DNA is **the small circular chromosome** found inside mitochondria. Hence, **statement 1 is correct**.
- Mitochondrial DNA is different in a way from the DNA (Deoxyribonucleic Acid) that's in the nucleus.
 - ◆ The mitochondrial genome is not enveloped, and it is not packaged into chromatin.
 - ◆ Mitochondrial DNA, unlike nuclear DNA, is inherited from the mother, while nuclear DNA is inherited from both parents. Hence, **statement 3 is correct**.

186. Ans: B

Exp:

- **Shaurya** is a land variant of short-range **Submarine Launched Ballistic Missile (SLBM)** K-15 Sagarika, which has a range of at least 750 kilometers.
 - ◆ It is capable of carrying payloads of 200 kg to 1000 kg.
 - ◆ It is a surface-to-surface tactical missile.
- **BrahMos** is a Supersonic cruise missile.
 - ◆ Being developed with Russia as a private joint-venture.
 - ◆ Multi-platform cruise can strike from various types of platforms.
 - ◆ Among the world fastest supersonic cruise missiles with speeds ranging between Mach 2.5 – 2.8.
 - ◆ A 'fire and forget' weapon i.e. requiring no further guidance from the control centre once the target has been assigned
- **Prithvi** is the first indigenously built ballistic missile.
 - ◆ Surface-to-surface battlefield missile.
 - ◆ Demonstrates higher lethal effects and high level capability with field interchangeable warheads.
 - ◆ Range from 150 km to 300 km.
- **NAG** is a third generation 'fire-and-forget' anti-tank missile with a range of 4-8km.
 - ◆ Developed indigenously as an anti-armour weapon employing sensor fusion technologies for flight guidance.
 - ◆ HELINA (Helicopter Launched NAG) is the air-to-surface version of the NAG integrated into Dhruv Helicopters.
- Hence, option B is correct.

187. Ans: C

Exp:

- **AstroSat** is the first dedicated Indian astronomy mission aimed at studying celestial sources in X-ray, optical and UV spectral bands simultaneously with its five unique X-ray and ultraviolet telescopes working in tandem. Hence, statement 1 is correct.
- One of the unique features of AstroSat mission is that it enables the simultaneous multi-wavelength observations of various astronomical objects with a single satellite. Hence, statement 2 is correct.
- It is a multi-wavelength astronomy mission on an IRS-class (Indian Remote Sensing-Class) satellite in a 650-km, near-equatorial orbit.

188. Ans: C

- **Angiogenesis** is the physiological process through which new blood vessels form from pre-existing vessels. Hence, statement 1 is correct.
- It is critical in the growth of cancer because tumors need blood supply to grow. Tumors trigger the growth of blood cells by giving off chemical signals that stimulate angiogenesis.
- Inhibition of tumor angiogenesis has become a popular anti-cancer strategy after chemotherapy.
 - ◆ Angiogenesis inhibitors are unique cancer-fighting agents because they block the growth of blood vessels that support tumor growth rather than blocking the growth of tumor cells themselves. Hence, statement 2 is correct.

189. Ans: C

Exp:

- Researchers from Indian Institute of Technology Madras have developed such a material, called **Origami metamaterials** which could have many uses.
 - ◆ These combine the Japanese art of paper folding (origami) and the existing material of choice and fold it to obtain desired properties. Hence, statement 2 is correct.
- Researchers have developed a special class of origami metamaterials which show a constant value of **Poisson Ratio** when subjected to stress. Hence, statement 3 is correct.
 - ◆ When a material is crushed or stretched along a particular direction, it undergoes a modification in the perpendicular, or lateral, direction.
 - ◆ The ratio between the deformation along the force and the deformation in a direction lateral to the force is called the Poisson ratio. The Poisson ratio can be positive or negative.
 - ◆ In order to be useful, materials need to maintain a constant Poisson ratio when they crumble under pressure. However, they are prone not to do so, and the Poisson ratio varies as they deform.
 - ◆ The benefit is that the observed property does not depend on whether it is made from a sheet of paper, polymer or metal but under impact the sheet folds up along the creases.
- Metamaterials are smart materials that have a wide range of properties and can be so different from each other that there isn't a definition for them, although what they all have in common is that they are from an artificial origin.
- This means that they aren't found in nature and have been created by people. Hence, statement 1 is not correct.

190. Ans: C

Exp:

Artificial Intelligence (AI)

- It describes the action of machines accomplishing tasks that have historically required human intelligence. **Hence statement 1 is correct.**
- It includes technologies like machine learning, pattern recognition, big data, neural networks, self algorithms etc. **Hence statement 2 is correct.**
- The origin of the concept can be traced back to Greek mythology, although it is only during modern history when stored program electronic computers were developed.
- AI involves complex things such as feeding a particular data into the machine and making it react as per the different situations. It is basically about creating self-learning patterns where the machine can give answers to the never answered questions like a human would ever do.

191. Ans: A

Exp:

- Synthetic biology refers to the science of **using genetic sequencing, editing, and modification** to create unnatural organisms or organic molecules that can function in living systems.
- The term 'synthetic biology' was first used by **Barbara Hobomin in 1980**, to describe bacteria that had been genetically engineered using **recombinant DNA technology**.
- More broadly in this sense, the term has been used with reference to efforts to '**redesign life**'. **Hence, statement 1 is correct.**
- India is yet to formally come up with its national strategy on synthetic biology (both policy and regulatory). Recently, the **Department of Biotechnology**, Ministry of Science & Technology released a **draft foresight paper on synthetic biology**.
- The document stresses on the **need for a national policy** that can consolidate India's stand on the issue. **Hence, statement 2 is NOT correct.**

192. Ans: C

Exp:

Stem Cells:

- Stem cells are **special cells that can make copies of themselves** and change into the many different kinds of cells that the body needs. **Hence statement 1 is correct.**

- They have **two unique properties** that enable them to do this:
 - ◆ They can divide over and over again to produce new cells.
 - ◆ As they divide, they can change into the other types of cell that make up the body.
- There are **several kinds of stem cells** and they are found in different parts of the body at different times.
- **Cancer and cancer treatment** can damage the **hematopoietic stem cells**. **Hematopoietic stem cells** are stem cells that turn into blood cells.

Use of Stem Cells:

- **Research:** It helps in understanding the basic biology of how living things work and what happens in different types of cell during disease.
- **Therapy** – In replacing lost or damaged cells that the bodies can't replace naturally. **Hence statement 2 is correct.**

193. Ans: B

Exp:

- Recently, the Indian Space Research Organisation (ISRO) **launched an Earth Observation Satellite (EOS-04)** along with two other smaller satellites into space **using a PSLV (Polar Satellite Launch Vehicle) rocket**. This was the 54th flight of the PSLV rocket.
- The **rockets have powerful propulsion systems that generate the huge amount of energy required to lift heavy objects like satellites** into space, overcoming the gravitational pull of the earth.
- **Satellites** carry one or more instruments that do the scientific work for which they are sent into space. Their **operational life sometimes extends up to decades**.
 - ◆ But **rockets, or launch vehicles, become useless after the launch**. Rockets' only job is to take the satellites to their intended orbits.
- **Rockets have several detachable energy-providing parts**.
 - ◆ They burn different kinds of fuels to power the rocket. Once their fuel is exhausted, they detach from the rocket and fall off, often burning off in the atmosphere due to air-friction, and getting destroyed.
 - ◆ Only a small part of the original rocket goes till the intended destination of the satellite. Once the satellite is finally ejected, **this last part of the rocket either becomes part of space debris, or once again burns off after falling into the atmosphere.**
- **Hence option B is correct.**

194. Ans: B

Exp:

Geospatial Technology:

- Geospatial technology uses tools like **GIS (Geographic Information System), GPS (Global Positioning System) and Remote Sensing** for geographic mapping and analysis. **Hence statement 1 is correct.**
- These tools **capture spatial information about objects, events and phenomena** (indexed to their geographical location on earth, geotag). The location data **may be Static or Dynamic. Hence statement 2 is not correct.**
- Static location data include position of a road, an earthquake event or malnutrition among children in a particular region while dynamic location data include data related to a moving vehicle or pedestrian, the spread of an infectious disease etc.
- The technology may be used to create intelligent maps to help identify spatial patterns in large volumes of data.
- The technology facilitates decision making based on the importance and priority of scarce resources.

195. Ans: D

Exp:

- A neutrino is a **fundamental elementary particle**, and atmospheric neutrinos can be studied when solar radiation hits the earth's atmosphere. **Hence, statement 1 is correct.**
- They are **very hard to detect** as they **hardly interact with other forms of matter** due to their **lack of electrical charge. Hence, statement 2 is correct.**
 - ◆ However, they seem to play an important role in the universe of elementary physics, which physicists have been trying to understand for a few decades now.
- They are produced in **high-energy processes** such as within stars and in supernovae.
- On earth, they are produced by **particle accelerators** and nuclear power plants.
- They are produced in high-energy processes such as within stars and in **supernovae. Hence, statement 3 is correct.**
- On earth, they are produced by particle accelerators and nuclear power plants.
- So far, neutrino physics has been **mostly limited to outer space sources**, observing neutrinos from farther-away stars and galaxies.

196. Ans: C

Exp:

- **Giant Metrewave Radio Telescope (GMRT)** is an array of **thirty fully steerable parabolic radio telescopes of 45 metre diameter. Hence, statement 1 is correct.**

- ◆ It is operated by the National Centre for Radio Astrophysics of the Tata Institute of Fundamental Research (NCRA-TIFR).

- ◆ GMRT is an **indigenous project**. Its design is based on the 'SMART' concept - for Stretch Mesh Attached to Rope Trusses. **Hence, statement 2 is correct.**

- It functions at the metre wavelength part of the radio spectrum because man-made radio interference is considerably lower in this part of the spectrum in India and there are many outstanding astrophysics problems which are best studied at metre wavelengths.

197. Ans: A

Exp:

- In 2015, the **National Supercomputing Mission** was launched to enhance the research capacities and capabilities in the country by connecting them to form a Supercomputing grid, with National Knowledge Network (NKN) as the backbone. **Hence, statement 1 is correct.**

- ◆ The NKN project is aimed at establishing a strong and robust Indian network which will be capable of providing secure and reliable connectivity.

- It supports the government's vision of 'Digital India' and 'Make in India' initiatives.

- The Mission is being jointly steered by the **Department of Science and Technology (DST) and the Ministry of Electronics and Information Technology (MeitY). Hence, statement 2 is not correct.**

- ◆ It is implemented by the Center for Development of Advanced Computing (C-DAC), Pune, and the IISc, Bengaluru.

198. Ans: C

Exp:

Ammonia and Green Ammonia:

- Ammonia is a chemical which is used mainly in the manufacture of nitrogenous fertilisers, like urea and ammonium nitrate, but can be put to other uses too, such as to run engines.

- Green ammonia production is where the **process of making ammonia is 100% renewable and carbon-free. Hence, statement 1 is correct.**

- One way of making green ammonia is by using hydrogen from water electrolysis and nitrogen separated from the air. These are then fed into the Haber process (also known as Haber-Bosch), all powered by sustainable electricity.



- ◆ In the **Haber process**, hydrogen and nitrogen are reacted together at high temperatures and pressures to produce ammonia, NH₃. Hence, **statement 2 is correct**.

199. Ans: B

Exp:

Japanese Encephalitis:

- It is a disease **caused by a flavivirus** that affects the membranes around the brain. Hence, **statement 1 is not correct**.
 - ◆ Japanese encephalitis virus (JEV) is also a major cause of Acute Encephalitis Syndrome (AES) in India.
- The disease is transmitted to humans through bites from infected mosquitoes of the Culex species.
 - ◆ These mosquitoes breed mainly in rice fields and large water bodies rich in aquatic vegetation.
 - ◆ Migratory birds along with pigs in the community also play an important role in the transmission of JE from one area to other areas.
- **Most people infected with JE do not have symptoms or have only mild symptoms. Hence, statement 2 is correct.**
 - ◆ However, a small percentage of infected people develop inflammation of the brain (encephalitis), with symptoms including sudden onset of headache, high fever, disorientation, coma, tremors and convulsions.
- There is **no antiviral treatment for patients with JE**. Treatment, available, is supportive to relieve symptoms and stabilise the patient. **Hence, statement 3 is correct.**
- Safe and effective JE vaccines are available to prevent the disease.
 - ◆ In India, mass vaccination with JE vaccine was started in a phased manner subsequent to the major outbreak in 2005.
 - ◆ JE vaccination is also included under the Universal Immunisation Program of the Government of India.

200. Ans: C

Exp:

- QKD, also called **Quantum Cryptography**, is a mechanism to **develop secure communication**.
 - ◆ It provides a way of **distributing and sharing secret keys** that are necessary for cryptographic protocols.
 - ◆ **Hence, statement 1 is correct.**
- In the QKD, encryption keys are sent as **'qubits' (or quantum bits) in an optical fibre**.

- ◆ **Qubits -- the equivalent of bits in a binary system.**

- ◆ **Optical fibres** are capable of transmitting more data over longer distances and faster than other mediums. It works on the **principle of total internal Reflections**. Hence, **statement 2 is correct**.

201. Ans: A

Exp:

Artificial Neural Network (ANN):

- It is a vital subset of machine learning that helps computer scientists in their work on complex tasks, such as, strategizing, making predictions, and recognizing trends.
 - ◆ It is a computational model that **mimics the way nerve cells work in the human brain**. It is designed to simulate the way the human brain analyzes and processes information. **Hence, statement 1 is correct.**
- It is **not like other machine learning algorithms that crunch numbers** or organize data, it is an algorithm that **learns from experience and repeated tasks** performed by its users. **Hence, statement 2 is not correct.**
- It is also known as a Neural Network (NN). ANN is a computational model based on the functions and structure of biological neural networks.
- **Information that runs through the network affects the structure** of the artificial neural network due to the fact that a neural network learns or changes based on the input and output. **Hence, statement 3 is not correct.**
- NNs are fed massive volumes of data in the beginning phases. In most cases, training is done by providing input and informing the network about what should be the output.
 - ◆ Many smartphone makers, for example, have recently integrated facial recognition technology.

202 Ans: B

Exp:

- Bioremediation is a branch of biotechnology that **employs the use of living organisms, like microbes and bacteria, in the removal of contaminants, pollutants, and toxins** from soil, water, and other environments. **Hence, statement 1 is correct**
- Bioremediation may be done "in situ"—at the site of the contamination—or "ex situ"—away from the site. **Hence, statement 2 is not correct.**



- **Benefits of Bioremediation:**

- ◆ **By relying solely on natural processes, it minimizes damage to ecosystems. Hence, statement 3 is correct.**
- ◆ The bioremediation process creates relatively few harmful byproducts.

- ◆ Bioremediation is cheaper than most cleanup methods because it does not require substantial equipment or labor.

203 Ans: A

Exp:

	Fission	Fusion
Definition	Fission is the splitting of a large atom into two or more smaller ones.	Fusion is the fusing of two or more lighter atoms into a larger one.
Occurrence	Fission reaction does not normally occur in nature.	Fusion occurs in stars, such as the sun.
Energy Requirement	Takes little energy to split two atoms in a fission reaction.	The Energy released by fusion is three to four times greater than the energy released by fission.
Energy Released	The energy released by fission is a million times greater than that released in chemical reactions, but lower than the energy released by nuclear fusion.	The Energy released by fusion is three to four times greater than the energy released by fission.
Energy Production	Fission is used in nuclear power plants.	Fusion is an experimental technology for producing power.

- **Hence, statement 1 is not correct but statement 2 is correct.**